Final

Basewide Per- and Polyfluoroalkyl Substances Site Inspection Report

Naval Auxiliary Landing Field Fentress Chesapeake, Virginia

Contract Task Order WE01

October 2018

Prepared for

Department of the Navy
Naval Facilities Engineering Command
Mid-Atlantic

Under the

NAVFAC CLEAN 9000 Program
Contract N62470-16-D-9000

Prepared by



Virginia Beach, Virginia

Executive Summary

Historical use of aqueous film-forming foam (AFFF) at Naval Auxiliary Landing Field (NALF) Fentress in Chesapeake, Virginia during firefighting activities and disposal of AFFF prompted the Department of the Navy (the Navy) to conduct a per- and polyfluoroalkyl substances (PFAS) Site Inspection (SI) at the installation. The United States Environmental Protection Agency (USEPA) has described PFAS as "emerging contaminants," and established federal lifetime health advisories (L-HAs) for two PFAS compounds (perfluorooctanoic acid [PFOA] and perfluorooctane sulfonate [PFOS]). A Regional Screening Level (RSL) is also published for perfluorobutanesulfonic acid (PFBS). There are currently no legally enforceable federal or Virginia standards for PFAS constituents.

The objectives of the NALF Fentress SI were identified in the *Final Sampling and Analysis Plan, Basewide Perfluorinated Compound Site Investigation, Naval Auxiliary Landing Field Fentress, Chesapeake, Virginia* (CH2M, 2016e), hereinafter referred to as the "SAP." Objectives were to:

- Determine if PFAS[1] are present in the Base potable/non-potable water supply.
- Determine the groundwater flow direction, gradient, and velocity, to allow the better assessment of fate and transport at the site.
- Determine if PFAS are present in suspected source areas at NALF Fentress.
- Determine whether PFAS are present at levels posing potentially unacceptable human health risks in groundwater at NALF Fentress.
- Determine the potential for off-Base migration of PFAS at NALF Fentress.

Preliminary investigation activities included a desktop study and interviews with Base personal to determine potential source areas of PFAS. The field investigation was conducted between December 2015 and November 2017 and consisted of 1) on and off-Base monitoring well installation (screened in the Columbia/surficial and Yorktown/deep aquifers); 2) groundwater sampling of on-Base newly-installed and existing monitoring wells screened in both aquifers; and off-Base newly-installed monitoring wells screened in both aquifers; 3) on-Base drinking water sampling, 4) off-Base drinking water sampling, and 5) the collection of on-Base soil samples in potential source areas.

Results of the investigation measured against objectives specified above are as follows:

- PFAS was determined to be present in the Base potable/non-potable water supply at levels exceeding the L-HA.
- Groundwater flow in the Columbia/Surficial aquifer was determined to be radial from the approximate location of the original runway at the Base, with a stronger component of flow to the north and east toward the Intracoastal Waterway. Groundwater flow in the Yorktown/deep aquifer is primarily to the north and east toward the Intracoastal Waterway. The groundwater velocity in the Columbia/Surficial aquifer at NALF Fentress is estimated to be 0.0468 foot per day (ft/day) or approximately 17.07 feet per year (ft/year) and the groundwater velocity in the Yorktown aquifer at NALF Fentress is estimated to be 0.0778 ft/day or approximately 28.38 ft/year.
- PFAS were identified in groundwater at levels greater than the L-HA in samples from several of the potential source areas. PFAS were also detected in soils in all areas analyzed, including potential secondary source areas. While many soil concentrations were less than screening levels for direct exposure and potential unacceptable risks were not identified, there may be continuing impacts from the potential for leaching PFAS from the soil.

[1] In order to include a more comprehensive list of chemicals, the industry standard language for this class of chemicals has been modified from perfluorinated compounds (PFCs) to per- and polyfluorinated alkyl substances (PFAS). Consequently, the original objectives included in the SAP have been modified for this document to globally replace "PFCs" with "PFAS."

- Concentrations in groundwater pose a potential unacceptable risk across much of the site, including off-Base private drinking water wells. While risks are acceptable in many of the Yorktown aquifer perimeter wells, it is important to note that potential wells drilled through the confining unit into the deep Yorktown aquifer off-Base pose unacceptable risk, indicating preferential pathways are created during private well installation.
- PFAS were confirmed to have migrated off-Base at levels posing potential unacceptable risks.

An Expanded SI is recommended to refine understanding of the conceptual site model. This would include:

1. Installation of additional shallow and deep monitoring wells off-Base at NALF Fentress to better assess potential migration in both the Columbia/Surficial aquifer and Yorktown/deep aquifer; the wells should be focused to the north and east of the facility in the directions of groundwater flow.
2. Installation of additional Yorktown/deep monitoring wells in locations on-Base with L-HA exceedances in the Columbia/Surficial aquifer, but without existing deep wells (e.g., Site 17 [revised], UST 20B, and within the irrigation sprayfields), and at a deeper depth interval than existing well OF-MW8D to delineate the vertical extent of PFAS levels exceeding the L-HAs in the vicinity of the Crash Truck Test Area.
3. Collection of additional soil samples to assess potential source areas that were not evaluated during the initial sampling effort (e.g., Site 17 [revised]).
4. Continued refinement and monitoring of vertical and horizontal migration of PFAS in the Columbia and Yorktown aquifers.
5. Continued assessment of toxicity data for human and ecological receptors to complete an RI.

Contents

Executive Summary ..... **iii**

Acronyms and Abbreviations ..... **ix**

1 Introduction **1-1**

1.1 Objectives and Approach 1-1

1.2 Report Organization 1-2

2 Site Background and Physical Characteristics **2-1**

2.1 Site Background and Previous Investigations 2-1

2.1.1 NALF Fentress 2-1

2.1.2 Site 14 – Fentress Landfill 2-1

2.1.3 Site 17 – Former Firefighter Training Area 2-2

2.1.4 Underground Storage Tank 20B (Petroleum Oil Lubricant Program) 2-2

2.1.5 Other Areas Identified for PFAS Evaluation 2-3

2.2 Physical Setting 2-3

2.2.1 Climate 2-3

2.2.2 Topography and Surface Drainage Features 2-3

2.2.3 Land Use 2-3

2.2.4 Water Use 2-3

2.2.5 Geologic Setting 2-4

2.2.6 Groundwater Flow 2-4

3 Investigation Methodology **3-1**

3.1 Objectives and Approach 3-1

3.2 Pre-investigation Activities 3-1

3.3 Soil Borings and Monitoring Well Installation 3-1

3.4 Monitoring Well Development 3-2

3.5 Groundwater Elevation Measurement and Aquifer Testing 3-2

3.6 Groundwater Sampling 3-3

3.6.1 On- Base Non-Potable Groundwater Sampling 3-3

3.6.2 Off- Base Non-Potable Groundwater Sampling 3-4

3.6.3 On-Base Potable Water Sampling 3-4

3.6.4 Off-Base Potable Well Sampling 3-4

3.7 Soil Sampling 3-5

3.8 Quality Assurance and Quality Control 3-5

3.9 Decontamination Procedures 3-6

3.10 Surveying 3-6

3.11 Investigation-derived Waste Management 3-6

3.12 Data Quality Evaluation 3-7

4 Investigation Results **4-1**

4.1 Hydraulic Characteristics of Aquifers 4-1

4.2 Groundwater Chemistry and Analytical Results 4-2

4.2.1 General Groundwater Geochemistry 4-2

4.2.2 On- Base PFAS Groundwater Analytical Results 4-2

4.2.3 Off- Base PFAS Groundwater Analytical Results 4-3

4.2.4 PFAS Potable Water Analytical Results 4-4

4.2.5 PFAS Soil Analytical Results 4-5

5 Human Health Risk Screening **5-1**

5.1 Data Evaluation 5-1

5.2 Human Health Risk Screening Methodology 5-1

5.3 Human Health Risk Screening Results 5-3
5.3.1 Crash Truck Test Area 5-3
5.3.2 Perimeter Wells North 5-3
5.3.3 Perimeter Wells South 5-4
5.3.4 Perimeter Wells East 5-4
5.3.5 Perimeter Wells West 5-4
5.3.6 UST 20B Site 5-5
5.3.7 Site 14 5-5
5.3.8 Site 17 Original 5-5
5.3.9 Site 17 Revised 5-5
5.3.10 New Irrigation Sprayfield 5-5
5.3.11 Old Irrigation Sprayfield 5-6
5.3.12 Off-Base Non-Potable Groundwater Wells 5-6
5.3.13 Off-Base Residential Wells 5-6
5.3.14 On-Base Potable Water 5-6
5.3.15 On-Base Soil 5-7
5.4 Human Health Risk Screening Findings 5-7
6 Conclusions and Recommendations 6-1
6.1 Conclusions 6-1
6.2 Recommendations 6-2
7 References 7-1

Appendixes

A NALF Fentress Fire Department Interviews
B Soil Boring Logs
C Monitoring Well Completion Diagrams
D Professional Land Survey Reports
E Investigation-Derived Waste Profiles and Disposal Manifests
F Data Quality Evaluation
G Slug Test Results

Tables

3-1 Investigation-Derived Waste Aqueous Analytical Data (January 2016)
3-2 Investigation-Derived Waste Soil Analytical Data (January 2016)
3-3 Investigation-Derived Waste Soil Analytical Data (March 2017)
3-4 Investigation-Derived Waste Aqueous Analytical Data (April 2017)
3-5 Investigation-Derived Waste Aqueous Analytical Data (June 2017)

4-1 NALF Fentress Groundwater Elevations
4-2 Hydraulic Conductivity Summary
4-3 Water Quality Parameters – On-Base Wells
4-4 Columbia Aquifer Groundwater Analytical Data (December 2015-June 2017)
4-5 Yorktown Aquifer Groundwater Analytical Data (December 2015-June 2017)
4-6 Columbia Aquifer Off-Base Groundwater Analytical Data (November 2017)
4-7 Yorktown Aquifer Off-Base Groundwater Analytical Data (November 2017)
4-8 On-Base Potable Water Analytical Data (December 2015-May 2016)
4-9 Off-Base Potable Water Analytical Data (February 2016-May 2016)
4-10 On-Base Soil Analytical Data (February 2017)

5-1 Crash Truck Test Area Columbia Aquifer - Occurrence, Distribution, and Selection of Chemicals of Potential Concern
5-1a Crash Truck Test Area Columbia Aquifer - Risk Ratio Screening
5-2 Crash Truck Test Area Yorktown Aquifer - Occurrence, Distribution, and Selection of Chemicals of Potential Concern
5-2a Crash Truck Test Area Yorktown Aquifer - Risk Ratio Screening
5-3 Perimeter Wells North Columbia Aquifer - Occurrence, Distribution, and Selection of Chemicals of Potential Concern
5-3a Perimeter Wells North Columbia Aquifer - Risk Ratio Screening
5-4 Perimeter Wells North Yorktown Aquifer - Occurrence, Distribution, and Selection of Chemicals of Potential Concern
5-5 Perimeter Wells South Columbia Aquifer - Occurrence, Distribution, and Selection of Chemicals of Potential Concern
5-5a Perimeter Wells South Columbia Aquifer - Risk Ratio Screening
5-6 Perimeter Wells South Yorktown Aquifer - Occurrence, Distribution, and Selection of Chemicals of Potential Concern
5-6a Perimeter Wells South Yorktown Aquifer - Risk Ratio Screening
5-7 Perimeter Wells East Columbia Aquifer - Occurrence, Distribution, and Selection of Chemicals of Potential Concern
5-7a Perimeter Wells East Columbia Aquifer - Risk Ratio Screening
5-8 Perimeter Wells East Yorktown Aquifer - Occurrence, Distribution, and Selection of Chemicals of Potential Concern
5-9 Perimeter Wells West Columbia Aquifer - Occurrence, Distribution, and Selection of Chemicals of Potential Concern
5-9a Perimeter Wells West Columbia Aquifer - Risk Ratio Screening
5-10 Perimeter Wells West Yorktown Aquifer - Occurrence, Distribution, and Selection of Chemicals of Potential Concern
5-11 UST 20B Site Columbia Aquifer- Occurrence, Distribution, and Selection of Chemicals of Potential Concern
5-11a UST 20B Site Columbia Aquifer - Risk Ratio Screening
5-12 Site 14 Columbia Aquifer - Occurrence, Distribution, and Selection of Chemicals of Potential Concern
5-12a Site 14 Columbia Aquifer - Risk Ratio Screening
5-13 Site 14 Yorktown Aquifer - Occurrence, Distribution, and Selection of Chemicals of Potential Concern
5-14 Site 17 Original Columbia Aquifer - Occurrence, Distribution, and Selection of Chemicals of Potential Concern
5-14a Site 17 Original Columbia Aquifer - Risk Ratio Screening
5-15 Site 17 Original Yorktown Aquifer - Occurrence, Distribution, and Selection of Chemicals of Potential Concern
5-16 Site 17 Revised Columbia Aquifer - Occurrence, Distribution, and Selection of Chemicals of Potential Concern
5-16a Site 17 Revised Columbia Aquifer - Risk Ratio Screening
5-17 New Irrigation Sprayfield Columbia Aquifer - Occurrence, Distribution, and Selection of Chemicals of Potential Concern
5-17a New Irrigation Sprayfield Columbia Aquifer - Risk Ratio Screening
5-18 Old Irrigation Sprayfield Columbia Aquifer - Occurrence, Distribution, and Selection of Chemicals of Potential Concern
5-18a Old Irrigation Sprayfield Columbia Aquifer - Risk Ratio Screening
5-19 Off-Base Non-Potable Columbia Aquifer - Occurrence, Distribution, and Selection of Chemicals of Potential Concern
5-19a Off-Base Non-Potable Columbia Aquifer - Risk Ratio Screening
5-20 Off-Base Non-Potable Yorktown Aquifer - Occurrence, Distribution, and Selection of Chemicals of Potential Concern

5-20a Off-Base Non-Potable Yorktown Aquifer - Risk Ratio Screening
5-21 Residential Wells - Occurrence, Distribution, and Selection of Chemicals of Potential Concern
5-21a Residential Wells - Risk Ratio Screening
5-22 On-Base Potable Water - Occurrence, Distribution, and Selection of Chemicals of Potential Concern
5-22a On-Base Potable Water - Risk Ratio Screening
5-23 On- Base Soil- Occurrence, Distribution and Selection of Chemicals of Potential Concern
5-23a On-Base Soil- Risk Ratio Screening

Figures

2-1 Installation Location Map
2-2 Potential PFAS Source Areas

3-1 Soil Boring and Monitoring Well Installation
3-2 Groundwater Sampling Locations
3-3 Potable Wells Sampling from Parcels Located Off- Base
3-4 Soil Sample Locations

4-1 Groundwater Contours Measured in the Columbia/Surficial Aquifer in September 2016 and May 2017
4-2 Groundwater Contours Measured in the Yorktown Aquifer in September 2016 and May 2017
4-3 Cross-Section Layout
4-4 Cross- Section A-A'
4-5 Cross-Section B-B'
4-6 Groundwater Sampling Locations and Soil Types
4-7 PFAS Concentrations and Groundwater Contours Measured in the Columbia/Surficial Aquifer- September 2016
4-8 PFAS Concentrations and Groundwater Contours Measured in the Columbia/Surficial Aquifer- May 2017
4-9 PFAS Concentrations and Groundwater Contours Measured in the Yorktown Aquifer- September 2016
4-10 PFAS Concentrations and Groundwater Contours Measured in the Yorktown Aquifer- May 2017
4-11 Off-Base PFAS Concentrations in the Columbia/Surficial Aquifer- November 2017
4-12 Off-Base PFAS Concentrations in the Yorktown Aquifer- November 2017
4-13 PFAS Detections and Exceedances from Parcels Located Off-Base
4-14 PFAS Concentrations in Soil Samples

5-1 Human Health Risk Screening for PFAS in Groundwater

Acronyms and Abbreviations

°C	degree Celsius
µg/kg	microgram per kilogram
AFFF	aqueous film-forming foam
bgs	below ground surface
BTEX	benzene, toluene, ethylbenzene, and xylene
CLEAN	Comprehensive Long-term Environmental Action—Navy
cm/s	centimeter per second
COPC	chemical of potential concern
CSM	conceptual site model
DI	deionized
DO	dissolved oxygen
ft/day	foot per day
ft/min	foot per minute
ft/year	foot per year
HHRS	human health risk screening
HI	hazard index
HQ	hazard quotient
HSA	hollow-stem auger
ID	inside diameter
IDW	investigation-derived waste
L-HA	lifetime health advisory
mg/L	milligram per liter
MS	matrix spike
mS/cm	milliSiemen per centimeter
MSD	matrix spike duplicate
mV	millivolt
NAD83	North American Datum 1983
NALF	Naval Auxiliary Landing Field
NAS	Naval Air Station
NAVD	National American Vertical Datum
NAVFAC	Naval Facilities Engineering Command
Navy	Department of the Navy
ng/L	nanogram per liter
NTU	Nephelometric Turbidity Units
ORP	oxidation-reduction potential
PFAS	polyfluoroalkyl substances
PFBS	perfluorobutanesulfonic acid
PFHpA	perfluoroheptanoic acid
PFHxS	perfluorohexanesulfonic acid
PFNA	perfluorononanoic acid
PFOA	perfluorooctanoic acid
PFOS	perfluorooctane sulfonate
POL	Petroleum Oil Lubricant

ppm	part per million
PVC	polyvinyl chloride
QA	quality assurance
QC	quality control
RCRA	Resource Conservation and Recovery Act
RSL	Regional Screening Level
SAP	Sampling and Analysis Plan
SI	Site Inspection
SOP	Standard Operating Procedure
SVOC	semivolatile organic compound
SWCB	State Water Control Board
SWMU	Solid Waste Management Unit
TCLP	toxicity characteristic leachate procedure
TPH	total petroleum hydrocarbons
UCMR	Unregulated Contaminant Monitoring Rule
UFP	Uniform Federal Policy
USEPA	United States Environmental Protection Agency
UST	Underground Storage Tank
VDEQ	Virginia Department of Environmental Quality
VOC	volatile organic compound

SECTION 1

Introduction

This Site Inspection (SI) report presents the data and findings obtained from field activities conducted to determine if a release of per- and polyfluoroalkyl substances (PFAS) occurred at Naval Auxiliary Landing Field (NALF) Fentress in Chesapeake, Virginia. This report was prepared for the Department of the Navy (Navy), Naval Facilities Engineering Command (NAVFAC) Mid-Atlantic, under the Comprehensive Long-term Environmental Action—Navy (CLEAN) 9000, Contract N62470-16-D-9000, Contract Task Order WE01, for submittal to NAVFAC Mid-Atlantic, the United States Environmental Protection Agency (USEPA) Region 3, and the Virginia Department of Environmental Quality (VDEQ). The Navy, USEPA, and VDEQ work jointly as the Naval Air Station (NAS) Oceana/NALF Fentress Tier 1 Partnering Team.

The field activities discussed in this report were conducted between December 2015 and June 2017 in accordance with the Uniform Federal Policy (UFP) – Sampling and Analysis Plan (SAP) titled *Final Sampling and Analysis Plan, Basewide Perfluorinated Compound Site Investigation, Naval Auxiliary Landing Field Fentress, Chesapeake, Virginia* (CH2M, 2016e) and the UFP-SAP addendum titled *Final Sampling and Analysis Plan Addendum 1, Basewide Per- and Polyfluoroalkyl Substances Site Investigation, Naval Auxiliary Landing Field Fentress, Chesapeake, Virginia* (CH2M, 2017). Field activities included monitoring well installation, groundwater sampling, soil sampling, on-Base potable water sampling, and off-Base private potable well sampling. Additionally, a desktop review of historical data and personnel interviews were conducted to determine potential source areas of PFAS on-Base. A summary of the technical approach for conducting these activities and the field and laboratory analytical results are detailed below.

1.1 Objectives and Approach

The objectives of this Basewide SI were as follows:

- To determine if PFAS are present in the Base potable/non-potable water supply
- To determine groundwater flow direction, gradient, and velocity to better allow for assessment of fate and transport at the site
- To determine whether PFAS are present in groundwater in and/or downgradient of likely source areas at the installation
- To determine whether PFAS are present at levels posing potentially unacceptable human health risks in groundwater at NALF Fentress
- To determine the potential for off-Base migration of PFAS and whether PFAS are present at levels posing potentially unacceptable human health risks in groundwater and drinking water

The activities completed to support the objectives of the SI activities at NALF Fentress were as follows:

- Installation of 22 shallow (Columbia aquifer) and 15 deep (Yorktown aquifer) monitoring wells
- Completion of a groundwater elevation survey and collection of groundwater samples from the 29 new treatment plant system
- Collection of off-Base potable water samples from 56 private drinking water wells
- Collection of soil samples in potential source areas
- Completion of slug tests in select shallow and deep wells to assess hydraulic conductivity and groundwater velocity
- Quantitative assessment of the potential human health with exposure to contaminated groundwater

1.2 Report Organization

The SI report is organized as follows:

- **Section 1** – Introduction
- **Section 2** – Site Background and Physical Characteristics
- **Section 3** – Investigation Methodology
- **Section 4** – Investigation Results
- **Section 5** – Human Health Risk Screening
- **Section 6** – Conclusions and Recommendations
- **Section 7** – References

Tables and figures are provided at the end of each respective section. Appendixes are included at the end of the report.

SECTION 2

Site Background and Physical Characteristics

This subsection provides background information on NALF Fentress, Site 14, Site 17, Underground Storage Tank (UST) 20B, other potential sources of PFAS at NALF Fentress, and relevant information on the physical and hydrogeologic setting at the site.

2.1 Site Background and Previous Investigations

2.1.1 NALF Fentress

NALF Fentress (**Figure 2-1**) is located in Chesapeake, Virginia and is a noncontiguous property under the command of NAS Oceana. Established in 1940, the installation encompasses just over 2,500 acres and approximately 8,700 acres in restrictive easements. The facility is primarily used by squadrons stationed at NAS Oceana or Naval Station Norfolk Chambers Field for field carrier landing practice operations. Neither storage nor maintenance of aircraft is routinely performed at NALF Fentress.

Previous environmental investigations indicated no further action was necessary at NALF Fentress. However, since that time certain PFAS, which were not previously evaluated at Navy sites, have been identified as emerging contaminants that could have been released historically as a result of aqueous film forming foam (AFFF) use during firefighting activities. Because PFAS are environmentally persistent, they can be present in environmental media long after a release. This, combined with recent research regarding potential toxicity from exposure to these compounds, is why these compounds were included in this investigation at NALF Fentress. In 2013, the USEPA added new PFAS sampling requirements to the Safe Drinking Water Act UCMR3, requiring all large potable water supply systems (supplying to more than 10,000 people) and 800 small public water supply systems to test for these chemicals before 2015.

In October 2014, the Assistant Secretary of the Navy, Energy, Installations and Environment issued a statement requiring evaluation of sites with the potential for PFAS to be present under the Defense Environmental Restoration Program and requiring sampling of PFAS in drinking water from finished water in Navy water supplies not included in the USEPA requirement, but where sources of PFAS upgradient (based on groundwater flow direction) are known or suspected. As a result of a review of sites, Site 14 and Site 17 at NALF Fentress were identified for further evaluation of PFAS.

2.1.2 Site 14 – Fentress Landfill

Site 14 (**Figure 2-2**) shows the location of the Fentress Landfill and was formerly known as Solid Waste Management Unit (SWMU) 23. The Fentress Landfill was in use from 1945 until 1970 (EarthTech, 1989). Site 14 was identified as a site requiring additional investigation in the Initial Assessment Study (NEESA, 1984). In 1986, groundwater, surface water, and sediment were sampled at Site 14 and the impacts were determined to be minor. However, a second round of monitoring for groundwater and surface water was recommended to confirm initial results. In 1989, the Resource Conservation and Recovery Act (RCRA) Facility Assessment identified Site 14 (referred to as SWMU 23 in that report) as requiring additional evaluation. The RFA noted that the landfill was unlined and used for the disposal of pesticides, construction materials, conductors, and solvents (EarthTech, 1989). A confirmation round of sampling was conducted at Site 14 in 1991, in response to the conclusions from the Round 1 Verification Step (CH2M, 1986). The report concluded that there were no unacceptable impacts to the environment from landfilling activities at Site 14 and recommended no further action (CH2M, 1991). A site inspection was completed at Site 14 in 1992 and results of previous investigations were confirmed. However, additional investigation was recommended to determine groundwater flow direction and to confirm groundwater data (Baker, 1992). In 1993, a Supplemental Site Investigation was completed and results of previous investigations for groundwater at Site 14 were confirmed and no additional action was recommended (Baker, 1993). PFAS constituents were not analyzed during these investigations.

In 2015, Site 14 at NALF Fentress was identified as requiring further evaluation of potential PFAS contamination as AFFF may have been disposed of in the Fentress Landfill.

2.1.3 Site 17 – Former Firefighter Training Area

Site 17 (**Figure 2-2**) is the location of the former Firefighter Training Area and was formerly known as SWMU 64. Site 17 consists of a burn pit with an earthen berm used to ignite fuel and other wastes for firefighter training exercises (CH2M, 1991). Site 17 was identified in the RCRA Facility Assessment, but was not recommended for additional evaluation (EarthTech, 1989). In 1991, soil and groundwater at Site 17 were analyzed for volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), total petroleum hydrocarbons (TPH), lead, and ignitability (soils only). Both soil and groundwater were determined to be contaminated with petroleum-related compounds and additional action was recommended to remove contaminated soils and monitor groundwater (CH2M, 1991). In 1992, an additional round of soil and groundwater sampling was completed and petroleum contamination was found in both soil and groundwater north of the runway intersection and in soil west of the runway intersection. Further delineation of petroleum-related contamination was recommended to support a soil removal action (Baker, 1992). In 1993, soil gas samples were analyzed in the field to determine additional soil sampling locations to better define the nature and extent of the petroleum-related contamination to support a soil removal action. A removal action of 7,400 cubic yards of contaminated soil was recommended. Installation of a downgradient well was also recommended to evaluate the effectiveness of the removal action in reducing groundwater contamination (Baker, 1993). Removal Action Alternatives were evaluated in the Engineering Evaluation/Cost Analysis and excavation and onsite treatment using bioremediation was identified as the recommended treatment alternative (FWI, 1994a). A decision document was finalized in 1994, selecting onsite bioremediation as the removal action for soil at Site 17 (FWI, 1994b). PFAS constituents were not analyzed from any of these investigations.

In 2015, Site 17 at NALF Fentress was identified as requiring further evaluation of potential PFAS contamination due to firefighting practices utilizing AFFF at the site.

During the initial evaluate of Site 17 to support the PFAS investigation, the site was located using previous documents. However, following the initial phase of investigation, historical air photos were reviewed and indicated an alternate site location based on ground discoloration. Both possible locations are shown on **Figure 2-2** and both were evaluated as part of this PFAS SI.

2.1.4 Underground Storage Tank 20B (Petroleum Oil Lubricant Program)

UST 20B (**Figure 2-2**) is the location of a former steel tank used to store gasoline. UST 20B was located south of Building 20 and has been removed. A site characterization was conducted for UST 20B in 1994 to determine the extent of contamination after the report of a release of gasoline. Soil and groundwater samples were collected and analyzed for TPH, benzene, toluene, ethylbenzene, and xylene (BTEX), toxicity characteristic leachate procedure (TCLP) lead (soil only), and total lead (groundwater only). Results indicated petroleum-related contamination was present in the soil and groundwater. Further delineation of groundwater contamination, followed by a remediation action was recommended, as well as limited remediation of soil (Baker, 1994). Based on recommendations from VDEQ, the NALF Fentress drinking water production wells were sampled for BTEX and TCE monthly for one quarter and quarterly until 1998, when new, deeper water production wells were put in use. In February 1995, an additional round of data was collected for TPH and BTEX from the monitoring wells installed during the site characterization. In 1998, the old water production wells were closed and new production wells were put into use (Navy, 1995, 1996a, 1996b, 1999, pers. comm.).

UST 20B was managed under the Petroleum Oil Lubricant (POL) program. During this NALF Fentress Basewide PFAS SI, the UST 20B monitoring wells were located and sampled to aid with characterization of the nature and extent of PFAS contamination in groundwater at NALF Fentress. The UST 20B monitoring wells are located near the former AFFF storage area.

2.1.5 Other Areas Identified for PFAS Evaluation

Additional areas at NALF Fentress were identified as requiring further evaluation of PFAS contamination based on historical activities or potential contaminant transport pathways (areas presented in **Appendix A**). The following areas were identified through desktop review and/or interviews with the NALF Fentress Fire Department:

- Crash Truck Test Area – This area was used to test AFFF spray nozzles on fire trucks by spraying AFFF directly onto the ground surface.
- Current and Former Irrigation Sprayfields – These areas were used to apply treated wastewater to the ground surface through spray irrigation. These were evaluated as secondary PFAS source areas because the water and wastewater treatment process at the Base was not designed to treat PFAS
- Perimeter Wells – Wells on the facility perimeter were evaluated for PFAS to assess off-Base migration potential (these wells included wells previously installed by State Water Control Board [SWCB]).

2.2 Physical Setting

This section describes the site setting, including geologic and hydrogeologic features to this investigation.

2.2.1 Climate

Chesapeake weather is typically very mild. This area experiences four distinct seasons with average temperatures of 77 degrees in the summer, 62 degrees in the fall, 41 degrees in the winter, and 57 degrees in the spring. Chesapeake receives about 45 inches of precipitation annually with a trace amount of snow during winter months (City of Chesapeake, 2017).

Coastal weather events in the form of severe thunderstorms, northeasters, and occasional hurricanes can have significant but temporary effects on the climate of the area. Winds are typically blown from a northerly direction from January through March and again in September and October. During the remaining months, winds generally blow from a southerly direction (Geo-Marine, Inc., 2001).

2.2.2 Topography and Surface Drainage Features

Topography at NALF Fentress is flat with relief varying by less than 5 feet across the entire installation (CH2M, 1992). Land surface elevations range between 10 and 15 feet above mean sea level. Surface runoff from the Base is directed to a system of drainage ditches and surface canals, which direct water north and east of the facility toward the Pocaty River and the marshland surrounding it. The Pocaty River is part of the Intracoastal Waterway (**Figure 2-1**).

2.2.3 Land Use

NALF Fentress is a noncontiguous property under the command of NAS Oceana. Established in 1940, the installation encompasses just over 2,500 acres and approximately 8,700 acres in restrictive easements. The facility is primarily used by squadrons stationed at NAS Oceana or Naval Station Norfolk Chambers Field for field carrier landing practice operations. Neither storage nor maintenance of aircraft is routinely performed at NALF Fentress. Land use surrounding the NALF Fentress is primarily residential and agricultural.

2.2.4 Water Use

The drinking water at NALF Fentress is supplied by two on-Base production wells that are pumped through a water treatment system (also located on-Base) that is owned and operated by the Navy Public Works Center (Malcolm Pirnie, Inc. 2008).

2.2.5 Geologic Setting

NALF Fentress is situated on the outer edge of the Atlantic Coastal Plan physiographic province. The Atlantic Coastal Plan is a broad wedge of unconsolidated sediments that dip and thicken to the east. The sediments consist of several thousand feet of unconsolidated sand, clay, silt, and gravels and are underlain by granite basement rock. From oldest to youngest, the five principal sedimentary units are the Potomac Formation, unnamed Upper Cretaceous deposits, the Pamunkey Group, the Chesapeake Group, and the Columbia Group (FWI, 1994b).

The Columbia Group sediments and the uppermost portion of the Chesapeake Group or the Yorktown aquifer, comprise one of the principal aquifers used locally for water supply. Regionally, a layer of silt and clay separates the Yorktown aquifer from the sediments of the Columbia Group. This clay layer has been designated as the Yorktown confining unit by Mend Harsh (1984), because of its role in the regional hydrogeology. At Fentress, the Yorktown confining unit was identified as being a layer of olive-gray clay and silty clay 0.5- to 15- feet thick, which was encountered at approximately 30 feet below the land surface. The Yorktown aquifer, was encountered at approximately 45 feet below the land surface, directly beneath the Yorktown confining unit. The aquifer consists primarily of gray, very fine to medium sand, and in some cases, coarse sand and gravel.

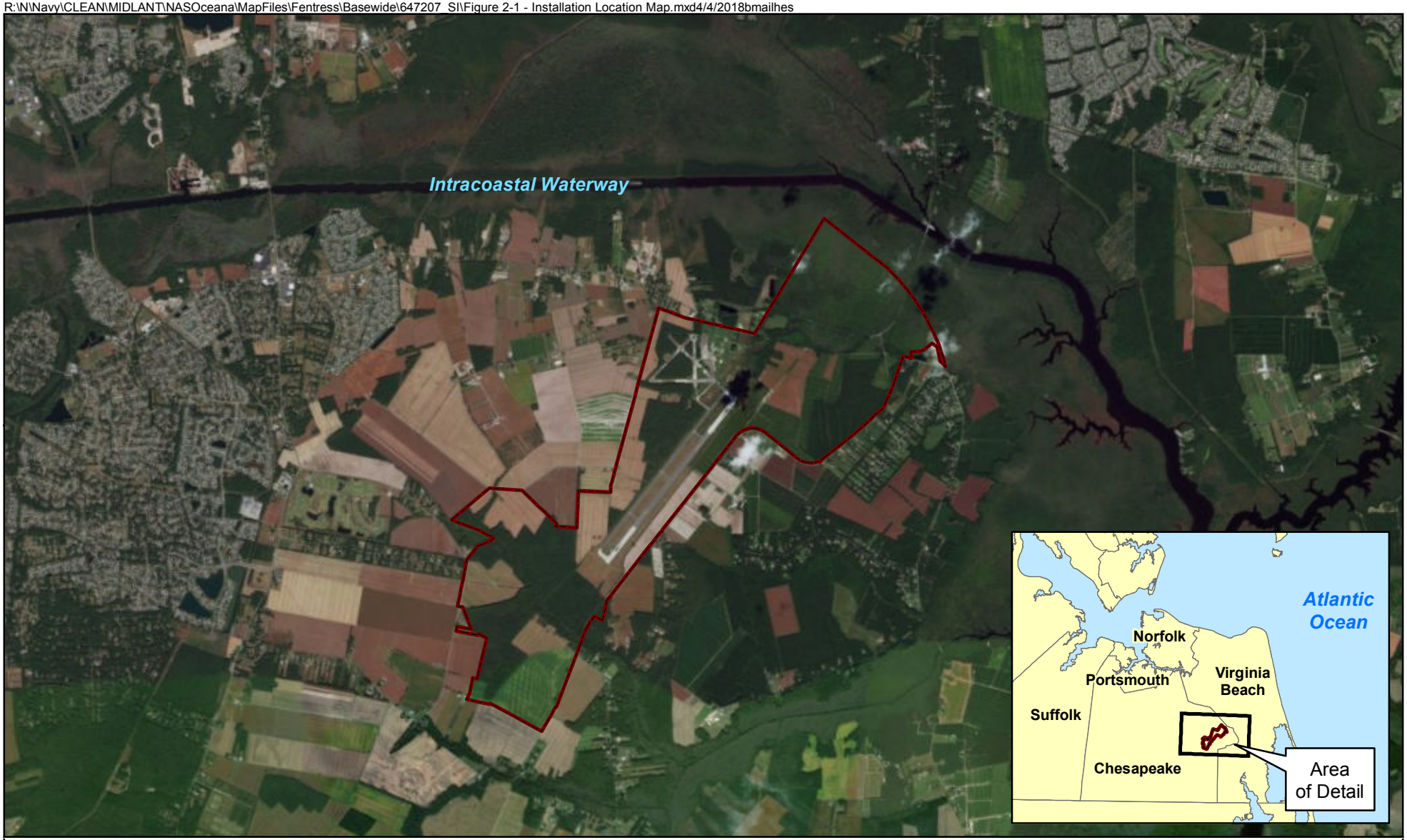
The sediments of the Columbia Group comprise the surface materials and consist of interbedded gravels, sands, silts, and clays. In the vicinity of Fentress, the thickness of these sediments is less than 30 feet, and typically the depth to groundwater is relatively shallow, less than 10 feet below the land surface. As a result, an unconfined aquifer with a saturated thickness of approximately 20 feet is present in the sediments beneath NALF Fentress.

2.2.6 Groundwater Flow

Local groundwater flow in the Columbia/Surficial aquifer is radial from the approximate location of the original runway at the Base with a higher component of flow to the northeast. Yorktown aquifer flow is toward the east. A downward vertical gradient exists between the Columbia and Yorktown aquifers. Flow characteristics observed during this investigation are discussed in more detail in **Section 3** of this report.

Groundwater at NAS Oceana is generally within 3 to 10 feet of the land surface. Aquifer conditions are unconfined in the Columbia Group and unconfined to semi-confined within the upper Yorktown Formation. In the southern portion of the facility, the confining unit (if present), is no more than 0.5 foot thick, possibly allowing the upper Yorktown and Columbia/Surficial act as a single, unconfined, hydrogeologic unit. Additionally, in some areas north of the facility, the confining unit is very sandy, possibly resulting in some hydraulic connection between the two aquifers.

R:\N\Navy\CLEAN\MIDLANT\NASOceana\MapFiles\Fentress\Basewide\647207_SI\Figure 2-1 - Installation Location Map.mxd4/4/2018bmailhes



Legend
Fentress Boundary

N
W E
S

0 0.5 1
Miles

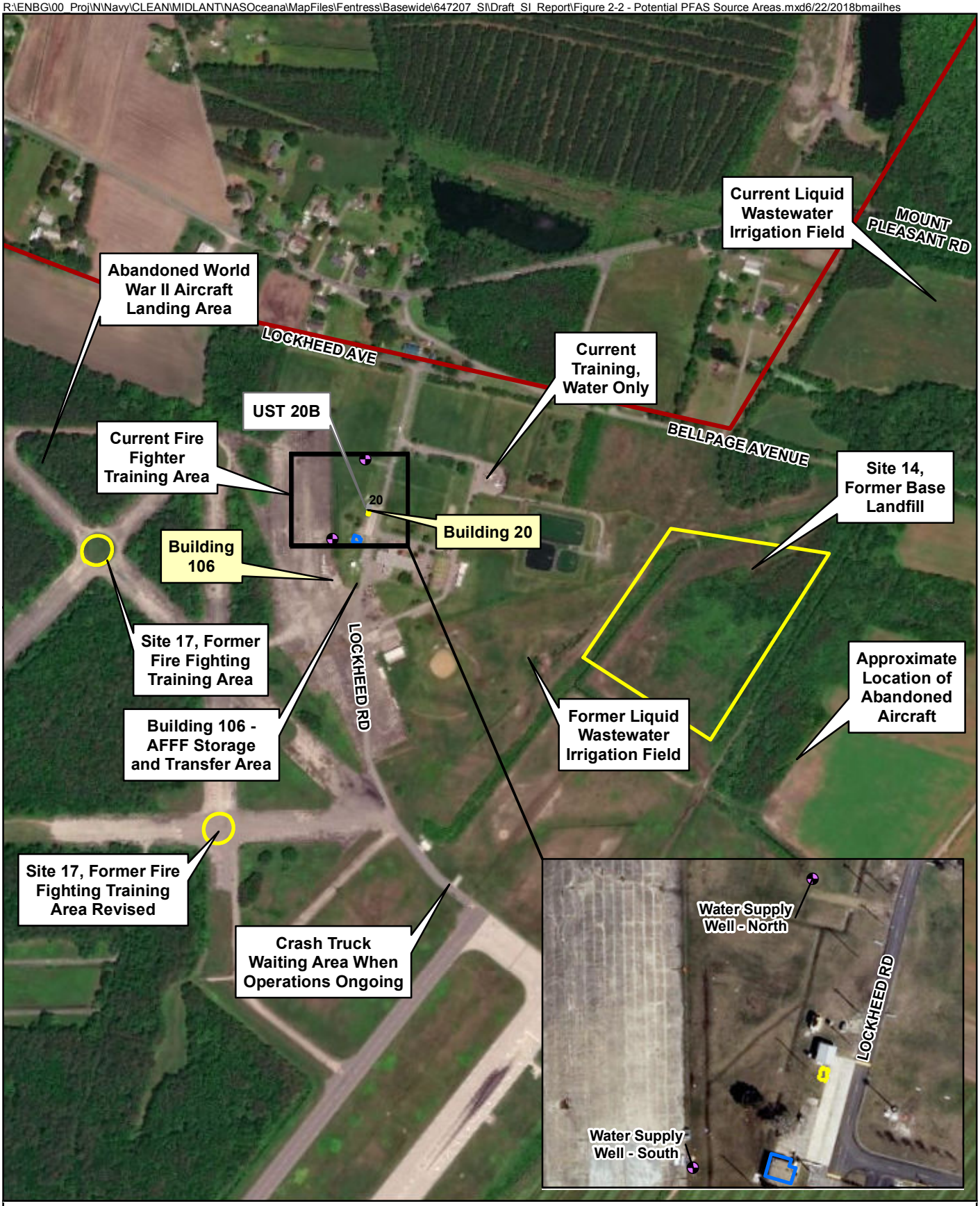
1 inch = 1 mile

Imagery Source: ©2017 Esri

Figure 2-1
Installation Location Map
Basewide Per- and Polyfluoroalkyl Substances Site Inspection Report
NALF Fentress, Chesapeake, Virginia

ch2m.

R:\ENBG\00_Proj\N\Navy\CLEAN\MIDLANT\NASOceana\MapFiles\Fentress\Basewide\647207_SI\Draft_SI_Report\Figure 2-2 - Potential PFAS Source Areas.mxd6/22/2018bmailhes



Legend

- Water Supply Well Location
- Site Boundary
- Water Treatment Plant
- Fentress Boundary

N

0 300 600 Feet

Imagery Source: ©2017, Esri

Figure 2-2
Potential PFAS Source Areas
Basewide Per- and Polyfluoroalkyl Substances Site Inspection Report
NALF Fentress, Chesapeake, Virginia

ch2m.

SECTION 3

Investigation Methodology

3.1 Objectives and Approach

The field activities discussed in this report were performed in accordance with the SAP (CH2M, 2016e) and SAP Addendum (CH2M, 2017). The initial phase of field activities (Phase I) was conducted from December 2015 to January 2016 and included on-Base monitoring well installation, on-Base groundwater sampling, and on-Base drinking water sampling. Based on the results of Phase I, CH2M performed an additional investigation (Phase II) from May 2016 to June 2017 which included the on-Base monitoring well installation, on- Base groundwater sampling, on-Base drinking water sampling, and the collection of surface soil and subsurface soil samples. A summary of the technical approach for conducting SI activities is in the sections that follow.

Additional investigations were also completed to assess and plan PFAS treatment options at the on-Base water and wastewater treatment plants and in off-Base drinking water. However, the methods for completing these assessments and the results of those assessments are not included in this SI report because they were completed as separate evaluations. Information on these studies is available in the following:

- *Granular Activated Carbon Treatment Systems to Remove PFOA and PFOS – Design Testing Work Plan Potable Water and Wastewater Systems, Naval Auxiliary Landing Field Fentress, Chesapeake, Virginia* (CH2M, 2016a),
- *Bench-Scale Treatability Study Results: Granular Activated Carbon Testing to Remove PFOA and PFOS in Wastewater, Naval Auxiliary Landing Field Fentress, Chesapeake, Virginia* (CH2M, 2016b),
- *Bench-Scale Treatability Study Results: Granular Activated Carbon Testing to Remove PFOA and PFOS in Drinking Water, Naval Auxiliary Landing Field Fentress, Chesapeake, Virginia* (CH2M 2016c), and
- *Pilot Test Work Plan: Granular Activated Carbon System Installation on Residential Drinking Water Systems to Remove PFOA and PFOS, Naval Auxiliary Landing Field Fentress, Chesapeake, Virginia* (CH2M, 2016d).

3.2 Pre-investigation Activities

Prior to the 2015 field activities, a desktop review of historical documents was conducted to determine any potential AFFF release areas. In November 2015, an interview of the NALF Fentress Fire Department was conducted to discuss the use of AFFF and identify any additional potential AFFF release areas. The record of meeting from this interview is provided in **Appendix A**.

Prior to the 2015 monitoring well installation activities, Accumark of Chesapeake, Virginia, conducted an underground utility clearance at NALF Fentress. Additionally, Virginia Utility Protection Service (formerly known as Miss Utility of Virginia) was contacted to support locating operations.

3.3 Soil Borings and Monitoring Well Installation

Parratt-Wolff, Inc., of Hillsborough, North Carolina, provided hollow-stem auger (HSA) and rotary well drilling and installation services using a combination of 4.25-inch-inside-diameter (ID) HSA, 8.25-inch ID HSA, and 6-inch rotary drilling methods. During well installation, soil cores were collected continuously into 4-foot-long acetate sleeves. Soil descriptions were recorded, including grain size, color, moisture content, relative density, consistency, soil structure, mineralogy, and other relevant information, such as possible evidence of contamination. Soil boring logs are included in **Appendix B**.

Seventeen (17) on-Base shallow monitoring wells were installed within the Columbia/Surficial aquifer to depths up to 40 feet below ground surface (bgs) (**Figure 3-1**). Twelve (12) on-Base deep monitoring wells were installed within the Yorktown aquifer to depths up to 64 feet bgs (**Figure 3-1**). In addition, five (5) shallow monitoring wells were installed off-Base within the Columbia/Surficial aquifer to depths up to 30.5 feet bgs and three (3) deep

monitoring wells were installed off-Base within the Yorktown aquifer to depths up to 130.5 feet bgs (**Figure 3-1**). Each monitoring well was installed in accordance with the standard operating procedures (SOPs) titled *General Guidance for Monitoring Well Installation, Installation of Shallow Monitoring Wells, and Installation of Deep Monitoring Wells,* as applicable, provided in the SAP (CH2M, 2016e). The monitoring well construction details are provided in **Appendix C**.

The new monitoring wells were constructed with flush-threaded, 2-inch-ID Schedule 40 polyvinyl chloride (PVC) casing and 10 feet long with 0.010-inch slot sized well screen. A silica sand filter pack was placed within the annular space around the well screen from the bottom of the boring and well screen to a depth of approximately 2 feet above the top of the screen. A bentonite layer (approximately 2 to 3 feet) was placed at the top of the sand pack and hydrated with water. After the bentonite was allowed to hydrate for at least 24 hours, a cement-bentonite grout was placed in the remaining annular space to the surface. Deep (Yorktown aquifer) wells were constructed by first grouting a 6-inch steel casing into the clay confining unit and drilling to depth using rotary drilling methods, so as to avoid creation of a preferential pathway for migration of contaminants. All monitoring wells were completed with either steel stick-up protective casings and surrounded by four protective bollards or a boltless flush-mounted cover. A locking, watertight cap was placed on the top of each casing, and the well identification numbers were clearly marked on the well with etched well identification tags.

3.4 Monitoring Well Development

Prior to sampling, all new monitoring wells were developed to restore the permeability of the aquifer material immediately surrounding the well, which may have been reduced by the drilling operations, and to remove fine-grained materials that may have collected inside the well during installation. Monitoring well development was performed after the grout used to construct the new monitoring wells was allowed to adequately set (at least 24 hours or more) to prevent grout contamination of the screened interval. Monitoring wells were developed using a submersible pump and a combination of surging and pumping throughout the length of the well screen.

Between 45 and 200 gallons of water were evacuated from each well during the entire monitoring well development event. During monitoring well development, in accordance with the SOPs provided in the SAP (CH2M, 2016e), water quality parameters (pH, oxidation-reduction potential [ORP], temperature, conductivity, turbidity, and dissolved oxygen [DO]) were recorded approximately every 5 minutes using a YSI water-quality meter. The YSI instrument was calibrated daily, and calibration results were recorded in the field notebook.

Generally, development continued until at least three well volumes were removed and the water produced was free of turbidity, sand, and silt (to the maximum extent practicable). A YSI water-quality meter was used to determine when the turbidity was low (preferably less than 20 Nephelometric Turbidity Units [NTUs]). If turbidity continued to decrease after the removal of three well volumes, development was continued until turbidity readings stabilized (that is, until turbidity readings were within 10 percent of each other for three consecutive readings). In addition, development typically ended once three successive measurements of pH, specific conductivity, and temperature within 10 percent of each other were achieved.

3.5 Groundwater Elevation Measurement and Aquifer Testing

A groundwater elevation survey was conducted at all new and existing monitoring wells prior to sampling. An electronic water-level meter was used to measure the depth to water from the surveyed marking on the top of the well casing to the nearest 0.01 foot.

In September 2017, falling- and rising-head slug tests were conducted in monitoring wells OF-MW09, OF-MW09D, OF-MW13, OF-MW13D, OF-MW15, and OF-MW15D to quantify spatial variations of the hydraulic properties of the Columbia/Surficial and Yorktown aquifers at the site.

Three rising-head (slug-out) and three falling-head (slug-in) tests were performed in each monitoring well. The static depth to water was manually measured and recorded before each slug test. A digital data logger (Level Troll 700™) was installed in the well to a depth of several feet below the static water level. The data logger was

programmed to linearly record the depth of water above the sensor at 0.25 second intervals. The slug used for all test consisted of a 5-foot-long, 1.5-inch-diameter section of solid PVC.

For each falling-head test the slug was rapidly lowered into the well and held steady while the digital data logger measured the changing depth of water. The slug remained in place until the static water level recovered to 90 percent of the pre-test level.

A rising-head test was conducted by rapidly removing the slug while the digital data logger measured the changing depth of water. The test continued until the water level recovered to 90 percent of the pre-test level.

All equipment that entered the well was decontaminated before testing was started and before the equipment was moved to test a new well. After the six tests at each well, the data logger was downloaded and the test results were examined. The field team moved to the next well only after verifying that a minimum of two rising head (slug out) tests provided usable data.

3.6 Groundwater Sampling

Between December 2015 and November 2017, groundwater samples were collected from:

- 29 on-Base newly installed monitoring wells
- 11 existing monitoring wells at Sites 14, 17, and the irrigation sprayfields
- Six (6) UST 20B site wells
- Five (5) SWCB wells
- On-Base potable system from the water supply treatment system
- Eight (8) off-Base newly installed monitoring wells
- 56 off-Base residential potable wells

3.6.1 On- Base Non-Potable Groundwater Sampling

Groundwater samples were collected in accordance with the SOPs provided in the SAP (CH2M, 2016e, 2017). Cross-contamination of PFAS was considered during sampling in accordance with the Standard Operating Procedure (SOP) titled *OPNAV PFC Sampling Policy* provided in the SAP (CH2M, 2016e). Groundwater samples were collected from new and existing monitoring wells, POL wells, and SWCB wells (**Figure 3-2**). Prior to groundwater sample collection, monitoring wells were purged to remove any stagnant water that may have accumulated within the well. Groundwater samples were collected from monitoring wells using a peristaltic pump and disposable tubing. Groundwater quality parameters, including pH, ORP, temperature, conductivity, turbidity, and DO, were measured during the purging of each well using a YSI water-quality meter and a flow-through cell to prevent the purged groundwater from contacting the atmosphere during parameter measurement.

Purging continued until water quality readings collected 5 minutes apart stabilized to within 10 percent of one another. Following parameter stabilization, a CHEMet test kit was used to confirm DO readings measured by the water-quality meter (Model Numbers K-7501 for 0 to 1 part per million [ppm] and K-7512 for 1 to 12 ppm). Once DO confirmation was recorded, the flow-through cell was disconnected and samples were collected directly into laboratory-prepared, pre-preserved sample bottles.

Since on-base non-potable groundwater sampling was conducted before September 2017, the groundwater samples were analyzed for six PFAS listed in the UCM3: perfluorooctanesulfonic acid (PFOS), perfluorooctanoic acid (PFOA), perfluorononanoic acid (PFNA), perfluorohexanesulfonic acid (PFHxS), perfluoroheptanoic acid (PFHpA), and perfluorobutanesulfonic acid (PFBS). Groundwater for the analytical samples was pumped through the tubing directly into the appropriate laboratory-provided bottleware. To avoid cross-contamination of PFAS, Teflon tubing was not utilized during sampling. After collection in sampling containers, and at the end of each day, the samples were packed on ice and shipped via overnight service to the laboratory for analysis.

3.6.2 Off- Base Non-Potable Groundwater Sampling

Off-Base groundwater samples (**Figure 3-2**) were collected by the same method as the on-Base monitoring wells (as described in Section 3.6.1).

Since off-base non-potable groundwater sampling was conducted after September 2017, the groundwater samples were analyzed for 14 PFAS constituents listed in the Interim PFAS Site Guidance for NAVFAC RPMS/September 2017 Update: PFOS, PFOA, PFNA, PFHxS, PFHpA, PFBS, perfluorohexanoic acid (PFHxA), perfluorodecanoic acid (PFDA), n-methyl perfluorooctanesulfonamidoacetic acid (NMeFOSAA), Perfluoroundecanoic acid (PFUnA), n-ethylperfluoroctansulfonamid (NEtFOSAA), perfluorododecanoic acid (PFDoA), perfluorotridecanoic acid (PFTrDA), and perfluorotetradecanoic Acid (PFTA or PFTeDA). Groundwater for the analytical samples was pumped through the tubing directly into the appropriate laboratory-provided bottleware. To avoid cross-contamination of PFAS, Teflon tubing was not utilized during sampling. After collection in sampling containers, and at the end of each day, the samples were packed on ice and shipped via overnight service to the laboratory for analysis.

3.6.3 On-Base Potable Water Sampling

Influent samples were collected from the NALF Fentress drinking water treatment plant including one total oxidizable precursor sample, in accordance with the SOP titled *Potable Water Supply Sampling* provided in the SAP (CH2M, 2016). Cross-contamination of PFAS was considered during sampling in accordance with the SOP titled *OPNAV PFC Sampling Policy* provided in the SAP (CH2M, 2016e). Two on-Base water supply wells, screened at the deep well (Yorktown aquifer), alternately pump groundwater providing water to the treatment plant (**Figure 3-2**). Potable water samples were collected in December 2015 and in May 2016. The influent samples were collected from a spigot on a storage tank prior to treatment, where groundwater from both production wells is mixed.

Since on-base potable water sampling was conducted before September 2017, the production well samples were analyzed for six PFAS: PFOS, PFOA, PFNA, PFHxS, PFHpA, and PFBS. After collection in sampling containers, and at the end of each day, the samples were packed on ice and shipped via overnight service to the laboratory for analysis.

3.6.4 Off-Base Potable Well Sampling

Off-Base drinking water samples were collected from private residential potable wells within the designated sampling area (**Figure 3-3**). Samples were collected from 56 parcels, for which the property owner's requested sampling. Drinking water samples were collected in accordance with the SOP titled *Potable Water Supply Sampling* provided in the SAP (CH2M, 2016e). Cross-contamination of PFAS was considered during sampling in accordance with the SOP titled *OPNAV PFC Sampling Policy* provided in the SAP (CH2M, 2016e). Drinking water samples were collected prior to any treatment system, either at the well head or from a faucet inside of the residences if no treatment system was utilized. Prior to sample collection, drinking water wells were purged by allowing water to flow for 10 to 15 minutes to remove any stagnant water that may have accumulated within the pipes and to ensure that the sample was coming directly from the well. Drinking water samples were collected directly from the spigot or faucet into laboratory-prepared sample bottles.

Since the off-base potable well sampling was conducted before September 2017, the drinking water samples were analyzed for six PFAS: PFOS, PFOA, PFNA, PFHxS, PFHpA, and PFBS. In rare instances, drinking water for the analytical samples was purged through a hose connected to the spigot. To avoid cross-contamination of PFAS, the hose was disconnected during sampling. After collection in sampling containers, and at the end of each day, the samples were packed on ice and shipped via overnight service to the laboratory for analysis.

3.7 Soil Sampling

In February 2017 surface soil and subsurface soil samples were collected in accordance with SOPs provided in the SAP (CH2M, 2016e, 2017) to evaluate the presence of soil sources onsite. Sample locations are presented in **Figure 3-4**. Cross-contamination of PFAS was considered during sampling in accordance with the SOP titled *OPNAV PFC Sampling Policy* provided in the SAP (CH2M, 2016e). Soil samples were collected using stainless steel augers or trowels and placed into laboratory-prepared sample containers.

Since the soil sampling was conducted before September 2017, the soil samples were analyzed for six PFAS: PFOS, PFOA, PFNA, PFHxS, PFHpA, and PFBS. After collection in sampling containers, and at the end of each day, the samples were packed on ice and shipped via overnight service to the laboratory for analysis.

3.8 Quality Assurance and Quality Control

Samples collected for this field investigation were analyzed using USEPA approved methods with Level IV quality assurance (QA)/quality control (QC), as identified in the SAP (CH2M, 2016e). For definitive data, samples were reported by the laboratories with the equivalent of USEPA Contract Laboratory Program Level IV QA/QC.

Field QA/QC samples were collected during the sampling program. These samples were obtained to:

- Ensure that disposable and reusable sampling equipment were free of contaminants
- Evaluate field methodology
- Establish ambient field background conditions
- Evaluate whether cross-contamination occurred during sampling and/or shipping

Several types of field QA/QC samples were collected and analyzed in accordance with the SAP (CH2M, 2016e). They are defined as follows:

- **Equipment Rinsate Blank (decontaminated equipment):** Equipment blanks were collected at the frequency noted in Worksheets #12-1 and #12-2 of the SAP (one per medium per day of sampling). These samples were obtained by running laboratory-grade deionized (DI) water over or through sample collection equipment after the decontamination procedures had been conducted. These samples were used to determine whether decontamination procedures for reusable equipment were adequate.
- **Equipment Rinsate Blank (disposable equipment):** Equipment blanks were collected at the frequency noted in Worksheets #12-1 and #12-2 of the SAP (once per lot). These samples were obtained by running laboratory-grade DI water over or through sample collection equipment prior to the equipment's use. These samples were used to determine whether disposable, one-time-use equipment was contaminant free prior to use.
- **Field Blank:** Field blanks were collected at the frequency noted in Worksheets #12-1 and #12-2 of the SAP (one per week for groundwater and soil sampling and one per sample for drinking water and effluent sampling). These samples were obtained by pouring laboratory-grade DI water directly into laboratory-prepared sample bottles. These samples were used to determine whether cross-contamination occurred during sampling or shipping.
- **Duplicate Sample:** Duplicate samples were collected at the same time and under identical conditions as their respective associated sample at the frequency noted in Worksheets #12-1 and #12-2 of the SAP (one per 10 field samples of similar matrix). These samples were collected to evaluate the field and laboratory reproducibility of sample results and are one way to evaluate field methodology.

In addition to samples collected to monitor field QC, samples were also collected to monitor quality within the laboratory. These included the following:

- **Matrix Spike (MS):** An aliquot of a matrix (that is, soil, surface sediment, subsurface sediment, surface water, groundwater, and so forth) was spiked with known quantities of analytes of interest and subjected to the

entire analytical procedure. By measuring the recovery of these spiked quantities, the appropriateness of the method for the matrix was demonstrated.

- **Matrix Spike Duplicate (MSD):** These samples were collected as second aliquots of the same matrix as the MS to determine the precision of the method.

One MS sample and one MSD sample were collected for every 20 environmental samples collected (or greater than or equal to 5 percent of the samples collected) per medium, per site.

3.9 Decontamination Procedures

All decontamination activities were conducted in accordance with the SOPs titled *Decontamination of Drilling Rigs and Equipment* and *Decontamination of Personnel and Equipment* provided in the SAP, as applicable (CH2M, 2016e). Disposable sampling equipment and personal protective equipment, such as Masterflex tubing and nitrile gloves, were not decontaminated after use and instead were disposed of as non-hazardous solid waste. After use, disposable equipment was placed in plastic contractor bags and disposed of in an onsite trash dumpster. Non-disposable sampling equipment, such as hand augers, were decontaminated prior to each use.

Reusable heavy equipment, such as drilling rods and augers, was decontaminated before and in between the collection of each sample using a high-pressure steam cleaner with potable-grade water. Pressure washing was conducted at the temporary decontamination pad, which had been constructed prior to the start of drilling activities. The decontamination pad consisted of a raised wood frame lined with a high-density polyethylene tarp, which acted as a basin to collect fluids. These fluids were then pumped into approved 55-gallon drums to await characterization and disposal. All heavy equipment decontamination procedures were conducted in accordance with the SOP titled *Decontamination of Drilling Rigs and Equipment* provided in the SAP (CH2M, 2016e).

Water generated during decontamination of sampling equipment was collected and transferred to an approved 55-gallon drum to await characterization and disposal.

3.10 Surveying

Miller Stephenson and Associates, and Pennoni Associates, of Virginia Beach, Virginia (both Virginia-licensed and registered surveyors), conducted a survey of the monitoring wells installed during Phase I and II investigations, respectively. Each of the monitoring wells was surveyed for vertical and horizontal control to an accuracy of ±0.01 foot and ±0.1 foot, respectively (**Appendix D**). Monitoring wells were surveyed at the top of the PVC casing (where marked) and at the ground surface. The vertical elevations were referenced to National American Vertical Datum of 1988 (NAVD 88) to remain consistent with the coordinate system and datum currently in use on the project site. Horizontal coordinates were referenced to the Virginia State Plane Coordinate System, South Zone, North American Datum 1983 (NAD83)/94 HARN.

3.11 Investigation-derived Waste Management

Investigation-derived waste (IDW) generated during the SI included drill cuttings from the soil borings for monitoring well installation, purge water (from well development and groundwater sampling), as well as decontamination rinse-water from all non-disposable sampling equipment and heavy equipment. The IDW was containerized in approved 55-gallon drums that were properly labeled and stored within secondary containment at the site. A total of 83 drums of solid IDW and 58 drums of aqueous IDW were generated during the SI field activities.

Prior to disposal, CH2M field staff collected one composite sample from all aqueous IDW drums and one composite sample from all solid IDW drums per round. All IDW samples were analyzed for full Toxicity Characteristic Leachate Procedure analyses (VOCs, SVOCs, pesticides, and inorganic constituents), ignitability, reactive cyanide, reactive sulfide, and corrosivity. Additionally, aqueous IDW generated in April 2017 and May 2017 was sampled for PFAS in accordance with Navy policy. IDW generated prior to April of 2017, was identified

as non-hazardous and disposed of by Clearfield, MMG within 90 days of generation at the company's approved disposal facility located in Chesapeake, Virginia. Aqueous IDW generated in 2017 exceeded the (lifetime health advisory) L-HA for PFOA and PFOS and was disposed of through high temperature incineration.

An analytical summary for the IDW samples is provided in **Tables 3-1** through **Table 3-5**. All IDW handling and disposal information is included in **Appendix E.**

3.12 Data Quality Evaluation

The data quality evaluation and validation is a multi-tiered approach. The process begins with an internal laboratory review, continues with an independent review by a third-party validator, and ends with an overall review by the CH2M project chemistry team. The results of data quality evaluation are included as **Appendix F**.

Table 3-1. Investigation- Derived Waste Aqueous Analytical Data (January 2016)

Basewide PFAS Site Inspection

NALF Fentress, Chesapeake, Virginia

Sample ID	OF-IDW02-011316
Sample Date	1/13/16
Chemical Name	
TCLP Volatile Organic Compounds (MG/L)	
No Detections	
TCLP Semivolatile Organic Compounds (MG/L)	
No Detections	
TCLP Pesticides/Polychlorinated Biphenyls (MG/L)	
No Detections	
TCLP Herbicides (MG/L)	
No Detections	
TCLP Metals (MG/L)	
Barium	0.14 J
Mercury	5.00E-05 J
Wet Chemistry	
Cyanide (MG/KG)	0.17 J
pH (pH Units)	3.81

Notes:

J - Analyte present. Value may or may not be accurate or precise

MG/KG - Milligrams per kilogram

MG/L - Milligrams per liter

Shading indicates detection

Table 3-2. Investigation- Derived Waste Soil Analytical Data (January 2016)

Basewide PFAS Site Inspection

NALF Fentress, Chesapeake, Virginia

Sample ID	OF-IDW02-011316
Sample Date	1/13/16
Chemical Name	
TCLP Volatile Organic Compounds (MG/L)	
No Detections	
TCLP Semivolatile Organic Compounds (MG/L)	
No Detections	
TCLP Pesticides/Polychlorinated Biphenyls (MG/L)	
No Detections	
TCLP Herbicides (MG/L)	
No Detections	
TCLP Metals (MG/L)	
Barium	0.14 J
Mercury	5.00E-05 J
Wet Chemistry	
Cyanide (MG/KG)	0.17 J
pH (pH Units)	3.81

Notes:

J - Analyte present. Value may or may not be accurate or precise

MG/KG - Milligrams per kilogram

MG/L - Milligrams per liter

Shading indicates detection

Table 3-3. Investigation- Derived Waste Soil Analytical Data (March 2017)

Basewide PFAS Site Inspection

NALF Fentress, Chesapeake, Virginia

Sample ID	OF-IDW-SO-033117
Sample Date	3/31/17
Chemical Name	
TCLP Volatile Organic Compounds (UG/L)	
No Detections	
TCLP Semivolatile Organic Compounds (UG/L)	
No Detections	
TCLP Pesticides/Polychlorinated Biphenyls (UG/L)	
No Detections	
TCLP Herbicides (UG/L)	
No Detections	
TCLP Metals (UG/L)	
Barium	124
Cadmium	0.86 J
Silver	2.5 J
Wet Chemistry (pH units)	
pH	7.9

Notes:

DEG/C - Degrees centigrade

J - Analyte present. Value may or may not be accurate or precise

MG/KG - Milligrams per kilogram

NS - Not sampled

PH - pH units

U - The material was analyzed for, but not detected

UG/L - Micrograms per liter

Shading indicates detection

Table 3-4. Investigation- Derived Waste Aqueous Analytical Data (April 2017)

Basewide PFAS Site Inspection

NALF Fentress, Chesapeake, Virginia

Sample ID	OF-IDW-AQ-01-0417
Sample Date	4/14/17
Chemical Name	
TCLP Volatile Organic Compounds (UG/L)	
No Detections	
Semivolatile Organic Compounds (NG/L)	
Perfluorooctane Sulfonate (PFOS)	3.39 J
TCLP Semivolatile Organic Compounds (UG/L)	
No Detections	
TCLP Pesticides/Polychlorinated Biphenyls (UG/L)	
No Detections	
TCLP Herbicides (UG/L)	
No Detections	
TCLP Metals (UG/L)	
Barium	37.4
Wet Chemistry (pH units)	
pH	7.1

Notes:

DEG/C - Degrees centigrade

MG/KG - Milligrams per kilogram

NS - Not sampled

PH - pH units

U - The material was analyzed for, but not detected

UG/L - Micrograms per liter

Shading indicates detection

Table 3-5. Investigation- Derived Waste Aqueous Analytical Data (June 2017)

Basewide PFAS Site Inspection

NALF Fentress, Chesapeake, Virginia

Sample ID	IDW-AQ-01-0617
Sample Date	6/1/17
Chemical Name	
TCLP Volatile Organic Compounds (UG/L)	
No Detections	
Semivolatile Organic Compounds (NG/L)	
Perfluorooctane Sulfonate (PFOS)	12,900 B
Perfluorooctanoic acid (PFOA)	1,530
TCLP Semivolatile Organic Compounds (UG/L)	
No Detections	
TCLP Pesticides/Polychlorinated Biphenyls (UG/L)	
No Detections	
TCLP Herbicides (UG/L)	
No Detections	
TCLP Metals (UG/L)	
Barium	38
Wet Chemistry	
pH (pH Units)	6.5

Notes:

B - Analyte not detected above the level reported in blanks

DEG/C - Degrees centigrade

J - Analyte present. Value may or may not be accurate or precise

MG/KG - Milligrams per kilogram

NG/L - Nanograms per liter

NS - Not sampled

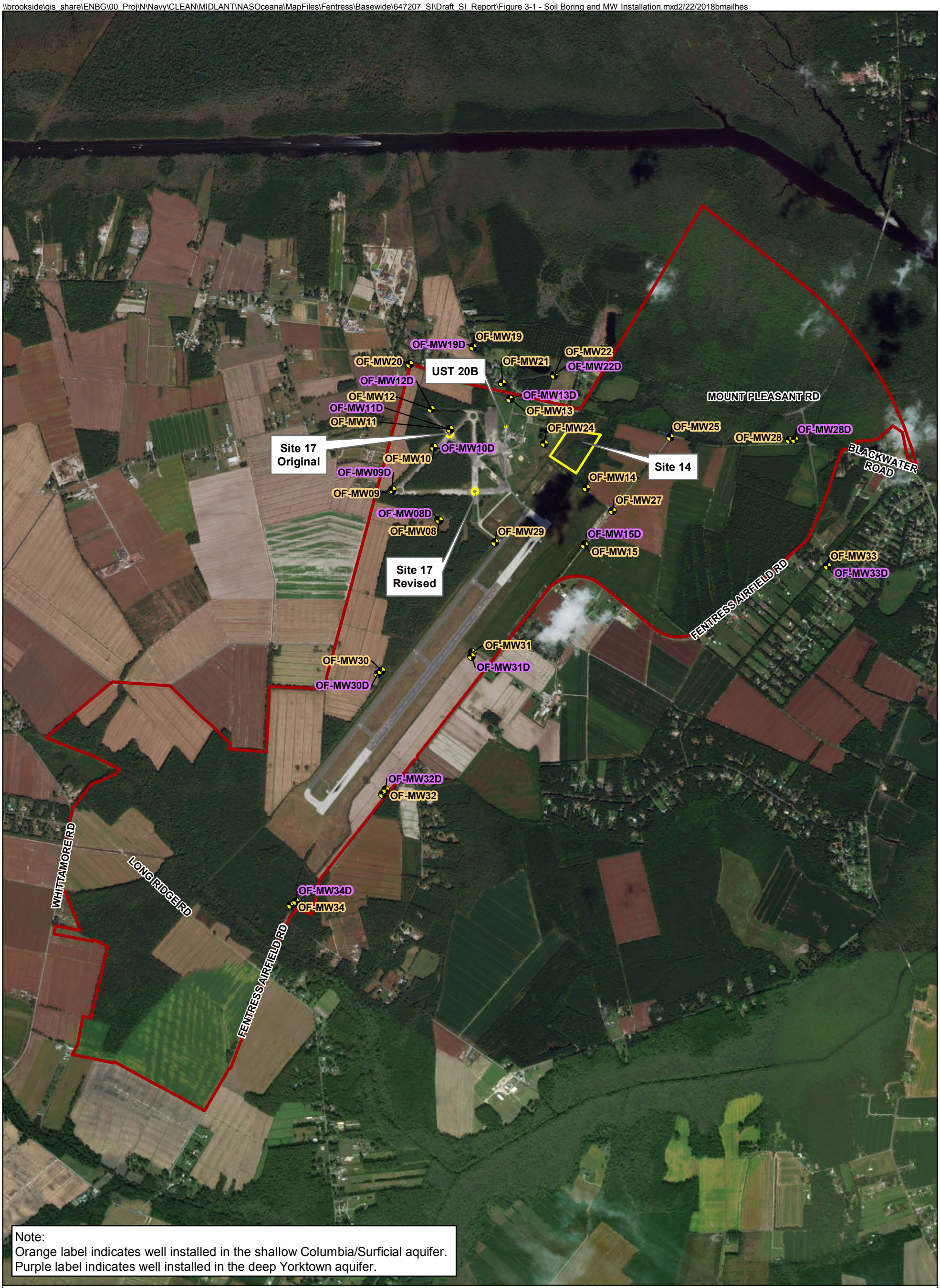
PH - pH units

U - The material was analyzed for, but not detected

UG/L - Micrograms per liter

Shading indicates detection

\\brookside\gis_share\ENBG\00_Proj\N\Navy\CLEAN\MIDLANT\NASOceana\MapFiles\Fentress\Basewide\647207_SI\Draft_SI_Report\Figure 3-1 - Soil Boring and MW Installation.mxd2/22/2018bmailhes



Legend

- Newly Installed Monitoring Well Location
- Site Boundary
- Fentress Boundary

N

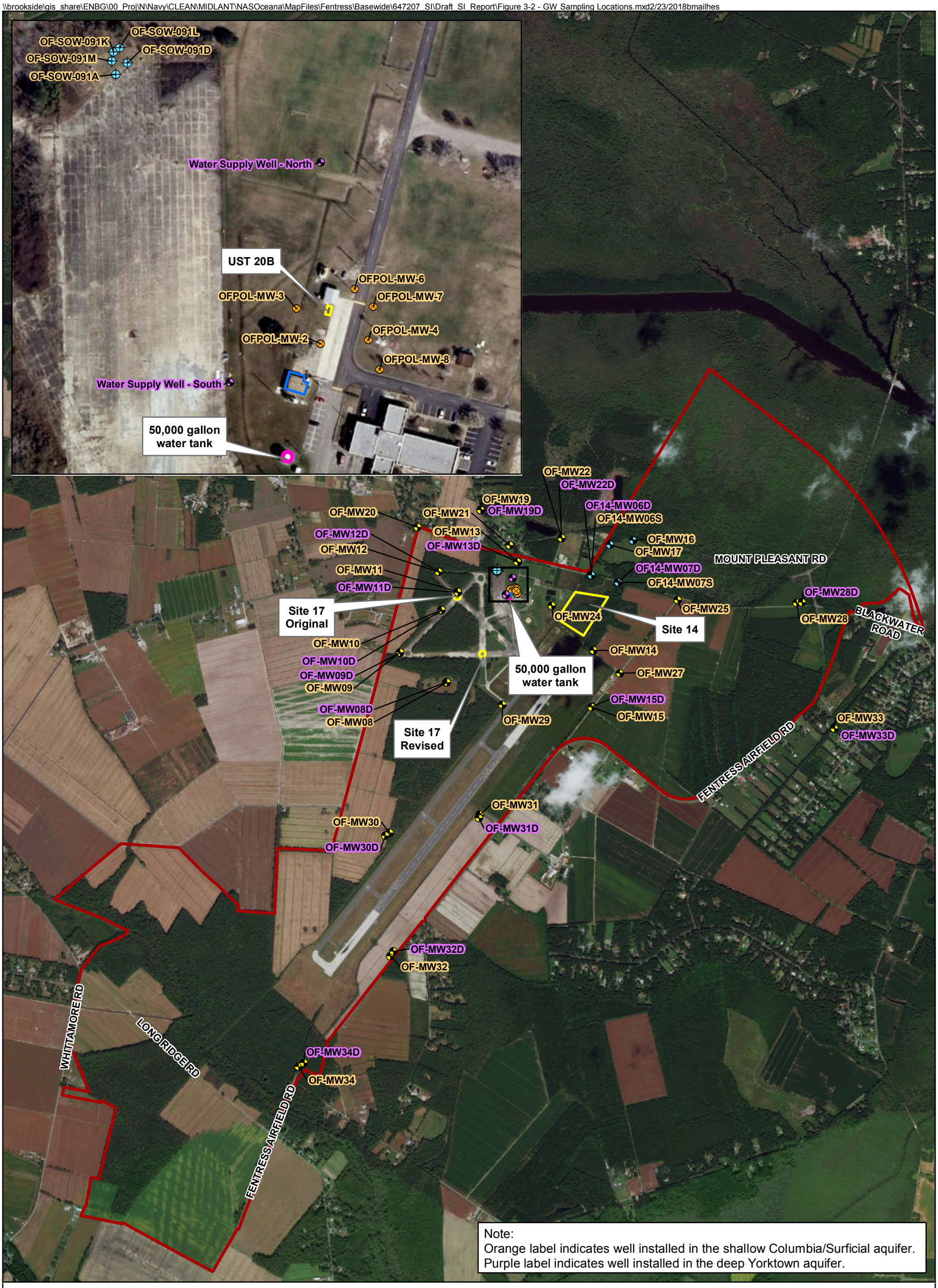
0 1,000 2,000 Feet

Imagery Source: ©2017 Esri

Figure 3-1
New Monitoring Well Installation Locations
Basewide Per- and Polyfluoroalkyl Substances Site Inspection Report
NALF Fentress, Chesapeake, Virgnia

ch2m.

\\brookside\gis_share\ENBG\00_Proj\N\Navy\CLEAN\MIDLANT\NASOceana\MapFiles\Fentress\Basewide\647207_SI\Draft_SI_Report\Figure 3-2 - GW Sampling Locations.mxd2/23/2018bmailhes



Note:
Orange label indicates well installed in the shallow Columbia/Surficial aquifer.
Purple label indicates well installed in the deep Yorktown aquifer.

Legend

- Newly Installed Monitoring Well Location
- Existing Monitoring Well Lcoation
- UST 20B Well Location
- On-Base Water Supply Well Location
- State Water Control Board Well Location
- Site Boundary
- 50,000 gallon water tank
- Water Treatment Plant
- Fentress Boundary

N

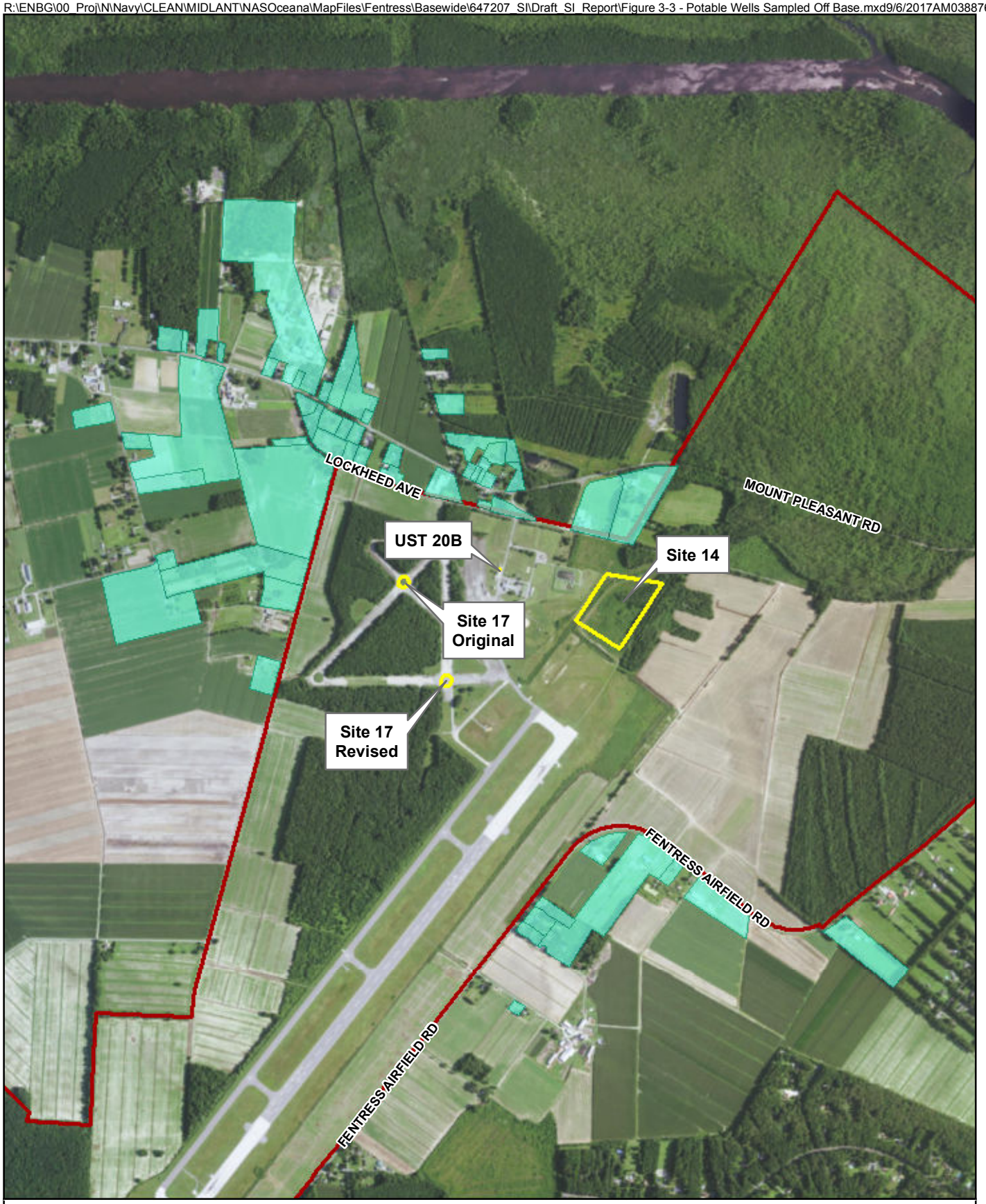
0 1,000 2,000 Feet

Imagery Source: ©2017 Esri

Figure 3-2
Groundwater Sampling Locations
Basewide Per- and Polyfluoroalkyl Substances Site Inspection Report
NALF Fentress, Chesapeake, Virgnia

ch2m

R:\ENBG\00_Proj\N\Navy\CLEAN\MIDLANT\NASOceana\MapFiles\Fentress\Basewide\647207_SI\Draft_SI_Report\Figure 3-3 - Potable Wells Sampled Off Base.mxd9/6/2017AM038876



Legend

- Parcel - Sample Collected
- Site Boundary
- Fentress Boundary

N
W E
S

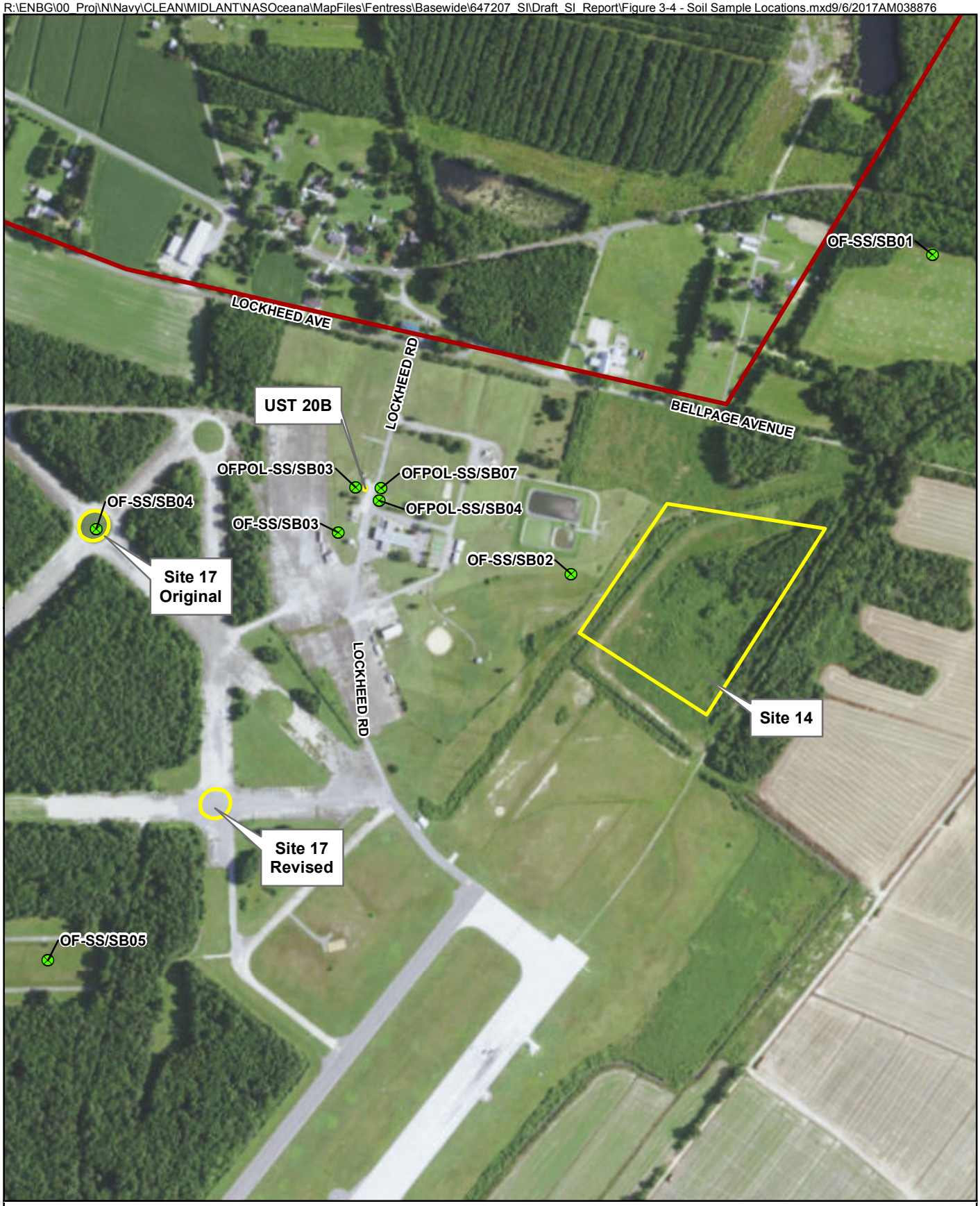
0 850 1,700
Feet

Imagery Source: ©2017, Esri

Figure 3-3
Potable Wells Sampling from Parcels Located Off-Base
Basewide Per- and Polyfluoroalkyl Substances Site Inspection Report
NALF Fentress, Chesapeake, Virgnia

ch2m.

R:\ENBG\00_Proj\N\Navy\CLEAN\MIDLANT\NASOceana\MapFiles\Fentress\Basewide\647207_SI\Draft_SI_Report\Figure 3-4 - Soil Sample Locations.mxd9/6/2017AM038876



Legend
- Soil Sample Location
- Site Boundary
- Fentress Boundary

N
W E
S

0 300 600
Feet

Imagery Source: ©2017, Esri

Figure 3-4
Soil Sample Locations
Basewide Per- and Polyfluoroalkyl Substances Site Inspection Report
NALF Fentress, Chesapeake, Virginia

ch2m.

SECTION 4

Investigation Results

This section presents the results of the investigation described in Section 3.

4.1 Hydraulic Characteristics of Aquifers

Water levels collected in September 2016 and May 2017 are provided as **Table 4-1**. Contour maps based on these water levels are provided as **Figures 4-1** and **4-2** for the Columbia/Surficial aquifer and Yorktown aquifer, respectively. Groundwater flow in the Columbia/Surficial aquifer at NALF Fentress is radial with a higher component of flow to the northeast. Groundwater flow in the Yorktown aquifer is toward the east. There is generally a downward vertical gradient between the Columbia/Surficial and Yorktown aquifers. Columbia/Surficial aquifer groundwater at NALF Fentress is generally within 3 to 10 feet of the land surface.

Aquifer conditions are unconfined in the Columbia Group and unconfined to semi-confined within the upper Yorktown Formation. When the clay confining unit overlying the Yorktown is very thin or absent (in the southern portion of the facility), the upper Yorktown and Columbia/Surficial aquifers may act as a single, unconfined, hydrogeologic unit (See cross section layout on **Figure 4-3,** cross sections on **Figures 4-4** and **4-5**, and confining unit soil types on **Figure 4-6**)**.** This phenomenon occurs in the southern portion of the Base. North of the facility, the confining unit is sandy, which may also allow for some hydraulic connection between the Columbia/Surficial and Yorktown aquifers. On NALF Fentress, groundwater flow in the Surficial/Columbia aquifer is to the north, northeast, east, and southeast from the approximate location of the original runway, with a higher component of flow to the northeast. However, there are smaller components of flow to the west and southwest. Yorktown aquifer flow is toward the east.

The slug test data sets collected in accordance with procedures described in **Section 3.5** were analyzed by AQTESOLV™ using the Bouwer-Rice solution method. The graphical AQTESOLV™ analysis sheets are presented in **Appendix G**, and the hydraulic conductivity estimates are summarized in **Table 4-2**. The Bouwer-Rice solution was developed to accommodate the analysis of slug tests in unconfined aquifers and is theoretically appropriate for these slug tests (Bouwer and Rice, 1976). The measured hydraulic conductivity for the Columbia aquifer ranged from 1.45×10^{-3} feet per minute (ft/min) to 1.14×10^{-2} ft/min or 7.4×10^{-4} centimeters per second (cm/s) to 5.8×10^{-3} cm/s. The measured hydraulic conductivity for the Yorktown aquifer ranged from 4.99×10^{-3} ft/min to 3.70×10^{-2} ft/min or 2.53×10^{-3} cm/s to 1.87×10^{-2} cm/s. Values for both aquifers are consistent with a silty to clean sand (Freeze and Cherry, 1979).

Groundwater flow velocity was calculated for each aquifer using the following equation:

$$V=Ki/N_e$$

Where:

V= the estimated groundwater flow velocity
K= the average hydraulic conductivity
i = the groundwater gradient
N_e = the estimated effective porosity, as a decimal fraction

Site-specific input parameters for the Columbia/Surficial aquifer are as follows:

K = 6.04×10^{-3} ft/min (average of values calculated during slug tests)
i = 0.00152 ft/ft (based on the May 2017 groundwater levels)
N_e = 0.30 (estimated effective porosity of silty to clean sand)

In consideration of these parameter, the groundwater velocity in the Columbia/Surficial aquifer at NALF Fentress is estimated to be 0.0468 ft/day or approximately 17.07 ft/year.

Site-specific input parameters for the Yorktown aquifer are as follows:

$K = 1.62 \times 10^{-2}$ ft/min (average of values calculated during slug tests)
i = 0.0010 (based on the May 2017 groundwater levels)
$N_e = 0.30$ (estimated effective porosity of silty to clean sand)

In consideration of these parameters, the groundwater velocity in the Yorktown aquifer at NALF Fentress is estimated to be 0.0778 ft/day or approximately 28.38 ft/year.

4.2 Groundwater Chemistry and Analytical Results

4.2.1 General Groundwater Geochemistry

Measurements of DO, ORP, pH, temperature, conductivity, salinity, and turbidity were collected at each monitoring well following purging and immediately prior to sampling (**Table 4-3**). The DO readings collected during purging activities, which provide an indication of the potential for aerobic or anaerobic biodegradation of some contaminants, ranged between 0.02 milligrams per liter (mg/L) and 2.25 mg/L. Values were generally less than 0.5 mg/L in both the Columbia/Surficial and Yorktown aquifers, indicating anaerobic conditions. Temperature readings ranged between 15.4 degrees Celsius (°C) and 28.1°C. The ORP values ranged between -371.2 millivolts (mV) and 240.4 mV and were generally indicative of reducing to mildly oxidizing conditions. The pH values were generally neutral, with an average of 6.13, but outliers ranged from 1.7 to 9.43. Conductivity values, which provide an indication of the concentration of total dissolved solids within groundwater, ranged between 0.023 milliSiemen per centimeter (mS/cm) and 0.55 mS/cm, which is indicative of freshwater conditions. Salinity values ranged between 0.03 and 0.26 part per thousand, also indicating freshwater conditions. In general, turbidity "refers to solids and organic matter that do not settle out of water" (Driscoll, 1986) and is caused by suspended and colloidal matter in water. Turbidity measurements were generally low (below 20 NTU) with an average of 11.73 NTU, although outliers ranged from 0.02 NTU to 152 NTU.

4.2.2 On- Base PFAS Groundwater Analytical Results

Analytical results from non-potable on-Base groundwater samples collected are presented in **Table 4-4** and **Figures 4-7** and **4-8** for the Columbia/Surficial aquifer, and in **Table 4-5** and **Figures 4-9** and **4-10** for the Yorktown aquifer. Groundwater analytical data for PFOS and PFOA (Individually and combined detected value) were screened against the USEPA L-HA screening criteria of 70 nanograms per liter (ng/L) (based on comparison to PFOA, PFOS, or the sum of PFOA plus PFOS concentration), and the tap water USEPA Regional Screening Level (RSL) calculated using the RSL calculator with a hazard quotient (HQ) of 0.1 (40 ng/L) and analytical data for PFBS were screened against the tap water RSL from the RSL summary table using an HQ of 0.1 (40,000 ng/L). Determination of exceedances were only made based on PFAS with screening criteria, which include PFBS, PFOS, and PFOA. Analysis was also conducted for PFAS which do not have screening criteria (PFNA, PFHxS, PFHpA), the results of which may be consulted in the future, if criteria are established. A summary of the results is presented below:

Columbia/Surficial Aquifer

Analysis of the groundwater samples collected from the Columbia/Surficial aquifer indicate the following:

- Twenty-three (23) samples indicated combined PFOS or PFOA concentrations exceeding the L-HA screening criteria of 70 ng/L.
- Ten (10) samples indicated detections of PFOS or PFOA with detected concentrations below the L-HA.
- Three (3) samples indicated no detection of PFOS or PFOA.
- Exceedances of the L-HA were observed in the northern portion of the Base with the higher detected concentrations in the vicinities of UST 20B and Site 17 Revised.

- Concentrations were the highest in the sample from station OFPOL-MW-7 with a PFOS concentration of 49,300 ng/L, PFOA concentration of 3,600 ng/L, and total PFOS/PFOA concentration of 52,900 ng/L and at Site 17 Revised (OF17-MW04), with PFOS concentration of 44,500 ng/L, PFOA concentration of 3,400 ng/L, and Total PFOS/PFOA concentration of 47,900 ng/L.
- None of the samples indicated detections for PFBS greater than the RSL.
- Other PFAS without current screening values (PFHxS, PFHpA, or PFNA) were detected in most (33) samples.

Yorktown Aquifer

Analysis of the groundwater samples collected from monitoring wells screened in the Yorktown aquifer indicated the following:

- One sample (OF-MW08D; adjacent to Site 17 Revised) indicated PFOS and Total PFOS/PFOA concentrations of 6,880 and 6,941.1 ng/L, respectively, exceeding the USEPA L-HA screening criteria of 70 ng/L.
- Twelve (12) samples indicated detections for PFOS or PFOA but with concentrations below L-HA.
- One sample in the southernmost portion of the facility (OF-MW34D) indicated no detections of PFOS or PFOA.
- PFBS was detected in three samples, all located adjacent to Site 17 Original and Revised with concentrations below the RSL.

4.2.3 Off- Base PFAS Groundwater Analytical Results

Analytical results from non-potable off-Base groundwater samples collected are presented in **Table 4-6** and **Figure 4-11** for the Columbia/Surficial aquifer, and in **Table 4-7** and **Figure 4-12** for the Yorktown aquifer. Groundwater analytical data for PFOS and PFOA (individually and combined detected value) were screened against the USEPA L-HA screening criteria of 70 ng/L (based on comparison to PFOA, PFOS, or the sum of PFOA plus PFOS concentration), and the tap water USEPA RSL calculated using the RSL calculator with a HQ of 0.1 (40 ng/L) and analytical data for PFBS were screened against the tap water RSL from the RSL summary table using an HQ of 0.1 (40,000 ng/L). Determination of exceedances were only made based on PFAS with screening criteria, which include PFBS, PFOS, and PFOA. Analysis was also conducted for PFAS which do not have screening criteria (PFNA, PFHxS, PFHpA, PFHxA), PFDA, NMeFOSAA, PFUnA, NEtFOSAA, PFDoA, PFTrDA, and PFTeDA), the results of which may be consulted in the future, if criteria are established. A summary of the results is presented below:

Columbia/Surficial Aquifer

Analysis of the groundwater samples collected from the off-Base Columbia/Surficial aquifer indicate the following:

- Two (2) samples (OF-MW21 and OF-MW22) indicated combined PFOS or PFOA concentrations exceeding the L-HA screening criteria of 70 ng/L.
- One (1) sample (OF-MW19) indicated detections of PFOS or PFOA with detected concentrations below the L-HA.
- Two (2) samples (OF-MW20 and OF-MW33) indicated no detection of PFOS or PFOA.
- Exceedances of the L-HA were observed north of the Base with the highest detected concentrations in OF-MW22, northeast of UST 20B.
- Concentrations were the highest in the sample from station OF-MW22 with a PFOS concentration of 829 ng/L, PFOA concentration of 126 ng/L, and total PFOS/PFOA concentration of 955 ng/L.
- None of the samples indicated detections for PFBS greater than the RSL.
- Of the other PFAS without current screening values only PFHxS, PFHpA, PFNA, and PFHxA were detected in the shallow off-Base monitoring wells.

Yorktown Aquifer

Analysis of the groundwater samples collected from the off-Base monitoring wells screened in the Yorktown aquifer indicated the following:

- No samples indicated detection for PFOS or PFOA exceeding the USEPA L-HA screening criteria of 70 ng/L.
- One sample north of the facility (OF-MW22D) indicated detections for PFOS or PFOA but with concentrations below L-HA.
- Two (2) samples southeast (OF-MW33D) and north (OF-MW19D) of the facility indicated no detections of PFOS or PFOA.
- PFBS was not detected in any of the deep off-Base monitoring wells.
- Other PFAS without current screening values (PFNA, PFHxS, PFHpA, PFHxA), PFDA, NMeFOSAA, PFUnA, NEtFOSAA, PFDoA, PFTrDA, and PFTeDA) were not detected in any of the deep off-Base monitoring wells.

4.2.4 PFAS Potable Water Analytical Results

On-Base potable water samples were collected from water treatment plant influent, which consists of water from two water supply wells at NALF Fentress (**Figures 4-9** and **4-10**). Off-Base potable well samples were collected from 59 private residential wells (**Figure 4-13**). Laboratory analytical results for on-Base potable groundwater samples collected from water treatment plant influent at NALF Fentress and off-Base potable drinking samples collected from residential wells are summarized in **Tables 4-8** and **4-9**, respectively. A summary of results is presented below.

On-Base Potable Water

Results conducted on the on-Base potable well samples indicate the following:

- The influent samples from station OF-INF01 indicated exceedances of PFOS and PFOA L-HA both times sampled.
- The detected concentrations of PFOS and PFOA from the influent samples increased between December 2016 to May 2016. This is likely due to the intermittent pumping of the two production wells and the closer proximity of one of the wells to the UST 20B source area.
- One total oxidizable precursor sample was collected during the May 2016 round of monitoring. This sample indicated higher concentrations of PFOA and PFOS than were observed in the unoxidized sample collected at the same time, indicating the potential for presence of precursors, which may degrade to PFOA and PFOS when oxidized.
- PFAS without current screening values (PFHxS, PFHpA, or PFNA) were detected in both samples.

Off-Base Private Potable Wells

Results conducted on the potable residential well samples indicate the following:

- Seven (7) private potable wells at six (6) residential properties detected Total PFOS/PFAS at concentrations above the L-HA of 70 ng/L. These samples were collected from residential areas north of the NALF Fentress boundary.
- Fifteen (15) potable water sample locations detected PFOS or PFOA at concentrations below the L-HA of 70 ng/L. These samples were collected from residential areas west and north of the NALF Fentress boundary.
- The remaining 35 potable water sample locations were showing no detections for PFOS or PFOA. This included all the samples collected south of the NALF Fentress boundary and most of the samples collected northwest of the Base.
- None of the samples exceeded the RSL for PFBS.

- Two samples which did not have detections of PFOA, PFOS, or PFBS, had detections of one or more other PFAS constituents without current screening values (PFHxS, PFHpA, or PFNA).

Well depths are not available for most for the residential wells.

4.2.5 PFAS Soil Analytical Results

Soil data were collected to evaluate the potential for PFAS sources to remain in soil at the site. Laboratory analytical results for soil samples collected are summarized and presented in **Table 4-10 and Figure 4-14**.

Surface and subsurface soil analytical data for PFOS and PFOA were screened against the residential soil RSL calculated using the USEPA RSL calculator with an HQ of 0.1 (130 micrograms per kilogram [µg/kg]) and analytical data for PFBS were screened against the residential soil RSL from the RSL summary table using an HQ of 0.1 (130,000 µg/kg).

Analysis of the soil samples collected at NALF Fentress indicate the following:

- PFOS was detected in surface soil samples at a concentration greater than the soil RSL of 130 µg/kg in samples in the vicinity of UST 20B (OFPOL-SS04) and in the Crash Truck Test Area (OF-SS05).
- PFOS was detected in both surface and subsurface soil at a concentration greater than the soil RSL of 130 µg/kg approximately 105 feet southeast of the southern production well (OF-SS03 and OF-SB03).
- While other PFOA and PFOS concentrations were less than the soil RSL values, they may still indicate potential for leaching to groundwater. Concentrations exceed the conservative USEPA soil screening levels (SSLs) for protection of groundwater (0.172 µg/L for PFOA and 0.378 µg/L for PFOS) in most samples collected.
- PFAS without current screening values (PFHxS, PFHpA, or PFNA) were detected in all 16 samples.

Table 4-1. NALF Fentress Groundwater Elevations

Basewide PFAS Site Inspection

NALF Fentress

Well ID	Date	Well Screen Interval (feet bgs)	Top of Casing Elevation (feet amsl)	Depth to Water (feet below TOC)	Groundwater Elevation (feet amsl)
OF14-MW06	9/9/2016	6.75 - 16.75	10.94	5.78	5.16
	5/17/2017		10.94	5.53	5.41
OF14-MW06D	9/9/2016	44 - 54	11.43	7.76	3.67
	5/17/2017		11.43	6.41	5.02
OF14-MW07	9/9/2016	7.5-17.5	8.12	5.39	2.73
	5/17/2017		8.12	2.9	5.22
OF14-MW07D	9/9/2016	45 - 55	7.77	4.23	3.54
	5/17/2017		7.77	5.25	2.52
OF-MW08	9/9/2016	19 - 29	11.71	2.3	9.41
	5/17/2017		11.71	NA	--
OF-MW08D	9/9/2016	45 - 55	12.35	7.23	5.12
	5/17/2017		12.35	5.62	6.73
OF-MW09	9/9/2016	17 - 27	13.00	3.77	9.23
	5/17/2017		13.00	2.59	10.41
OF-MW09D	9/9/2016	50 - 60	12.87	7.33	5.54
	5/17/2017		12.87	5.89	6.98
OF17-MW01	6/1/2017	9-19	16.12	3.15	12.97
OF17-MW02	5/31/2017	10-20	15.83	4.75	11.08
OF17-MW-3	5/31/2017	10-20	15.42	4.77	10.65
OF17-MW04	6/1/2017	5-15	14.46	4.2	10.26
OF-MW10	9/9/2016	17 - 27	12.99	3.2	9.79
	5/17/2017		12.99	2.25	10.74
OF-MW10D	9/9/2016	53 -63	13.02	7.94	5.08
	5/17/2017		13.02	6.42	6.6
OF-MW11	9/9/2016	17 - 27	12.89	3.24	9.65
	5/17/2017		12.89	2.19	10.7
OF-MW11D	9/9/2016	50 - 60	13.14	8.45	4.69
	5/17/2017		13.14	6.6	6.54
OF-MW12	9/9/2016	15 - 25	11.95	2.59	9.36
	5/17/2017		11.95	1.44	10.51
OF-MW12D	9/9/2016	54 - 64	11.93	7.2	4.73
	5/17/2017		11.93	5.6	6.33
OF-MW13	9/9/2016	15 - 25	11.97	3.67	8.3
	5/17/2017		11.97	3	8.97
OF-MW13D	9/9/2016	50 - 60	12.23	8.32	3.91
	5/17/2017		12.23	6.76	5.47
OF-MW14	9/9/2016	17 - 27	11.52	5.72	5.8
	5/17/2017		11.52	5.51	6.01
OF-MW15	9/9/2016	20 - 30	11.56	5.23	6.33
	5/17/2017		11.56	NA	--
OF-MW15D	9/9/2016	51 - 61	11.74	8.3	3.44
	5/17/2017		11.74	7.04	4.7
OF-MW16	9/9/2016	5 - 15	8.84	6.09	2.75
	5/17/2017		8.84	5.6	3.24

Table 4-1. NALF Fentress Groundwater Elevations

Basewide PFAS Site Inspection

NALF Fentress

Well ID	Date	Well Screen Interval (feet bgs)	Top of Casing Elevation (feet amsl)	Depth to Water (feet below TOC)	Groundwater Elevation (feet amsl)
OF-MW17	9/9/2016	5 - 15	9.23	4.07	5.16
	5/17/2017		9.23	3.45	5.78
OF-MW24	9/9/2016	19 - 29	10.75	4.65	6.1
	5/17/2017		10.75	4.62	6.13
OF-MW25	9/9/2016	18.5 - 28.5	11.57	8.27	3.3
	5/17/2017		11.57	7.55	4.02
OF-MW27	9/9/2016	22 - 32	11.72	5.33	6.39
	5/17/2017		11.72	4.64	7.08
OF-MW28	9/9/2016	15.5 - 25.5	7.56	4.55	3.01
	5/17/2017		7.56	3.75	3.81
OF-MW28D	9/9/2016	44 - 54	7.39	4.98	2.41
	5/17/2017		7.39	4	3.39
OF-MW29	9/9/2016	20- 30	13.55	5.28	8.27
	5/17/2017		13.55	4.47	9.08
OF-MW30	9/9/2016	19.5 - 29.5	11.91	3.99	7.92
	5/17/2017		11.91	2.15	9.76
OF-MW30D	9/9/2016	50 - 60	11.77	6.74	5.03
	5/17/2017		11.77	5	6.77
OF-MW31	9/9/2016	21 - 31	14.1	6.45	7.65
	5/17/2017		14.1	5.56	8.54
OF-MW31D	9/9/2016	48 - 58	13.74	9.84	3.9
	5/17/2017		13.74	7.21	6.53
OF-MW32	9/9/2016	14- 24	13.96	8.18	5.78
	5/17/2017		13.96	5.59	8.37
OF-MW32D	5/17/2017	40- 50	14.46	7.07	7.39
OF-MW34	9/9/2016	30- 40	10.31	6.31	4.00
	5/17/2017		10.31	5.52	4.79
OF-MW34D	5/17/2017	50- 60	10.21	5.15	5.06
OFPOL-MW-2	9/9/2016	2.57 - 12.07	11.81	3.68	8.13
	5/17/2017		11.81	3.02	8.79
OFPOL-MW-3	9/9/2016	1.91 - 11.58	13.96	5.7	8.26
	5/17/2017		13.96	5.01	8.95
OFPOL-MW-4	9/9/2016	2.49 - 12.05	11.84	3.82	8.02
	5/17/2017		11.84	3.21	8.63
OFPOL-MW-6	9/9/2016	2.06 - 11.55	12.29	4.08	8.21
	5/17/2017		12.29	3.45	8.84
OFPOL-MW-7	9/9/2016	2.06 - 11.55	12.13	4.02	8.11
	5/17/2017		12.13	3.45	8.68
OFPOL-MW-8	9/9/2016	2.42 - 12.11	11.91	4.02	7.89
	5/17/2017		11.91	3.49	8.42

Notes:

bgs - below ground surface

amsl - above mean sea level

TOC - top of casing

Table 4-2. Hydraulic Conductivity Summary

Basewide PFAS Site Inspection

Chesapeake, Virginia

Well ID	Test Date	Aquifer	Test Type/ID	Hydraulic Conductivity (ft/min)	Average Aquifer Hydraulic Conductivity (ft/min)
MW09	9/15/2017	Columbia	Rising Head #1	4.81E-03	5.28E-03
			Rising Head #2	6.22E-03	
			Rising Head #3	ND	
			Falling Head #1	7.22E-04	
			Falling Head #2	7.41E-03	
			Falling Head #3	7.22E-03	
MW09D		Yorktown	Rising Head #1	2.81E-03	4.99E-03
			Rising Head #2	ND	
			Rising Head #3	0.004257	
			Falling Head #1	0.007911	
			Falling Head #2	ND	
			Falling Head #3	ND	
MW13		Colombia	Rising Head #1	8.78E-03	1.14E-02
			Rising Head #2	1.05E-02	
			Rising Head #3	ND	
			Falling Head #1	ND	
			Falling Head #2	ND	
			Falling Head #3	1.50E-02	
MW13D		Yorktown	Rising Head #1		3.70E-02
			Rising Head #2	0.03573	
			Rising Head #3	0.03822	
			Falling Head #1	ND	
			Falling Head #2	ND	
			Falling Head #3	ND	
MW15		Colombia	Rising Head #1	1.41E-03	1.45E-03
			Rising Head #2	ND	
			Rising Head #3	1.48E-03	
			Falling Head #1	ND	
			Falling Head #2	ND	
			Falling Head #3	ND	
MW15D		Yorktown	Rising Head #1	ND	6.52E-03
			Rising Head #2	5.87E-03	
			Rising Head #3	7.17E-03	
			Falling Head #1	ND	
			Falling Head #2	ND	
			Falling Head #3	ND	

Notes:

ft - feet

min - minute

ND - Test resulted unusable data

Table 4-3. Water Quality Parameters - On- Base Wells

Basewide PFAS Site Inspection

Chesapeake, Virginia

Well ID	Date	Temperature	pH	Conductivity	Salinity	ORP	Turbidity	DO
OF14-MW06S	12/21/2015	16.29	1.7	0.225	0.11	352.3	≤0.1	1.32
	6/20/2016	18	5.59	0.184	-	203.3	6	2.06
OF-14MW06D	12/22/2015	16.4	6.15	0.156	0.07	-46.8	0.93	0.12
	6/20/2016	19.9	6.58	0.132	-	-47.5	3.3	0.04
OF-14MW07S	12/21/2015	16.59	2.06	0.282	0.16	240.4	2.49	0.23
	6/20/2016	15.6	5.66	0.3	-	38.2	6.02	0.1
OF14-MW07D	12/22/2015	16.2	6.06	0.152	0.07	-58.6	0.59	0.1
	6/20/2016	15.9	6.27	0.143	-	-41.5	2.11	0.06
OF14-GW05	3/8/2017	15.6	5.32	0.067	0.03	129.3	29.3	0.19
MW08	12/28/2015	18.2	5.65	0.109	0.05	27.6	5.07	0.22
	6/22/2016	18.9	5.69	0.077	-	20.4	5.33	0.05
MW08D	7/14/2016	24.3	6.76	0.443	-	-45.2	69.7	0.03
OF-MW09	12/23/2015	17.5	5.24	0.15	0.077	34.7	3.45	0.12
	6/22/2016	17	5.53	0.145	-	18.6	6.28	0.06
MW09D	1/12/2016	16.4	9.43	0.375	0.22	24.7	9.87	0.61
	6/22/2016	19.3	9.22	0.254	-	-371.2	52.6	0.02
OF-MW10	12/23/2015	19.8	6.72	0.307	0.15	-28.1	1.55	0.1
	6/22/2016	19.1	6.01	0.274	-	-66.6	3.92	0.07
MW10D	1/11/2016	18.1	6.98	0.323	0.18	-95.7	3.29	0.08
	6/22/2016	19.3	6.84	0.257	-	-108.4	7.65	0.05
MW11S	12/28/2015	18.1	7.03	0.485	0.22	-75.1	2.91	0.5
	6/17/2016	19	6.33	0.0289	-	-23.9	10.2	0.04
MW11D	1/12/2016	18.4	8.97	0.276	0.15	-343.1	4.1	0.03
	6/21/2016	23.4	6.82	0.228	-	-129	19.3	0.03
MW12S	12/28/2015	17.9	5.63	0.13	0.06	7.9	2.11	0.33
	6/21/2016	18.8	5.6	0.093	-	-24.1	3.14	0.07
MW12D	6/21/2016	19	7.11	0.236	-	-92.7	4.16	0.05
MW13S	12/28/2015	17.6	5.45	0.146	0.07	93.7	4.16	0.26
	6/17/2016	17	5.46	0.104	-	73.8	9.62	0.32

Table 4-3. Water Quality Parameters - On- Base Wells

Basewide PFAS Site Inspection

Chesapeake, Virginia

Well ID	Date	Temperature	pH	Conductivity	Salinity	ORP	Turbidity	DO
MW13D	1/11/2016	17.2	6.6	0.218	0.12	-84.3	3.48	0.07
	6/21/2016	20.8	6.72	0.21	-	-103.9	4.97	0.04
MW14	12/28/2015	15.4	5.69	0.185	0.09	27.3	2.34	0.43
	6/20/2015	17.7	6	0.174	-	-15.3	4.32	0.05
OF-MW15	12/23/2015	17.8	5.67	0.286	0.14	-3.6	8.44	0.18
	6/20/2016	18.2	6.1	0.249	-	-6.4	26.3	0.07
MW15D	1/11/2016	16.3	6.45	0.317	0.18	-19.9	8.2	0.07
	6/20/2016	19.1	6.59	0.263	-	-90.8	10.5	0.03
OF-MW16	12/22/2015	17.4	4.72	0.096	0.04	206.6	4.11	1.59
	6/20/2016	17	4.79	0.127	-	162.4	2.37	2.25
OF-MW17	12/22/2015	17.1	4.85	0.504	0.24	149.9	0.02	0.16
	6/20/2016	15.9	5.72	0.526	-	111.8	2.7	0.17
MW24	7/11/2016	18.9	5.88	0.089	0.05	58.5	10	0.04
MW25	7/6/2016	19.5	7.55	0.339	0.18	-49.2	9.8	0.1
MW27	7/12/2016	19	5.82	0.23	0.13	151.9	9.2	0.05
MW28D	7/13/2016	28.1	6.89	0.38	0.18	-89.7	5.26	0.06
MW28S	7/6/2016	20.3	5.75	0.398	0.21	110	4	0.91
MW29	7/14/2016	20.3	6.04	0.146	0.07	30	7.33	0.05
MW30	7/16/2016	18.9	6.76	0.262	0.12	-69	5.32	0.05
MW30D	7/13/2016	24.1	6.83	0.484	0.23	-62.3	21.9	0.03
MW31D	7/14/2016	24.7	7.2	0.55	0.26	-50.5	31.5	0.04
MW32	7/13/2016	22.1	7.16	0.51	0.26	-114	39	0.05
MW34	7/14/2016	21	6.86	0.224	0.11	-97.9	152	0.04
OF17-MW01	6/1/2017	25.1	5.42	0.086	0.04	113.1	1.15	0.09
OF17-MW02	5/31/2017	19.5	5.95	0.129	0.06	140.8	3.3	0.22
OF17-MW03	5/31/2017	20.3	5.71	0.096	0.04	131.3	4.64	0.15
OF17-MW04	6/1/2017	21	6.5	0.189	0.09	103.5	5.1	0.13
OF-SOW-091A	3/8/2017	17.5	8.54	1.2	0.15	-282.1	78.8	2.45
OF-SOW-091D	3/8/2017	17.2	6.64	0.323	0.15	-124.7	43.3	0.04
OF-SOW-091K	3/8/2017	17.2	7.67	0.91	0.45	-159.4	5.38	0.1
OF-SOW-091L	3/8/2017	17.5	6.85	0.245	0.12	-90.9	7.36	0.08

Table 4-3. Water Quality Parameters - On- Base Wells

Basewide PFAS Site Inspection

Chesapeake, Virginia

Well ID	Date	Temperature	pH	Conductivity	Salinity	ORP	Turbidity	DO
OF-SOW-091M	3/8/2017	16.1	6.84	0.304	0.15	-121.4	83.5	0.08
OFPOL-MW-2	6/17/2016	20.5	5.81	0.08	0.04	7.6	3	0.05
OFPOL-MW-3	6/17/2016	18.7	5.71	0.066	0.03	19.1	3.75	0.15
OFPOL-MW-4	6/17/2016	19.7	5.88	0.143	0.07	-36.4	7.96	0.06
OFPOL-MW-6	6/17/2016	19.6	5.96	0.115	0.06	14.6	4.5	0.05
OFPOL-MW-7	6/17/2016	19	6.23	0.292	0.14	-61.1	4.58	0.07
OFPOL-MW-8	6/17/2016	19.3	5.82	0.137	0.06	-27.6	8.39	0.05

Table 4-4. Columbia Aquifer Groundwater Analytical Data (December 2015 - June 2017)

Basewide PFAS Site Inspection

NALF Fentress, Chesapeake, Virginia

Station ID	**RSLs Tapwater HQ = 0.1 (June 2017)**	**USEPA Lifetime Health Advisory (May 2016)**	OF-MW08				OF-MW09		OF-MW14	
Sample ID			OF-MW08-1215	OF-MW08P-1215	OF-MW08-0616	OF-MW08P-0616	OF-MW09-1215	OF-MW09-0616	OF-MW14-1215	OF-MW14-0616
Sample Date			12/28/15	12/28/15	6/22/16	6/22/16	12/23/15	6/22/16	12/28/15	6/20/16
Chemical Name										
Semivolatile Organic Compounds (ng/l)										
Perfluorooctane Sulfonate (PFOS)	--	70	**10000**	**11000**	**10400**	**11900**	12	7.84	2.7 U	3.97 U
Perfluorooctanoic acid (PFOA)	--	70	**320**	**300**	**465**	**514**	1.5 J	1.09 J	2 J	4.45 J
Perfluorohexanesulfonic acid (PFHxS)	--	--	5500	5000	8360	8120	13	9.07	1.2 B	3.97 U
Perfluorobutanesulfonic acid (PFBS)	40,000	--	550	640	1610	1580	1.4 J	3.91 U	1.8 U	3.97 U
Perfluoroheptanoic acid (PFHpA)	--	--	390	410	539	562	1.9 U	3.91 U	1.8 U	3.97 U
Perfluorononanoic acid (PFNA)	--	--	13	15	12	12.2	1.9 U	3.91 U	1.8 U	3.97 U
Total PFOS + PFOA*	--	70	**10320**	**11300**	**10865**	**12414**	13.5	8.93	4.7	4.45 J

Notes:

* In cases when both PFOS and PFOA are non-detect, non-detect values are added together to equal Total PFOS + PFOA. In cases when a detect and non-detect of PFOS and PFOA exist, only the detect value is used to determine Total PFOS + PFOA.

Underlined text indicates exceedance of the RSLs Tapwater HQ = 1.0 (June 2017)

Bolded text indicates exceedance of the USEPA Lifetime Health Advisory

NA - Not analyzed

B - Analyte not detected above the level reported in blanks

J - Analyte present, value may or may not be accurate or precise

U - The material was analyzed for, but not detected

ng/l - Nanograms per liter

Table 4-4. Columbia Aquifer Groundwater Analytical Data (December 2015 - June 2017)
Basewide PFAS Site Inspection
NALF Fentress, Chesapeake, Virginia

Station ID	**RSLs Tapwater HQ = 0.1 (June 2017)**	**USEPA Lifetime Health Advisory (May 2016)**	OF-MW15		OF-MW16			OF-MW17	
Sample ID			OF-MW15-1215	OF-MW15-0616	OF-MW16-1215	OF-MW16P-1215	OF-MW16-0616	OF-MW17-1215	OF-MW17-0616
Sample Date			12/23/15	6/20/16	12/22/15	12/22/15	6/20/16	12/22/15	6/21/16
Chemical Name									
Semivolatile Organic Compounds (ng/l)									
Perfluorooctane Sulfonate (PFOS)	--	70	3 U	4.2 U	66	**74**	**108**	19	33.2
Perfluorooctanoic acid (PFOA)	--	70	**140**	**185**	6.8 J	2.5 J	7.12 J	17	29.8
Perfluorohexanesulfonic acid (PFHxS)	--	--	9.70E-01 B	4.2 U	190	180	721	35	45.9
Perfluorobutanesulfonic acid (PFBS)	40,000	--	2 U	4.2 U	34	34	97.2	3.2	5.4 J
Perfluoroheptanoic acid (PFHpA)	--	--	8.6	11	2 U	2 U	1.32 J	2.3 J	2.57 J
Perfluorononanoic acid (PFNA)	--	--	2 U	4.2 U	2 U	2 U	3.97 U	9.90E-01 J	4.07 U
Total PFOS + PFOA*	--	70	**140**	**185**	**72.8**	**76.5**	**115**	36	63

Notes:
* In cases when both PFOS and PFOA are non-detect, non-detect values are added together to equal Total PFOS + PFOA. In cases when a detect and non-detect of PFOS and PFOA exist, only the detect value is used to determine Total PFOS + PFOA.
Underlined text indicates exceedance of the RSLs Tapwater HQ = 1.0 (June 2017)
Bolded text indicates exceedance of the USEPA Lifetime Health Advisory
NA - Not analyzed
B - Analyte not detected above the level reported in blanks
J - Analyte present, value may or may not be accurate or precise
U - The material was analyzed for, but not detected
ng/l - Nanograms per liter

Table 4-4. Columbia Aquifer Groundwater Analytical Data (December 2015 - June 2017)
Basewide PFAS Site Inspection
NALF Fentress, Chesapeake, Virginia

Station ID	**RSLs Tapwater HQ = 0.1 (June 2017)**	**USEPA Lifetime Health Advisory (May 2016)**	OF-MW24	OF-MW25	OF-MW27	OF-MW28	OF-MW29	OF-MW30	
Sample ID			OF-MW24-0716	OF-MW25-0716	OF-MW27-0716	OF-MW28-0716	OF-MW29-0716	OF-MW30-0716	OF-MW30P-0716
Sample Date			7/11/16	7/6/16	7/12/16	7/6/16	7/14/16	7/13/16	7/13/16
Chemical Name									
Semivolatile Organic Compounds (ng/l)									
Perfluorooctane Sulfonate (PFOS)	--	70	**3320**	6.1 J	4.2 U	3.97 U	**2960**	4.35 U	4.2 U
Perfluorooctanoic acid (PFOA)	--	70	**309**	4.26 J	1.33 J	3.97 U	**832**	4.35 U	4.2 U
Perfluorohexanesulfonic acid (PFHxS)	--	--	1650	4.85 J	4.2 U	1.09 J	4790	4.35 U	4.2 U
Perfluorobutanesulfonic acid (PFBS)	40,000	--	106	4.13 U	4.2 U	3.97 U	483	4.35 U	4.2 U
Perfluoroheptanoic acid (PFHpA)	--	--	57.7	4.13 U	4.2 U	3.97 U	341	4.35 U	4.2 U
Perfluorononanoic acid (PFNA)	--	--	8.63 J	4.13 U	4.2 U	3.97 U	22	4.35 U	4.2 U
Total PFOS + PFOA*	--	70	**3629**	10.4	1.33 J	7.94 U	**3792**	8.7 U	8.4 U

Notes:
* In cases when both PFOS and PFOA are non-detect, non-detect values are added together to equal Total PFOS + PFOA. In cases when a detect and non-detect of PFOS and PFOA exist, only the detect value is used to determine Total PFOS + PFOA.
Underlined text indicates exceedance of the RSLs Tapwater HQ = 1.0 (June 2017)
Bolded text indicates exceedance of the USEPA Lifetime Health Advisory
NA - Not analyzed
B - Analyte not detected above the level reported in blanks
J - Analyte present, value may or may not be accurate or precise
U - The material was analyzed for, but not detected
ng/l - Nanograms per liter

Table 4-4. Columbia Aquifer Groundwater Analytical Data (December 2015 - June 2017)
Basewide PFAS Site Inspection
NALF Fentress, Chesapeake, Virginia

Station ID	**RSLs Tapwater HQ = 0.1 (June 2017)**	**USEPA Lifetime Health Advisory (May 2016)**	OF-MW31	OF-MW32	OF-MW34	OF14-MW05	OF14-MW06S	
Sample ID			OF-MW31-0716	OF-MW32-0716	OF-MW34-0716	OF14-GW05-0317	OF14-MW06S-1215	OF14-MW06S-0616
Sample Date			7/6/16	7/13/16	7/14/16	3/8/17	12/21/15	6/20/16
Chemical Name								
Semivolatile Organic Compounds (ng/l)								
Perfluorooctane Sulfonate (PFOS)	--	70	1.6 J	3.94 U	6.15 J	0.922 U	**170**	**245**
Perfluorooctanoic acid (PFOA)	--	70	4.2 U	0.712 J	0.858 J	2.55 J	**190**	**298**
Perfluorohexanesulfonic acid (PFHxS)	--	--	4.2 U	1.16 J	3.65 J	7.76 J	210	305
Perfluorobutanesulfonic acid (PFBS)	40,000	--	4.2 U	3.94 U	4.07 U	4.1 U	14	21.7
Perfluoroheptanoic acid (PFHpA)	--	--	4.2 U	3.94 U	4.07 U	2.05 U	16	20
Perfluorononanoic acid (PFNA)	--	--	4.2 U	3.94 U	4.07 U	2.05 U	3.6	3.69 J
Total PFOS + PFOA*	--	70	1.6 J	0.712 J	7.01	2.55 J	**360**	**543**

Notes:
* In cases when both PFOS and PFOA are non-detect, non-detect values are added together to equal Total PFOS + PFOA. In cases when a detect and non-detect of PFOS and PFOA exist, only the detect value is used to determine Total PFOS + PFOA.
Underlined text indicates exceedance of the RSLs Tapwater HQ = 1.0 (June 2017)
Bolded text indicates exceedance of the USEPA Lifetime Health Advisory
NA - Not analyzed
B - Analyte not detected above the level reported in blanks
J - Analyte present, value may or may not be accurate or precise
U - The material was analyzed for, but not detected
ng/l - Nanograms per liter

Table 4-4. Columbia Aquifer Groundwater Analytical Data (December 2015 - June 2017)

Basewide PFAS Site Inspection

NALF Fentress, Chesapeake, Virginia

Station ID	**RSLs Tapwater HQ = 0.1 (June 2017)**	**USEPA Lifetime Health Advisory (May 2016)**	OF14-MW07S		OF17-MW01		OF17-MW02	OF17-MW03	OF17-MW04
Sample ID			OF14-MW07S-1215	OF14-MW07S-0616	OF17-MW01-0617	OF17-MW01P-0617	OF17-MW02-0517	OF17-MW03-0517	OF17-MW04-0617
Sample Date			12/21/15	6/20/16	6/1/17	6/1/17	5/31/17	5/31/17	6/1/17
Chemical Name									
Semivolatile Organic Compounds (ng/l)									
Perfluorooctane Sulfonate (PFOS)	--	70	5.3	9.3	**14,000**	**13,000**	**8,770**	**10,400**	**44,500 J**
Perfluorooctanoic acid (PFOA)	--	70	**270**	**371**	**1,840**	**1,710**	**816**	**2,760**	**3,400**
Perfluorohexanesulfonic acid (PFHxS)	--	--	390	457	4,590	3,640	3,850	11,100 J	3,770
Perfluorobutanesulfonic acid (PFBS)	40,000	--	78	75.7	181 J	184 J	67.9	739	156 J
Perfluoroheptanoic acid (PFHpA)	--	--	25	26.9	1,390	1,500	672	1,750	2,340
Perfluorononanoic acid (PFNA)	--	--	8.70E-01 J	4 U	403	388	292	714	627
Total PFOS + PFOA*	--	70	**275.3**	**380.3**	**15840**	**14710**	**9586**	**13160**	**47900**

Notes:

* In cases when both PFOS and PFOA are non-detect, non-detect values are added together to equal Total PFOS + PFOA. In cases when a detect and non-detect of PFOS and PFOA exist, only the detect value is used to determine Total PFOS + PFOA.

Underlined text indicates exceedance of the RSLs Tapwater HQ = 1.0 (June 2017)

Bolded text indicates exceedance of the USEPA Lifetime Health Advisory

NA - Not analyzed

B - Analyte not detected above the level reported in blanks

J - Analyte present, value may or may not be accurate or precise

U - The material was analyzed for, but not detected

ng/l - Nanograms per liter

Table 4-4. Columbia Aquifer Groundwater Analytical Data (December 2015 - June 2017)

Basewide PFAS Site Inspection

NALF Fentress, Chesapeake, Virginia

Station ID	**RSLs Tapwater HQ = 0.1 (June 2017)**	**USEPA Lifetime Health Advisory (May 2016)**	OF-MW10		OF-MW11		OF-MW12	
Sample ID			OF-MW10-1215	OF-MW10-0616	OF-MW11-1215	OF-MW11-0616	OF-MW12-1215	OF-MW12-0616
Sample Date			12/23/15	6/22/16	12/28/15	6/17/16	12/28/15	6/21/16
Chemical Name								
Semivolatile Organic Compounds (ng/l)								
Perfluorooctane Sulfonate (PFOS)	--	70	**290**	**283**	**3000**	**5320**	**6300**	**4220**
Perfluorooctanoic acid (PFOA)	--	70	**140**	**151**	**320**	**418**	**72**	69.8
Perfluorohexanesulfonic acid (PFHxS)	--	--	710	667	4800	7860	1200	1040
Perfluorobutanesulfonic acid (PFBS)	40,000	--	69	81.9	750	1420	60	95.1
Perfluoroheptanoic acid (PFHpA)	--	--	140	139	310	403	37	40.9
Perfluorononanoic acid (PFNA)	--	--	11	12.3	23	20.5	11	9.5
Total PFOS + PFOA*	--	70	**430**	**434**	**3320**	**5738**	**6372**	**4290**

Notes:

* In cases when both PFOS and PFOA are non-detect, non-detect values are added together to equal Total PFOS + PFOA. In cases when a detect and non-detect of PFOS and PFOA exist, only the detect value is used to determine Total PFOS + PFOA.

Underlined text indicates exceedance of the RSLs Tapwater HQ = 1.0 (June 2017)

Bolded text indicates exceedance of the USEPA Lifetime Health Advisory

NA - Not analyzed

B - Analyte not detected above the level reported in blanks

J - Analyte present, value may or may not be accurate or precise

U - The material was analyzed for, but not detected

ng/l - Nanograms per liter

Table 4-4. Columbia Aquifer Groundwater Analytical Data (December 2015 - June 2017)
Basewide PFAS Site Inspection
NALF Fentress, Chesapeake, Virginia

Station ID	**RSLs Tapwater HQ = 0.1 (June 2017)**	**USEPA Lifetime Health Advisory (May 2016)**	OF-MW13		OFPOL-MW-2	OFPOL-MW-3		OFPOL-MW-4	OFPOL-MW-6
Sample ID			OF-MW13-1215	OF-MW13-0616	OFPOL-MW-2-0616	OFPOL-MW-3-0616	OFPOL-MW-3P-0616	OFPOL-MW-4-0616	OFPOL-MW-6-0616
Sample Date			12/28/15	6/17/16	6/17/16	6/17/16	6/17/16	6/17/16	6/17/16
Chemical Name									
Semivolatile Organic Compounds (ng/l)									
Perfluorooctane Sulfonate (PFOS)	--	70	**4300**	**4090**	**12700**	**17200**	**18600**	**31000**	**14800**
Perfluorooctanoic acid (PFOA)	--	70	**880**	**657**	**1150**	**5570**	**5620**	**1600**	**1460**
Perfluorohexanesulfonic acid (PFHxS)	--	--	3300	2090	3300	8700	8380	5090	3540
Perfluorobutanesulfonic acid (PFBS)	40,000	--	220	77	202	335	397	321	215
Perfluoroheptanoic acid (PFHpA)	--	--	64	36.8	184	267	260	203	450
Perfluorononanoic acid (PFNA)	--	--	9	4.85 J	63.5	53	52.7	88.2	317
Total PFOS + PFOA*	--	70	**5180**	**4747**	**13850**	**22770**	**24220**	**32600**	**16260**

Notes:
* In cases when both PFOS and PFOA are non-detect, non-detect values are added together to equal Total PFOS + PFOA. In cases when a detect and non-detect of PFOS and PFOA exist, only the detect value is used to determine Total PFOS + PFOA.
Underlined text indicates exceedance of the RSLs Tapwater HQ = 1.0 (June 2017)
Bolded text indicates exceedance of the USEPA Lifetime Health Advisory
NA - Not analyzed
B - Analyte not detected above the level reported in blanks
J - Analyte present, value may or may not be accurate or precise
U - The material was analyzed for, but not detected
ng/l - Nanograms per liter

Table 4-4. Columbia Aquifer Groundwater Analytical Data (December 2015 - June 2017)

Basewide PFAS Site Inspection

NALF Fentress, Chesapeake, Virginia

Station ID	**RSLs Tapwater HQ = 0.1 (June 2017)**	**USEPA Lifetime Health Advisory (May 2016)**	OFPOL-MW-7	OFPOL-MW-8	OF-SOW-091A	OF-SOW-091D		OF-SOW-091K	OF-SOW-091L	OF-SOW-091M
Sample ID			OFPOL-MW-7-0616	OFPOL-MW-8-0616	OF-SOW-091A-0317	OF-SOW-091D-0317	OF-SOW-091DP-0317	OF-SOW-091K-0317	OF-SOW-091L-0317	OF-SOW-091M-0317
Sample Date			6/17/16	6/17/16	3/8/17	3/8/17	3/8/17	3/8/17	3/8/17	3/8/17
Chemical Name										
Semivolatile Organic Compounds (ng/l)										
Perfluorooctane Sulfonate (PFOS)	--	70	**49300**	**9020**	4.18 U	**1,940**	**1,650 J**	9.98	2.43 U	**2,350 J**
Perfluorooctanoic acid (PFOA)	--	70	**3600**	**1280**	3.79 J	**701**	**740**	2.53 J	2.1 U	**956**
Perfluorohexanesulfonic acid (PFHxS)	--	--	9840	2470	4.1 J	2,260	2,300	7.48 J	1.28 J	1,470
Perfluorobutanesulfonic acid (PFBS)	40,000	--	840	171	4.2 U	91.4 J	83.1 J	4.13 U	4.2 U	48.2 J
Perfluoroheptanoic acid (PFHpA)	--	--	2990	953	2.1 U	47.5 J	48.1 J	2.07 U	2.1 U	33.1 J
Perfluorononanoic acid (PFNA)	--	--	763	270	2.1 U	4.77 J	7.09 J	2.07 U	2.1 U	7.13 J
Total PFOS + PFOA*	--	70	**52900**	**10300**	3.79 J	**2641**	**2390**	12.51	4.53 U	**3306**

Notes:

* In cases when both PFOS and PFOA are non-detect, non-detect values are added together to equal Total PFOS + PFOA. In cases when a detect and non-detect of PFOS and PFOA exist, only the detect value is used to determine Total PFOS + PFOA.

Underlined text indicates exceedance of the RSLs Tapwater HQ = 1.0 (June 2017)

Bolded text indicates exceedance of the USEPA Lifetime Health Advisory

NA - Not analyzed

B - Analyte not detected above the level reported in blanks

J - Analyte present, value may or may not be accurate or precise

U - The material was analyzed for, but not detected

ng/l - Nanograms per liter

Table 4-5. Yorktown Aquifer Groundwater Analytical Data (December 2015- April 2017)

Basewide PFAS Site Investigation

NALF Fentress, Chesapeake, Virginia

Station ID	**RSLs Tapwater HQ = 0.1 (June 2017)**	**USEPA Lifetime Health Advisory**	OF-MW08D	OF-MW09D		OF-MW15D		OF-MW28D	OF-MW30D
Sample ID			OF-MW08D-0716	OF-MW09D-0116	OF-MW09D-0616	OF-MW15D-0116	OF-MW15D-0616	OF-MW28D-0716	OF-MW30D-0716
Sample Date			7/14/16	01/12/16	6/22/16	01/11/16	6/20/16	7/13/16	7/13/16
Chemical Name									
Semivolatile Organic Compounds (ng/l)									
Perfluorooctane Sulfonate (PFOS)	--	70	**6880**	9.6	5.49 J	6.6	2.19 J	6.9 J	2.08 J
Perfluorooctanoic acid (PFOA)	--	70	61.6	1.6 J	3.88 U	7.5	1.62 J	2.13 J	2.65 J
Perfluorohexanesulfonic acid (PFHxS)	--	--	514	2.6	3.88 U	9.70E-01 J	4.46 U	4.2 U	4.2 U
Perfluorobutanesulfonic acid (PFBS)	40,000	--	26.5	1.9 U	3.88 U	1.9 U	4.46 U	4.2 U	4.2 U
Perfluoroheptanoic acid (PFHpA)	--	--	99.4	1.9 U	3.88 U	8.20E-01 J	4.46 U	1.8 J	2.19 J
Perfluorononanoic acid (PFNA)	--	--	21.7	1.9 U	3.88 U	1.9 U	4.46 U	1.02 J	1.08 J
Total PFOS + PFOA*	--	70	**6941.6**	11.2	5.49	14.1	3.81	9.03	4.73

Notes:

* In cases when both PFOS and PFOA are non-detect, non-detect values are added together to equal Total PFOS + PFOA. In cases when a detect and non-detect of PFOS and PFOA exist, only the detect value is used to determine Total PFOS + PFOA.

Underlined text indicates exceedance of the RSLs Tapwater HQ = 1.0 (June 2017)

Bolded text indicates exceedance of the USEPA Lifetime Health Advisory

NA - Not analyzed

B - Analyte not detected above the level reported in blanks

J - Analyte present, value may or may not be accurate or precise

U - The material was analyzed for, but not detected

ng/l - Nanograms per liter

Table 4-5. Yorktown Aquifer Groundwater Analytical Data (December 2015- April 2017)

Basewide PFAS Site Investigation

NALF Fentress, Chesapeake, Virginia

Station ID	**RSLs Tapwater HQ = 0.1 (June 2017)**	**USEPA Lifetime Health Advisory**	OF-MW31D	OF-MW32D		OF-MW34D	OF14-MW06D	
Sample ID			OF-MW31D-0716	OF-MW32D-0417	OF-MW32DP-0417	OF-MW34D-0417	OF14-MW06D-1215	OF14-MW06D-0616
Sample Date			7/14/16	4/14/17	4/14/17	4/14/17	12/22/15	6/20/16
Chemical Name								
Semivolatile Organic Compounds (ng/l)								
Perfluorooctane Sulfonate (PFOS)	--	70	56.3	1.97 J	2.1 J	0.9 U	3 U	4.07 U
Perfluorooctanoic acid (PFOA)	--	70	4.54 J	2.03 U	2.05 U	2 U	2 U	0.779 J
Perfluorohexanesulfonic acid (PFHxS)	--	--	3.39 J	2.03 U	2.05 U	2 U	2 U	4.07 U
Perfluorobutanesulfonic acid (PFBS)	40,000	--	4.5 U	4.07 U	4.1 U	4 U	2 U	4.07 U
Perfluoroheptanoic acid (PFHpA)	--	--	3.93 J	2.03 U	2.05 U	2 U	2 U	4.07 U
Perfluorononanoic acid (PFNA)	--	--	2.42 J	2.03 U	2.05 U	2 U	2 U	4.07 U
Total PFOS + PFOA*	--	70	60.8	1.97	2.1	2.9 U	5 U	0.779

Notes:

* In cases when both PFOS and PFOA are non-detect, non-detect values are added together to equal Total PFOS + PFOA. In cases when a detect and non-detect of PFOS and PFOA exist, only the detect value is used to determine Total PFOS + PFOA.

Underlined text indicates exceedance of the RSLs Tapwater HQ = 1.0 (June 2017)

Bolded text indicates exceedance of the USEPA Lifetime Health Advisory

NA - Not analyzed

B - Analyte not detected above the level reported in blanks

J - Analyte present, value may or may not be accurate or precise

U - The material was analyzed for, but not detected

ng/l - Nanograms per liter

Table 4-5. Yorktown Aquifer Groundwater Analytical Data (December 2015- April 2017)
Basewide PFAS Site Investigation
NALF Fentress, Chesapeake, Virginia

Station ID	**RSLs Tapwater HQ = 0.1 (June 2017)**	**USEPA Lifetime Health Advisory**	OF14-MW07D		OF-MW10D		OF-MW11D	
Sample ID			OF14-MW07D-1215	OF14-MW07D-0616	OF-MW10D-0116	OF-MW10D-0616	OF-MW11D-0116	OF-MW11D-0616
Sample Date			12/22/15	6/20/16	01/11/16	6/22/16	01/12/16	6/21/16
Chemical Name								
Semivolatile Organic Compounds (ng/l)								
Perfluorooctane Sulfonate (PFOS)	--	70	3 U	3.94 U	4.1	4.73 J	28	7.45 J
Perfluorooctanoic acid (PFOA)	--	70	1.9 J	3.94 U	2 U	4 U	1.7 J	0.839 J
Perfluorohexanesulfonic acid (PFHxS)	--	--	2.8 B	3.94 U	9.90E-01 J	3.48 J	24	3.14 J
Perfluorobutanesulfonic acid (PFBS)	40,000	--	2 U	3.94 U	2 U	4 U	3.4	4 U
Perfluoroheptanoic acid (PFHpA)	--	--	2 U	3.94 U	2 U	4 U	1.5 J	4 U
Perfluorononanoic acid (PFNA)	--	--	2 U	3.94 U	2 U	4 U	1.9 U	4 U
Total PFOS + PFOA*	--	70	1.9	7.88 U	4.1	4.73	29.7	8.29

Notes:
* In cases when both PFOS and PFOA are non-detect, non-detect values are added together to equal Total PFOS + PFOA. In cases when a detect and non-detect of PFOS and PFOA exist, only the detect value is used to determine Total PFOS + PFOA.
Underlined text indicates exceedance of the RSLs Tapwater HQ = 1.0 (June 2017)
Bolded text indicates exceedance of the USEPA Lifetime Health Advisory
NA - Not analyzed
B - Analyte not detected above the level reported in blanks
J - Analyte present, value may or may not be accurate or precise
U - The material was analyzed for, but not detected
ng/l - Nanograms per liter

Table 4-5. Yorktown Aquifer Groundwater Analytical Data (December 2015- April 2017)
Basewide PFAS Site Investigation
NALF Fentress, Chesapeake, Virginia

Station ID	**RSLs Tapwater HQ = 0.1 (June 2017)**	**USEPA Lifetime Health Advisory**	OF-MW12D		OF-MW13D			
Sample ID			OF-MW12D-1215	OF-MW12D-0616	OF-MW13D-0116	OF-MW13DP-0116	OF-MW13D-0616	OF-MW13DP-0616
Sample Date			12/30/15	6/21/16	01/11/16	01/11/16	6/21/16	6/21/16
Chemical Name								
Semivolatile Organic Compounds (ng/l)								
Perfluorooctane Sulfonate (PFOS)	--	70	11	55.1	6.8	6.4	4.44 J	2.71 J
Perfluorooctanoic acid (PFOA)	--	70	7.9	2.77 J	5.2	6	4.5 J	3.5 J
Perfluorohexanesulfonic acid (PFHxS)	--	--	4.4	32.1	11	12	9.89	9.5
Perfluorobutanesulfonic acid (PFBS)	40,000	--	1.9 U	2.27 J	1.9 U	1.9 U	4.03 U	4.2 U
Perfluoroheptanoic acid (PFHpA)	--	--	1.9 U	3.88 U	1.9 U	8.90E-01 J	4.03 U	0.705 J
Perfluorononanoic acid (PFNA)	--	--	1.9 U	3.88 U	1.9 U	1.9 U	4.03 U	4.2 U
Total PFOS + PFOA*	--	70	18.9	57.87	12	12.4	8.94	6.21

Notes:
* In cases when both PFOS and PFOA are non-detect, non-detect values are added together to equal Total PFOS + PFOA. In cases when a detect and non-detect of PFOS and PFOA exist, only the detect value is used to determine Total PFOS + PFOA.
Underlined text indicates exceedance of the RSLs Tapwater HQ = 1.0 (June 2017)
Bolded text indicates exceedance of the USEPA Lifetime Health Advisory
NA - Not analyzed
B - Analyte not detected above the level reported in blanks
J - Analyte present, value may or may not be accurate or precise
U - The material was analyzed for, but not detected
ng/l - Nanograms per liter

Table 4-6. Columbia Aquifer Off-Base Groundwater Analytical Data (November 2017)

Basewide PFAS Site Inspection

NALF Fentress, Chesapeake, Virginia

Sample ID	**RSLs Tapwater HQ = 0.1 (June 2017)**	**USEPA Lifetime Health Advisory (May 2016)**	OF-MW19-1117	OF-MW20-1117	OF-MW20P-1117	OF-MW21-1117	OF-MW22-1117	OF-MW33-1117	
Sample Date			11/6/17	11/6/17	11/6/17	11/6/17	11/6/17	11/7/17	
Chemical Name									
Semivolatile Organic Compounds (NG/L)									
Perfluorobutanesulfonic acid (PFBS)	40,000	--	2.52 J	5.84 U	5.48 U	40	19.4	6.07	U
Perfluoroheptanoic acid (PFHpA)	--	--	5.68 U	5.84 U	5.48 U	15.9	9.15 J	6.07	U
Perfluorohexanesulfonic acid (PFHxS)	--	--	13.7	5.84 U	5.48 U	1,370	408	6.07	U
Perfluorononanoic acid (PFNA)	--	--	5.68 U	5.84 U	5.48 U	1.09 J	6.01 U	6.07	U
Perfluorooctane Sulfonate (PFOS)	--	70	5.68 U	5.84 U	5.48 U	5.58 U	**829**	6.07	U
Perfluorooctanoic acid (PFOA)	--	70	8.1 J	5.84 U	5.48 U	**243**	**126**	6.07	U
Perfluorohexanoic Acid (PFHxA)	--	--	5.68 U	5.84 U	5.48 U	96.1	44.9	6.07	U
Total PFOS + PFOA*	--	70	8.1 J	11.68 U	10.96 U	**243.0**	**955.0**	12.14	U

Notes:

* In cases when both PFOS and PFOA are non-detect, non-detect values are added together to equal Total PFOS + PFOA. In cases when a detect and non-detect of PFOS and PFOA exist, only the detect value is used to determine Total PFOS + PFOA.

Underlined text indicates exceedance of the RSLs Tapwater

Bolded text indicates exceedance of the USEPA Lifetime Health Advisory

J - The analyte is an estimated quantity. The associated numerical value is the approximate concentration of the analyte in the sample.

U - The analyte was analyzed for, but was not detected above the level of the reported sample quantitation limit.

NG/L - Nanograms per liter

Table 4-7. Yorktown Aquifer Off-Base Groundwater Analytical Data (November 2017)

Basewide PFAS Site Investigation

NALF Fentress, Chesapeake, Virginia

Sample ID **Sample Date**	**RSLs Tapwater HQ = 0.1 (June 2017)**	**USEPA Lifetime Health Advisory**	OF-MW19D-1117 11/6/17	OF-MW22D-1117 11/6/17	OF-MW33D-1117 11/7/17
Chemical Name					
Semivolatile Organic Compounds (NG/L)					
Perfluorobutanesulfonic acid (PFBS)	40,000	--	5.68 U	5.53 U	5.68 U
Perfluoroheptanoic acid (PFHpA)	--	--	5.68 U	5.53 U	5.68 U
Perfluorohexanesulfonic acid (PFHxS)	--	--	5.68 U	14.7	5.68 U
Perfluorononanoic acid (PFNA)	--	--	5.68 U	5.53 U	5.68 U
Perfluorooctane Sulfonate (PFOS)	--	70	5.68 U	59.5	5.68 U
Perfluorooctanoic acid (PFOA)	--	70	5.68 U	4.85 J	5.68 U
Perfluorohexanoic Acid (PFHxA)	--	--	5.68 U	5.53 U	5.68 U
Total PFOS + PFOA*	--	70	11.36 U	64.4	11.36 U

Notes:

* In cases when both PFOS and PFOA are non-detect, non-detect values are added together to equal Total PFOS + PFOA. In cases when a detect and non-detect of PFOS and PFOA exist, only the detect value is used to determine Total PFOS + PFOA.

Underlined text indicates exceedance of the RSLs Tapwater

Bolded text indicates exceedance of the USEPA Lifetime Health Advisory

J - The analyte is an estimated quantity. The associated numerical value is the approximate concentration of the analyte in the sample.

U - The analyte was analyzed for, but was not detected above the level of the reported sample quantitation limit.

NG/L - Nanograms per liter

Table 4-8. On-Base Potable Water Analytical Data (December 2015- May 2016)

Basewide PFAS Site Inspection

NALF Fentress, Chesapeake, Virginia

Sample ID **Sample Date**	**RSLs Tapwater HQ = 0.1 (June 2017)**	**USEPA Lifetime Health Advisory**	OF-INF01-1215 12/30/15	OF-INF01P-1215 12/30/15	OF-INF01-0516 5/10/16	OF-INF01-PT-0516 5/19/16
Chemical Name						
Semivolatile Organic Compounds (NG/L)						
Perfluorobutanesulfonic acid (PFBS)	40,000	--	12	12	35 J-	150
Perfluoroheptanoic acid (PFHpA)	--	--	10	8.8	98	130
Perfluorohexanesulfonic acid (PFHxS)	--	--	260	250	1000 J-	1300
Perfluorononanoic acid (PFNA)	--	--	1.8 J	1.7 J	38 U	6.4 J+
Perfluorooctane Sulfonate (PFOS)	--	70	**540**	**530**	**1800**	**2300**
Perfluorooctanoic acid (PFOA)	--	70	**300**	**290**	**5300**	**5900**
Total PFOS + PFOA*	--	70	**840**	**820**	**7100**	**8200**
Total Metals (UG/L)						
Iron	--	--	NS	NS	5,500	NS
Dissolved Metals (UG/L)						
Iron	--	--	NS	NS	170	NS
Wet Chemistry (MG/L)						
Total organic carbon (TOC)	--	--	NS	NS	NS	NS
Total suspended solids (TSS)	--	--	NS	NS	13	NS
Dissolved Wet Chemistry (MG/L)						
Dissolved organic carbon	--	--	NS	NS	NS	NS

Notes:

* In cases when both PFOS and PFOA are non-detect, non-detect values are added together to equal Total PFOS + PFOA. In cases when a detect and non-detect of PFOS and PFOA exist, only the detect value is used to determine Total PFOS + PFOA.

Sample IDs with "PT" indicate analysis of total oxidizable precursor PFCs

Underlined text indicates exceedance of the RSLs Tapwater HQ = 1.0 (June 2017)

Bolded text indicates exceedance of the USEPA Lifetime Health Advisory

J- - Analyte present. Value may be biased low. Value may be higher

J - Analyte present. Value may or may not be accurate or precise

J+ - Analyte present. Value may be biased high. Actual value may be lower

MG/L - Milligrams per liter

NG/L - Nanograms per liter

NS - Not sampled

U - The material was analyzed for, but not detected

UG/L - Micrograms per liter

Table 4-9. Off-Base Potable Water Analytical Data (February 2016 - May 2016)
Basewide PFAS Site Inspection
NALF Fentress, Chesapeake, Virginia

Station ID	RSLs Tapwater HQ = 0.1 (June 2017)	USEPA Lifetime Health Advisory	OF-RW02	OF-RW07	OF-RW08			OF-RW09	OF-RW11	OF-RW12	OF-RW15	OF-RW16	OF-RW18	OF-RW20	OF-RW21
Sample ID			OF-RW02-0216	OF-RW07-0316	OF-RW08-0216	OF-RW08P-0216	OF-RW08-0516	OF-RW09-0216	OF-RW11-0216	OF-RW12-0216	OF-RW15-0216	OF-RW16-0216	OF-RW18-0216	OF-RW20-0216	OF-RW21-0216
Sample Date			02/12/16	03/21/16	02/04/16	02/04/16	05/06/16	02/03/16	02/03/16	02/05/16	02/12/16	02/05/16	02/16/16	02/04/16	02/08/16
Chemical Name															
Semivolatile Organic Compounds (ng/l)															
Perfluorooctane Sulfonate (PFOS)	--	70	**86**	2.8 U	**180 J**	**170 J**	**160**	0.32 J	0.87 J	2.7 U	1 U	2.8 U	1 U	1 U	1 U
Perfluorooctanoic acid (PFOA)	--	70	42	0.72 B	13	14	10	0.41 J	1 U	1.8 U	1 U	1.9 U	1 U	1 U	1 U
Perfluorohexanesulfonic acid (PFHxS)	--	--	8.4	1.9 U	53	60	42 J	0.71 J	0.75 J	1.8 U	1 U	1.9 U	1 U	1 U	0.44 J
Perfluorobutanesulfonic acid (PFBS)	40,000	--	9.4	1.1 J	5	5.2	2.7	1 U	1 U	1.8 U	1 U	1.9 U	1 U	1 U	1 U
Perfluoroheptanoic acid (PFHpA)	--	--	11	1.9 U	2.9	3	1.4 J	1 U	1 U	1.8 U	1 U	1.9 U	1 U	1 U	1 U
Perfluorononanoic acid (PFNA)	--	--	5.5	1.9 U	0.43 J	0.39 J	1.9 U	1 U	1 U	1.8 U	1 U	1.9 U	1 U	1 U	1 U
Total PFOS + PFOA*	--	70	**128**	3.52	**193**	**184**	**170**	0.73	0.87	4.5 U	2 U	4.7 U	2 U	2 U	2 U

Notes:
* In cases when both PFOS and PFOA are non-detect, non-detect values are added together to equal Total PFOS + PFOA. In cases when a detect and non-detect of PFOS and PFOA exist, only the detect value is used to determine Total PFOS + PFOA.
Underlined text indicates exceedance of the RSLs Tapwater HQ = 1.0 (June 2017)
Bolded text indicates exceedance of USEPA Lifetime Health Advisory
NA - Not analyzed
B - Analyte not detected above the level reported in blanks
J - Analyte present, value may or may not be accurate or precise
J- - Analyte present, value may be biased low, actual value may be higher
J+ - Analyte present, value may be biased high, actual value may be lower
U - The material was analyzed for, but not detected
UJ - Analyte not detected, quantitation limit may be inaccurate
ng/l - Nanograms per liter

Table 4-9. Off-Base Potable Water Analytical Data (February 2016 - May 2016)
Basewide PFAS Site Inspection
NALF Fentress, Chesapeake, Virginia

Station ID	**RSLs Tapwater HQ = 0.1 (June 2017)**	**USEPA Lifetime Health Advisory**	OF-RW24	OF-RW25	OF-RW26	OF-RW27	OF-RW28	OF-RW30	OF-RW31	OF-RW34	OF-RW35	OF-RW36	OF-RW37
Sample ID			OF-RW24-0216	OF-RW25-0216	OF-RW26-0216	OF-RW27-0216	OF-RW28-0216	OF-RW30-0216	OF-RW31-0216	OF-RW34-0216	OF-RW35-0216	OF-RW36A-0216	OF-RW37-0216
Sample Date			02/10/16	02/05/16	02/04/16	02/04/16	02/03/16	02/04/16	02/10/16	02/09/16	02/03/16	02/04/16	02/03/16
Chemical Name													
Semivolatile Organic Compounds (ng/l)													
Perfluorooctane Sulfonate (PFOS)	--	70	0.9 J	2.7 U	1 U	1 U	1 U	1 U	2.7	1 UJ	1 U	1 U	0.81 J
Perfluorooctanoic acid (PFOA)	--	70	1 U	1.8 U	1 U	1 U	1 U	1 U	4.1	1 UJ	1 U	1 U	7.2
Perfluorohexanesulfonic acid (PFHxS)	--	--	1 U	1.8 U	1 U	0.66 J	0.75 J	1 U	1.4 J	1 UJ	1 U	0.69 J	3.3
Perfluorobutanesulfonic acid (PFBS)	40,000	--	1 U	0.99 B	1 U	0.67 J	1 U	1 U	4.3	1 UJ	1 U	0.74 J	0.79 J
Perfluoroheptanoic acid (PFHpA)	--	--	1 UJ	1.8 U	1 U	1 U	1 U	1 U	1 J	1 UJ	1 U	1 U	0.46 J
Perfluorononanoic acid (PFNA)	--	--	1 UJ	1.8 U	1 U	1 U	0.37 J	1 U	0.7 J	1 UJ	1 U	1 U	1 U
Total PFOS + PFOA*	--	70	0.9 J	4.5 U	2 U	2 U	2 U	2 U	6.8	2 UJ	2 U	2 U	8.01

Notes:
* In cases when both PFOS and PFOA are non-detect, non-detect values are added together to equal Total PFOS + PFOA. In cases when a detect and non-detect of PFOS and PFOA exist, only the detect value is used to determine Total PFOS + PFOA.
Underlined text indicates exceedance of the RSLs Tapwater HQ = 1.0 (June 2017)
Bolded text indicates exceedance of USEPA Lifetime Health Advisory
NA - Not analyzed
B - Analyte not detected above the level reported in blanks
J - Analyte present, value may or may not be accurate or precise
J- - Analyte present, value may be biased low, actual value may be higher
J+ - Analyte present, value may be biased high, actual value may be lower
U - The material was analyzed for, but not detected
UJ - Analyte not detected, quantitation limit may be inaccurate
ng/l - Nanograms per liter

Table 4-9. Off-Base Potable Water Analytical Data (February 2016 - May 2016)
Basewide PFAS Site Inspection
NALF Fentress, Chesapeake, Virginia

Station ID	RSLs Tapwater HQ = 0.1 (June 2017)	USEPA Lifetime Health Advisory	OF-RW38	OF-RW39	OF-RW40	OF-RW41		OF-RW42							
Sample ID			OF-RW38-0216	OF-RW39-0216	OF-RW40-0216	OF-RW41-0216	OF-RW41P-0216	OF-RW42A-0216	OF-RW42B-0216	OF-RW42A-0516	OF-RW42B-0516	OF-RW42B2-0516	OF-RW42C-0516	OF-RW42CP-0516	OF-RW42D-0517
Sample Date			02/09/16	02/03/16	02/03/16	02/04/16	02/04/16	02/03/16	02/03/16	05/05/16	05/05/16	05/05/16	05/05/16	05/05/16	05/25/17
Chemical Name															
Semivolatile Organic Compounds (ng/l)															
Perfluorooctane Sulfonate (PFOS)	--	70	1 UJ	1.8 J	1 U	1 U	1 U	1 U	16	2.8 U	13	18	20	23	1.4 J
Perfluorooctanoic acid (PFOA)	--	70	1 UJ	1 U	1 U	1 U	1 U	5	**240 J**	3.1	**190**	**180**	**93**	**87**	22.4
Perfluorohexanesulfonic acid (PFHxS)	--	--	1 UJ	1 U	1 U	0.69 J	0.69 J	9.7	700 J	6.7 J	380 J	430 J	260 J	280 J	52.5
Perfluorobutanesulfonic acid (PFBS)	40,000	--	1 UJ	1 U	1 U	1 U	0.67 J	1.8 J	62	1.9 U	57	58	16	17	5.03 J
Perfluoroheptanoic acid (PFHpA)	--	--	1 UJ	1 U	1 U	1 U	1 U	0.94 J	16	1.9 U	13	13	5	4.5	1.49 J
Perfluorononanoic acid (PFNA)	--	--	1 UJ	1 U	1 U	1 U	1 U	1 U	0.88 J	1.9 U	1.4 J	2 U	1.8 U	1.9 U	1.88 U
Total PFOS + PFOA*	--	70	2 UJ	1.8	2 U	2 U	2 U	5	**256**	3.1	**203**	**198**	**113**	**110**	23.8

Notes:
* In cases when both PFOS and PFOA are non-detect, non-detect values are added together to equal Total PFOS + PFOA. In cases when a detect and non-detect of PFOS and PFOA exist, only the detect value is used to determine Total PFOS + PFOA.
Underlined text indicates exceedance of the RSLs Tapwater HQ = 1.0 (June 2017)
Bolded text indicates exceedance of USEPA Lifetime Health Advisory
NA - Not analyzed
B - Analyte not detected above the level reported in blanks
J - Analyte present, value may or may not be accurate or precise
J- - Analyte present, value may be biased low, actual value may be higher
J+ - Analyte present, value may be biased high, actual value may be lower
U - The material was analyzed for, but not detected
UJ - Analyte not detected, quantitation limit may be inaccurate
ng/l - Nanograms per liter

Table 4-9. Off-Base Potable Water Analytical Data (February 2016 - May 2016)
Basewide PFAS Site Inspection
NALF Fentress, Chesapeake, Virginia

Station ID	**RSLs Tapwater HQ = 0.1 (June 2017)**	**USEPA Lifetime Health Advisory**	OF-RW43	OF-RW44			OF-RW46	OF-RW47		OF-RW48	OF-RW49	OF-RW50	OF-RW51		
Sample ID			OF-RW43-0216	OF-RW44-0216	OF-RW44P-021	OF-RW44-0516	OF-RW46-0216	OF-RW47-0216	OF-RW47A-0216	OF-RW48-0216	OF-RW49-0216	OF-RW50-0216	OF-RW51-0216	OF-RW51A-0216	OF-RW51P-0216
Sample Date			02/03/16	02/08/16	02/08/16	05/04/16	02/11/16	02/08/16	02/08/16	02/08/16	02/04/16	02/09/16	02/04/16	02/04/16	02/04/16
Chemical Name															
Semivolatile Organic Compounds (ng/l)															
Perfluorooctane Sulfonate (PFOS)	--	70	11	**1100**	**1200**	**800**	1 U	1 UJ	1 U	1 U	0.41 J	1 UJ	1 U	1 U	1 U
Perfluorooctanoic acid (PFOA)	--	70	7.9	**410**	**460**	**360**	1 U	1 UJ	1 U	1 U	1 U	1 UJ	1 U	1 U	1 U
Perfluorohexanesulfonic acid (PFHxS)	--	--	10	520	580	320 J	1 U	1 UJ	1 U	1 U	0.88 B	1 UJ	1 U	0.68 J	1 U
Perfluorobutanesulfonic acid (PFBS)	40,000	--	1.2 J	49	46	13	1 U	0.57 J-	0.52 J	1 U	1 U	1 UJ	1 U	1 U	1 U
Perfluoroheptanoic acid (PFHpA)	--	--	0.81 J	28	28	14	1 U	1 UJ	1 U	1 U	1 U	1 UJ	6.6 J	1 U	4.2 J
Perfluorononanoic acid (PFNA)	--	--	0.57 J	5.9	6.5	3.8	1 U	1 UJ	1 U	1 U	1 U	1 UJ	1 U	1 U	1 U
Total PFOS + PFOA*	--	70	18.9	**1510**	**1660**	**1160**	2 U	2 UJ	2 U	2 U	0.41 J	2 UJ	2 U	2 U	2 U

Notes:
* In cases when both PFOS and PFOA are non-detect, non-detect values are added together to equal Total PFOS + PFOA. In cases when a detect and non-detect of PFOS and PFOA exist, only the detect value is used to determine Total PFOS + PFOA.
Underlined text indicates exceedance of the RSLs Tapwater HQ = 1.0 (June 2017)
Bolded text indicates exceedance of USEPA Lifetime Health Advisory
NA - Not analyzed
B - Analyte not detected above the level reported in blanks
J - Analyte present, value may or may not be accurate or precise
J- - Analyte present, value may be biased low, actual value may be higher
J+ - Analyte present, value may be biased high, actual value may be lower
U - The material was analyzed for, but not detected
UJ - Analyte not detected, quantitation limit may be inaccurate
ng/l - Nanograms per liter

Table 4-9. Off-Base Potable Water Analytical Data (February 2016 - May 2016)
Basewide PFAS Site Inspection
NALF Fentress, Chesapeake, Virginia

Station ID	**RSLs Tapwater HQ = 0.1 (June 2017)**	**USEPA Lifetime Health Advisory**	OF-RW54	OF-RW55	OF-RW56	OF-RW57		OF-RW58	OF-RW59		OF-RW60		OF-RW62	OF-RW63
Sample ID			OF-RW54-0216	OF-RW55-0216	OF-RW56-0216	OF-RW57-0216	OF-RW57P-0216	OF-RW58-0216	OF-RW59-0216	OF-RW59-0516	OF-RW60-0216	OF-RW60P-0216	OF-RW62-0216	OF-RW63-0216
Sample Date			02/04/16	02/04/16	02/04/16	02/05/16	02/05/16	02/03/16	02/09/16	05/12/16	02/11/16	02/11/16	02/09/16	02/09/16
Chemical Name														
Semivolatile Organic Compounds (ng/l)														
Perfluorooctane Sulfonate (PFOS)	--	70	1 U	1 U	1 U	2.8 U	2.8 U	1 U	**580 J**	**550**	2.1	1.9 J	1.5 J	44 J
Perfluorooctanoic acid (PFOA)	--	70	1 U	1 U	1 U	1.8 U	1.9 U	1 U	**87 J**	**86**	1.7 J	1.5 J	1 UJ	30 J
Perfluorohexanesulfonic acid (PFHxS)	--	--	1 U	1 U	1 U	1.8 U	1.9 U	1 U	360 J	300	0.99 J	1.1 J	0.75 J	22 J
Perfluorobutanesulfonic acid (PFBS)	40,000	--	1 U	1 U	0.81 J	1.8 U	1.9 U	1 U	19 J	11	0.72 J	0.85 J	1 UJ	6.5 J
Perfluoroheptanoic acid (PFHpA)	--	--	1 U	1 U	1 U	1.8 U	1.9 U	1 U	7 J	4.6	0.57 J	0.62 J	1 UJ	5.8 J
Perfluorononanoic acid (PFNA)	--	--	1 U	1 U	1 U	1.8 U	1.9 U	1 U	0.8 J	0.66 J	0.67 J	0.69 J	1 UJ	1.1 J
Total PFOS + PFOA*	--	70	2 U	2 U	2 U	4.6 U	4.7 U	2 U	**667**	**636**	3.8	3.4	1.5	**74**

Notes:
* In cases when both PFOS and PFOA are non-detect, non-detect values are added together to equal Total PFOS + PFOA. In cases when a detect and non-detect of PFOS and PFOA exist, only the detect value is used to determine Total PFOS + PFOA.
Underlined text indicates exceedance of the RSLs Tapwater HQ = 1.0 (June 2017)
Bolded text indicates exceedance of USEPA Lifetime Health Advisory
NA - Not analyzed
B - Analyte not detected above the level reported in blanks
J - Analyte present, value may or may not be accurate or precise
J- - Analyte present, value may be biased low, actual value may be higher
J+ - Analyte present, value may be biased high, actual value may be lower
U - The material was analyzed for, but not detected
UJ - Analyte not detected, quantitation limit may be inaccurate
ng/l - Nanograms per liter

Table 4-9. Off-Base Potable Water Analytical Data (February 2016 - May 2016)
Basewide PFAS Site Inspection
NALF Fentress, Chesapeake, Virginia

Station ID	RSLs Tapwater HQ = 0.1 (June 2017)	USEPA Lifetime Health Advisory	OF-RW65	OF-RW66	OF-RW67	OF-RW68	OF-RW69	OF-RW70	OF-RW71	OF-RW74	OF-RW77	OF-RW78		OF-RW83	OF-RW84
Sample ID			OF-RW65-0216	OF-RW66-0216	OF-RW67-0216	OF-RW68-0216	OF-RW69-0216	OF-RW70-0216	OF-RW71-0516	OF-RW74-0516	OF-RW77-0516	OF-RW78-0516	OF-RW78P-0516	OF-RW83-0516	OF-RW84-0516
Sample Date			02/08/16	02/04/16	02/03/16	02/04/16	02/04/16	02/08/16	05/06/16	05/11/16	05/10/16	05/09/16	05/09/16	05/16/16	05/06/16
Chemical Name															
Semivolatile Organic Compounds (ng/l)															
Perfluorooctane Sulfonate (PFOS)	--	70	1 U	1 U	1 U	1 U	1 U	1 UJ	2.9 U	2.9 U	2.8 U	2.7 B	2.7 U	9.4 J+	2.9 U
Perfluorooctanoic acid (PFOA)	--	70	1 U	1 U	1 U	0.41 J	1 U	1 UJ	2 U	0.76 J	1.8 U	1.7 B	1.8 B	1.9 U	1.9 U
Perfluorohexanesulfonic acid (PFHxS)	--	--	1 U	1 U	1 U	1 U	1 U	1 UJ	2 U	1.9 U	1.8 U	0.83 B	1.8 U	0.95 J	1.9 U
Perfluorobutanesulfonic acid (PFBS)	40,000	--	1 U	1 U	0.97 J	1 U	1 U	1 UJ	2 U	1.9 U	1.8 U	1.8 UJ	1.8 U	1.9 U	1.9 U
Perfluoroheptanoic acid (PFHpA)	--	--	1 U	1 U	1 UJ	1 U	1 U	1 UJ	2 U	1.9 U	1.8 U	1.8 UJ	1.8 U	1.9 U	1.9 U
Perfluorononanoic acid (PFNA)	--	--	1 U	1 U	1 U	1 U	1 U	1 UJ	2 U	1.1 J	1.8 U	1.8 UJ	1.8 U	1.9 U	1.9 U
Total PFOS + PFOA*	--	70	2 U	2 U	2 U	0.41	2 U	2 UJ	4.9 U	0.76 J	4.6 U	4.4 B	4.5 B	9.4	4.8 U

Notes:
* In cases when both PFOS and PFOA are non-detect, non-detect values are added together to equal Total PFOS + PFOA. In cases when a detect and non-detect of PFOS and PFOA exist, only the detect value is used to determine Total PFOS + PFOA.
Underlined text indicates exceedance of the RSLs Tapwater HQ = 1.0 (June 2017)
Bolded text indicates exceedance of USEPA Lifetime Health Advisory
NA - Not analyzed
B - Analyte not detected above the level reported in blanks
J - Analyte present, value may or may not be accurate or precise
J- - Analyte present, value may be biased low, actual value may be higher
J+ - Analyte present, value may be biased high, actual value may be lower
U - The material was analyzed for, but not detected
UJ - Analyte not detected, quantitation limit may be inaccurate
ng/l - Nanograms per liter

Table 4-10. On-Base Soil Analytical Data (February 2017)
Basewide PFAS Site Inspection
NALF Fentress, Chesapeake, Virginia

Sample ID	Residential Soil RSL	OFPOL-SB03-0102-0217	OFPOL-SB04-0203-0217	OFPOL-SB07-0102-0217	OFPOL-SB07P-0102-0217	OF-SB01-0405-0217	OF-SB02-0203-0217	OF-SB03-0203-0217	OF-SB04-0102-0217	OF-SB05-0203-0217
Sample Date	**HQ = 0.1 (June 2017)**	2/28/17	2/28/17	2/28/17	2/28/17	2/28/17	2/28/17	2/28/17	2/28/17	2/28/17
Chemical Name										
Semivolatile Organic Compounds (UG/KG)										
Perfluorobutanesulfonic acid (PFBS)	130,000	0.82	0.34 U	0.4 U	0.32 U	0.39 U	0.34 U	0.26 J	0.12 J	0.75
Perfluoroheptanoic acid (PFHpA)	--	0.9	0.71	5.3	3.9	0.39 U	0.31 J	0.29 J	1.8	3.2
Perfluorohexanesulfonic acid (PFHxS)	--	12	1.2	2.9 J	1.7 J	0.24 J	0.34 J	4.3	2.5	6.5
Perfluorononanoic acid (PFNA)	--	0.6 J	3.4	9.2 J	5.7 J	0.39 U	1	1.6	1.1	0.73
Perfluorooctane Sulfonate (PFOS)	130	110	93	57 J	32 J	0.25 J	30	**240**	63	68
Perfluorooctanoic acid (PFOA)	130	7.5	1.5	7.9 J	5.4 J	0.39 U	0.77	1.7	3.2	1.5
Wet Chemistry (MEQ/100G)										
Cation Exchange Capacity (MEQ/100G)	--	120	100	72	NS	66	64	71	81	150
pH (pH UNITS)	--	6.6	5.7	6.1	NS	5	5.1	6.5	5.3	5.2
Total organic carbon (TOC) (MG/KG)	--	17000 B	8300 B	6900 B	NS	3000 B	2600 B	8400 B	6600 B	4500 B

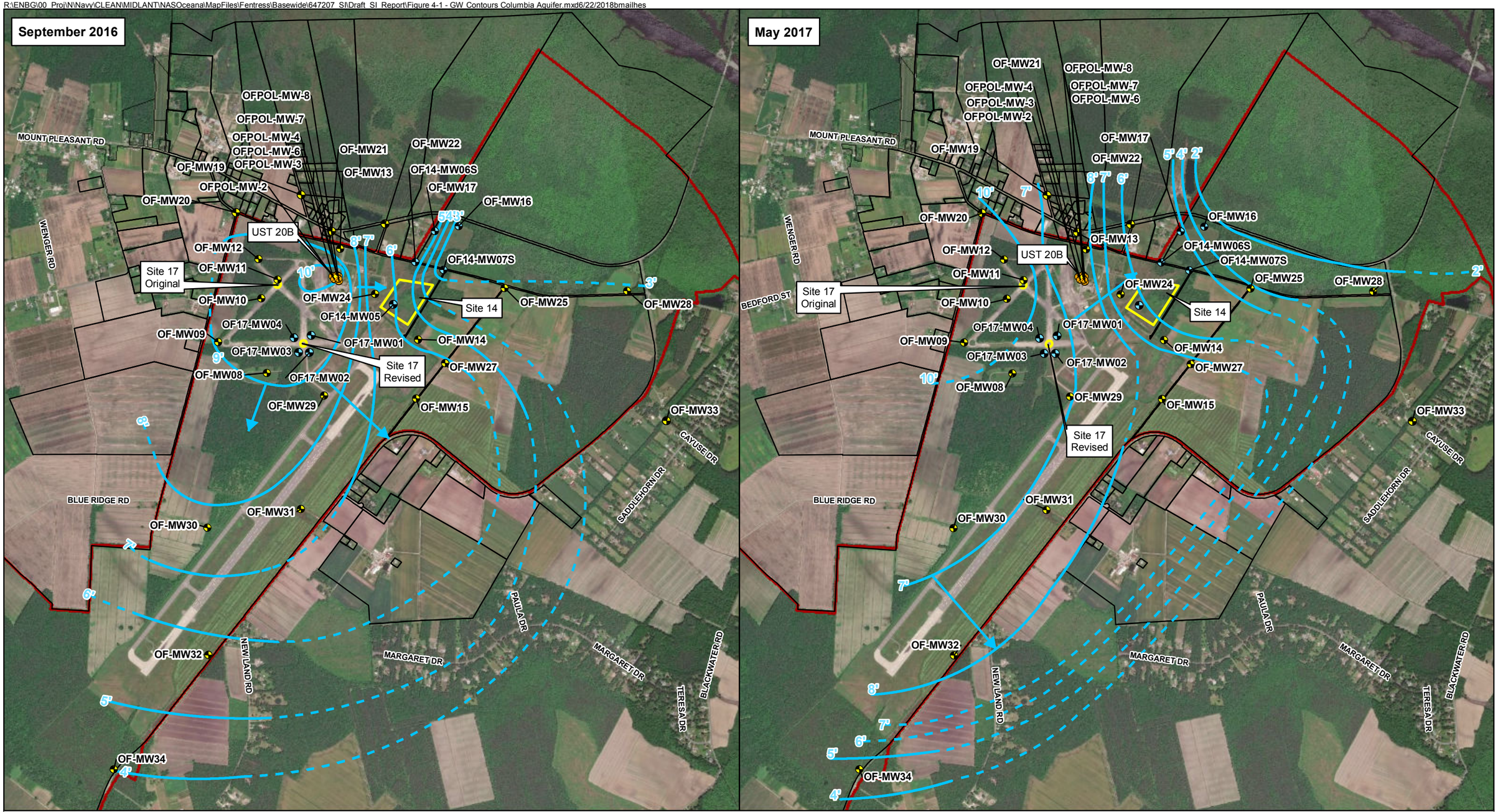
Notes:
Bolded text indicates exceedance of Residential Soil RSLs HQ = 0.1 (June 2017)
J - Analyte present. Value may or may not be accurate or precise
MEQ/100G - Milliequivalents per 100 grams
MG/KG - Milligrams per kilogram
NS - Not sampled
U - The material was analyzed for, but not detected
UG/KG - Micrograms per kilogram

Table 4-10. On-Base Soil Analytical Data (February 2017)
Basewide PFAS Site Inspection
NALF Fentress, Chesapeake, Virginia

Sample ID	**Residential Soil RSL**	OFPOL-SS03-0217	OFPOL-SS04-0217	OFPOL-SS07-0217	OF-SS01-0217	OF-SS01P-0217	OF-SS02-0217	OF-SS03-0217	OF-SS04-0217	OF-SS05-0217
Sample Date	**HQ = 0.1 (June 2017)**	2/28/17	2/28/17	2/28/17	2/28/17	2/28/17	2/28/17	2/28/17	2/28/17	2/28/17
Chemical Name										
Semivolatile Organic Compounds (UG/KG)										
Perfluorobutanesulfonic acid (PFBS)	130,000	0.46 J	0.44 J	0.21 J	0.39 U	0.35 U	0.46 U	0.4 U	0.2 J	1.5
Perfluoroheptanoic acid (PFHpA)	--	0.43 J	2.3	3.7	0.15 J	0.12 J	0.44 J	0.55 J	0.36 J	15
Perfluorohexanesulfonic acid (PFHxS)	--	8	8.7	3	0.92	0.95	0.91	3.2	2.9	30
Perfluorononanoic acid (PFNA)	--	0.66	9.6	5	0.31 J	0.26 J	1.6	0.88	0.82	4.4
Perfluorooctane Sulfonate (PFOS)	130	46	**280**	39	13	9.9	40	**240**	26 J	**390**
Perfluorooctanoic acid (PFOA)	130	4.5	9.9	10	0.51 J	0.49 J	0.93	2.9	0.94	7.9
Wet Chemistry (MEQ/100G)										
Cation Exchange Capacity (MEQ/100G)	--	120	130	96	78	NS	93	89	120	120
pH (pH UNITS)	--	5.8	5.8	5.4	5.7	NS	5.7	6.5	4.9	5
Total organic carbon (TOC) (MG/KG)	--	27000 B	41000 B	37000 B	15000 B	NS	11000 B	7500 B	15000 B	40000 B

Notes:
Bolded text indicates exceedance of Residential Soil RSLs HQ = 0.1 (June 2017)
J - Analyte present. Value may or may not be accurate or precise
MEQ/100G - Milliequivalents per 100 grams
MG/KG - Milligrams per kilogram
NS - Not sampled
U - The material was analyzed for, but not detected
UG/KG - Micrograms per kilogram

R:\ENBG\00_Proj\N\Navy\CLEAN\MIDLANT\NASOceana\MapFiles\Fentress\Basewide\647207_SI\Draft_SI_Report\Figure 4-1 - GW_Contours Columbia Aquifer.mxd6/22/2018bmailhes



Legend

- Newly Installed Monitoring Well Location
- Existing Monitoring Well Location
- UST 20B Well Location
- Parcel Boundary
- Site Boundary
- Fentress Boundary
- Groundwater Potentiometric Surface
- Inferred Groundwater Potentiometric Surface
- Groundwater Flow Direction
- 5.78 *Groundwater elevations measured in feet above mean sea level (ft amsl)*

N

0 1,000 2,000 Feet

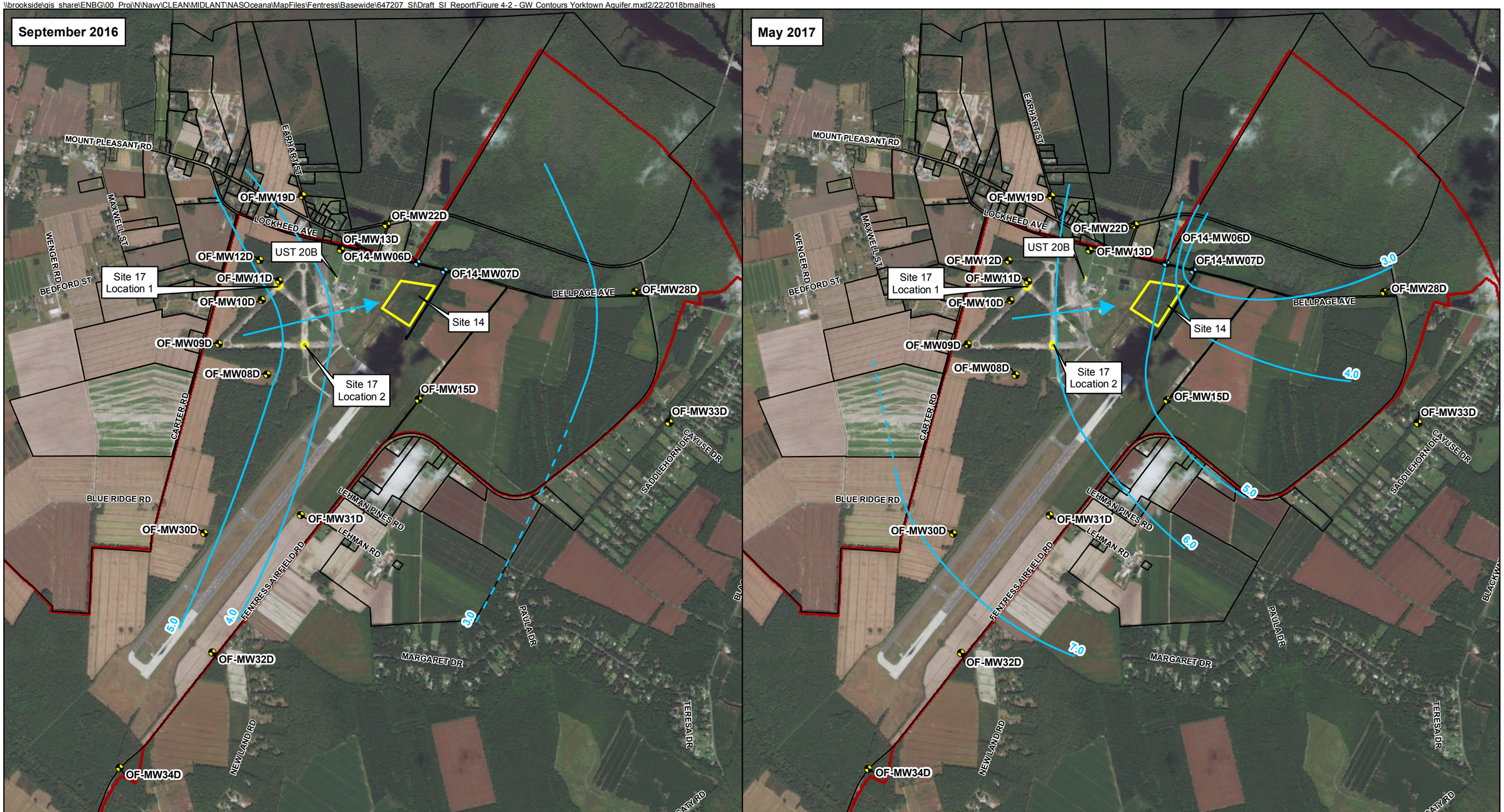
1 inch = 2,000 feet

Imagery Source: ESRI 2017

Figure 4-1
Groundwater Contours Measured in the Columbia/Surficial Aquifer in September 2016 and May 2017
Basewide Per- and Polyfluoroalkyl Substances Site Inspection Report
NALF Fentress, Chesapeake, Virginia

ch2m

\\brookside\gis_share\ENBG\00_Proj\N\Navy\CLEAN\MIDLANT\NASOceana\MapFiles\Fentress\Basewide\647207_SI\Draft_SI_Report\Figure 4-2 - GW Contours Yorktown Aquifer.mxd2/22/2018bmailhes



Legend

- Newly Installed Monitoring Well Location
- Existing Monitoring Well Location
- Parcel Boundary
- Site Boundary
- Fentress Boundary
- Groundwater Potentiometric Surface
- Inferred Groundwater Potentiometric Surface
- Groundwater Flow Direction

N

0 1,000 2,000 Feet

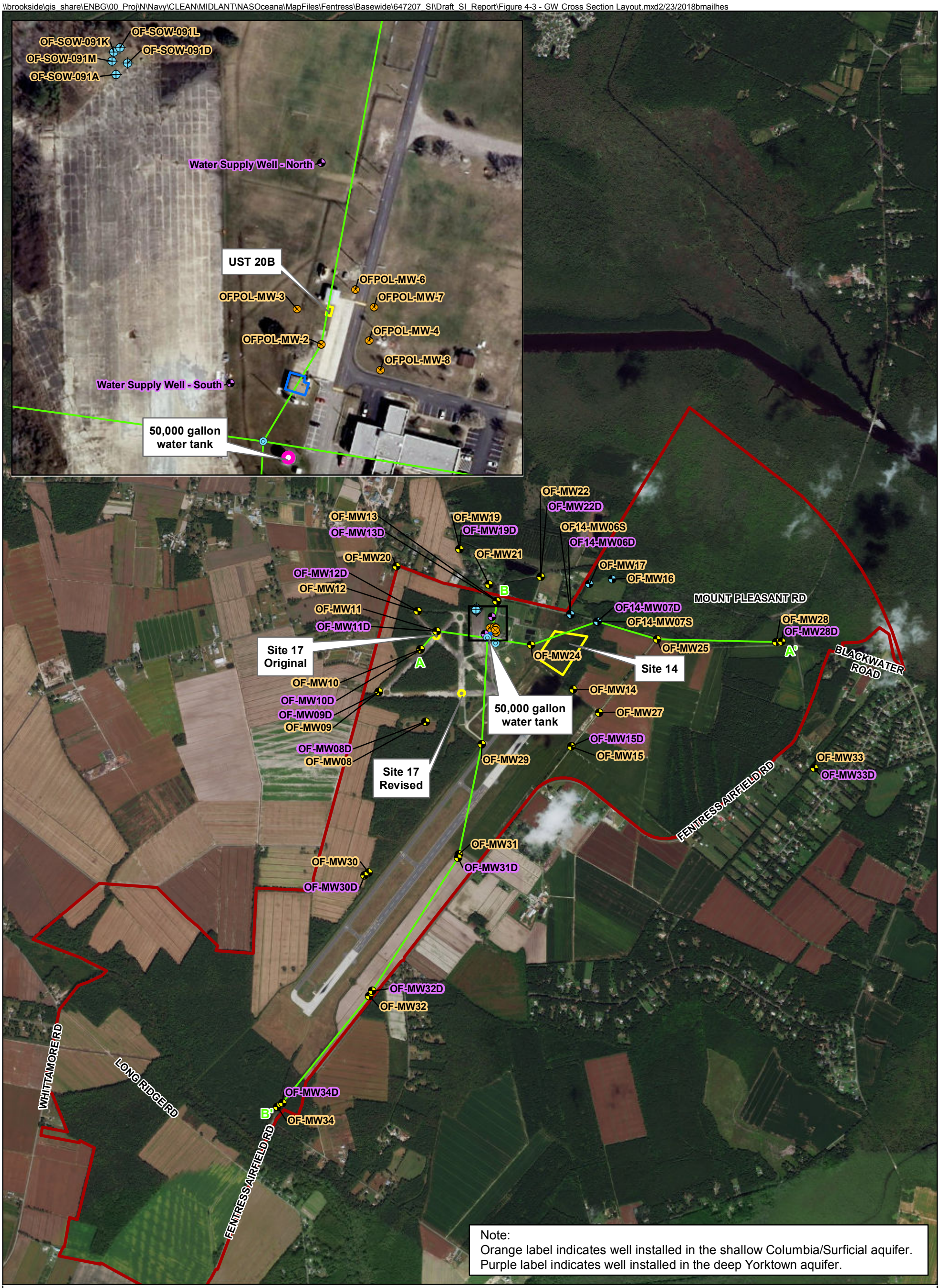
1 inch = 2,000 feet

Imagery Source: ESRI 2017

Figure 4-2
Groundwater Contours Measured in the Yorktown Aquifer in September 2016 and May 2017
Basewide Per- and Polyfluoroalkyl Substances Site Inspection Report
NALF Fentress, Chesapeake, Virginia

ch2m

\\brookside\gis_share\ENBG\00_Proj\N\Navy\CLEAN\MIDLANT\NASOceana\MapFiles\Fentress\Basewide\647207_SI\Draft_SI_Report\Figure 4-3 - GW Cross Section Layout.mxd2/23/2018bmailhes



Legend

- Newly Installed Monitoring Well Location
- Existing Monitoring Well Lcoation
- UST 20B Well Location
- On-Base Water Supply Well Location
- State Water Control Board Well Location
- Cross-Section
- Site Boundary
- 50,000 gallon water tank
- Water Treatment Plant
- Fentress Boundary

N

0 1,000 2,000 Feet

Imagery Source: ©2017 Esri

Figure 4-3
Cross-Section Layout
Basewide Per- and Polyfluoroalkyl Substances Site Inspection Report
NALF Fentress, Chesapeake, Virginia

ch2m

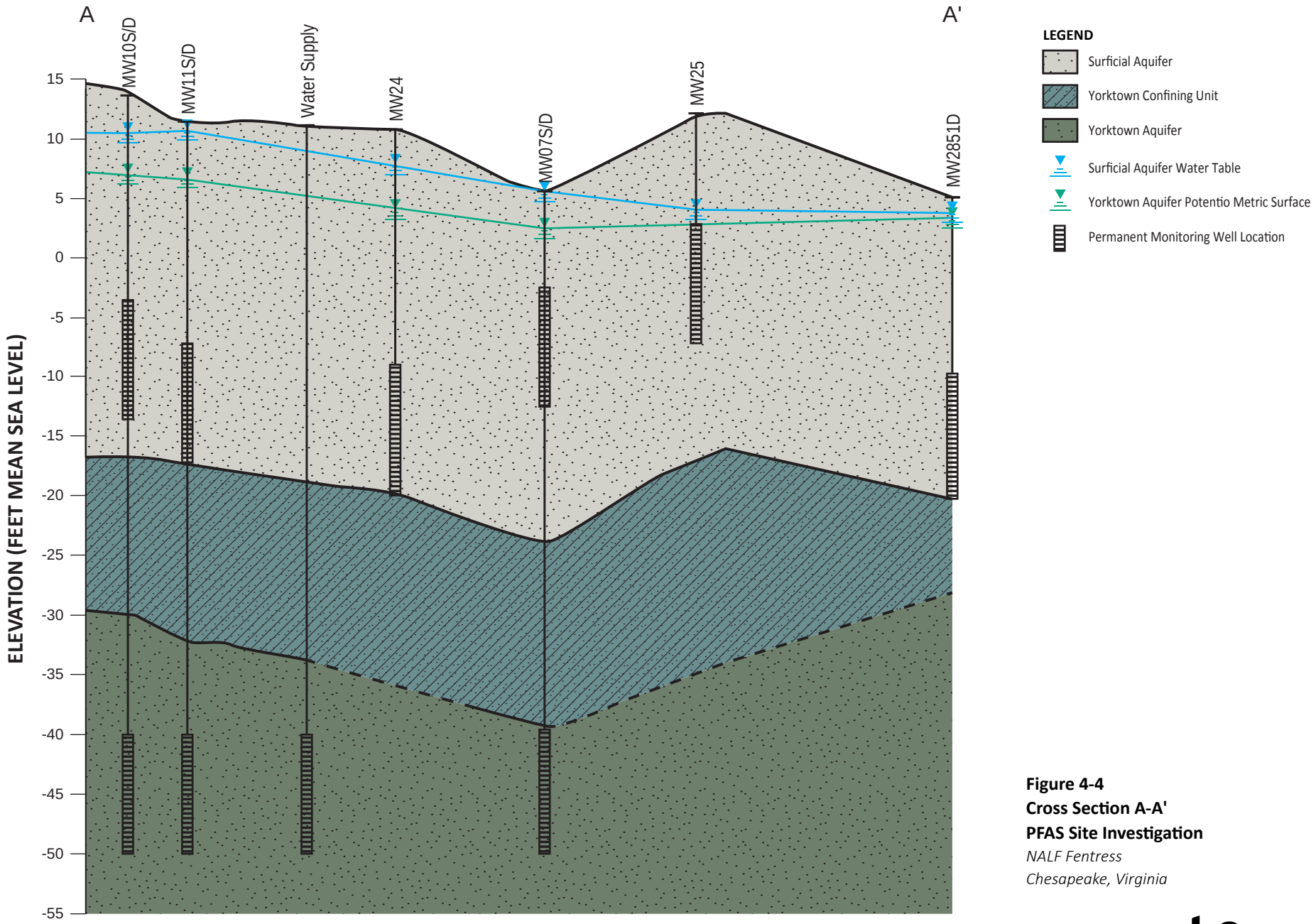


Figure 4-4
Cross Section A-A'
PFAS Site Investigation
NALF Fentress
Chesapeake, Virginia

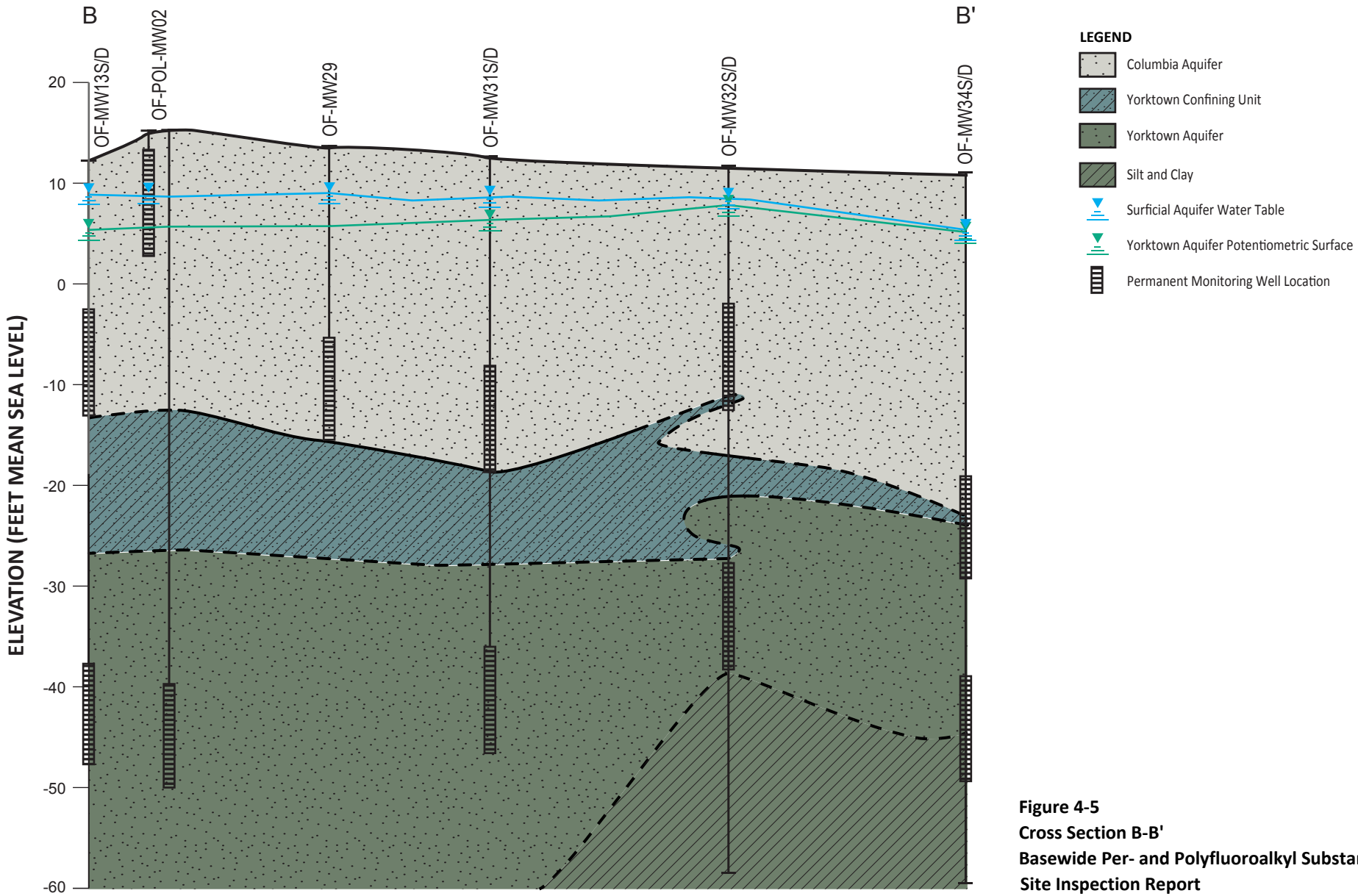


Figure 4-5
Cross Section B-B'
Basewide Per- and Polyfluoroalkyl Substances Site Inspection Report
NALF Fentress Chesapeake, Virginia

\\brooksidefiles\gis_share\ENBG\00_Proj\N\Navy\CLEAN\MIDLANT\NASOceana\MapFiles\Fentress\Basewide\674207_Misc\Figure 4-6 - GW Sampling Locations and Clay.mxd9/25/2018bmailhes

OF-SOW-091K
OF-SOW-091L
OF-SOW-091M
OF-SOW-091D
OF-SOW-091A
Water Supply Well - North
UST 20B
OFPOL-MW-6
OFPOL-MW-3
OFPOL-MW-7
OFPOL-MW-4
OFPOL-MW-2
OFPOL-MW-8
Water Supply Well - South
50,000 gallon water tank
NA
OF-MW22*
OF-MW22D*
OF14-MW06D
13
>/= 0.1
OF-MW20*
2
OF-MW21*
OF-MW19*
OF-MW19D*
OF14-MW06S
14.2
OF-MW17
OF-MW16
18
OF-MW12D
OF-MW12
OF-MW13
OF-MW13D
15
MOUNT PLEASANT RD
OF-MW28
9.5
OF-MW11
14.2
OF14-MW07S
17
OF-MW28D
OF-MW11D
OF14-MW07D
Site 17 Original
OF-MW24
OF-MW25
5
Site 14
BLACKWATER ROAD
18.5
OF-MW10
5
OF-MW14
3
OF-MW10D
50,000 gallon water tank
OF-MW27
3
22
OF-MW09D
OF-MW09
OF-MW15D
OF-MW08D
OF-MW29
OF-MW15
15
24
OF-MW08
2
20
10
15
20
FENTRESS AIRFIELD RD
OF-MW33*
OF-MW33D*
15.5
Site 17 Revised
OF-MW31
8
OF-MW30
15.5
OF-MW31D
OF-MW30D
OF-MW32D
OF-MW32
**
WHITTAMORE RD
LONG RIDGE RD
OF-MW34D
**
OF-MW34
FENTRESS AIRFIELD RD

Notes:
Orange label indicates well installed in the shallow Columbia/Surficial aquifer.
Purple label indicates well installed in the deep Yorktown aquifer.
White label and * indicate wells for which analytical data were collected after the time frame included in the report but are included for the purpose of completeness in mapping the confining unit.
** Boring was completed to a depth of 70 ft bgs and clay was present from 50-70 ft bgs. Because this depth interval is significantly deeper than the depth at which clay was encountered further north (typically 30 ft bgs), these wells were not included in the extent of contouring, as it is possible that the confining unit in these locations is pinched out and the unit encountered is the Chickahominy confining unit, which lies below the Yorktown aquifer in this portion of Virginia.
NA - Confining Unit Not Encountered

Legend

- Newly Installed Monitoring Well Location
- Existing Monitoring Well Lcoation
- UST 20B Well Location
- On-Base Water Supply Well Location
- Off-Base Monitoring Well Location
- State Water Control Board Well Location
- Site Boundary
- 50,000 gallon water tank
- Water Treatment Plant
- Fentress Boundary
- Confining Unit Thickness
- Estimated Boundary Between Confining Unit Soil Types

Confining Unit Soil Type

- Clay
- Sand/Clay Mixture
- Silt/Clay Mixture
- Silt/Sand/Clay Mixture

Figure 4-6
Groundwater Sampling Locations and Soil Types
Basewide Per- and Polyfluoroalkyl Substances Site Inspection Report
NALF Fentress, Chesapeake, Virgnia

N
0 1,000 2,000
Feet

Imagery Source: ©2017 Esri

ch2m

\\brooksidefiles\GIS_SHARE\ENBG\00_Proj\N\Navy\CLEAN\MIDLANT\NASOceana\MapFiles\Fentress\Basewide\647207_SI\Final_SI_Report\Figure 4-7 - PFAS Concentrations and GW Contours in Columbia Aquifer - Sept 2016.mxd10/4/2018AM038876

Station ID	OF-SOW-091D
Sample Date	3/8/17
PFOS	**1940**
PFOA	**740**
Total PFOS and PFOA	**2680**

Station ID	OFPOL-MW-4
Sample Date	6/17/16
PFOS	**31000**
PFOA	**1600**
Total PFOS and PFOA	**32600**

Station ID	OFPOL-MW-8
Sample Date	6/17/16
PFOS	**9020**
PFOA	**1280**
Total PFOS and PFOA	**10300**

Station ID	OF-MW13	
Sample Date	12/28/15	6/17/16
PFOS	**4300**	**4090**
PFOA	**880**	**657**
Total PFOS and PFOA	**5180**	**4747**

Station ID	OFPOL-MW-7
Sample Date	6/17/16
PFOS	**49300**
PFOA	**3600**
Total PFOS and PFOA	**52900**

Station ID	OF-SOW-091K
Sample Date	3/8/17
PFOS	9.98
PFOA	2.53
Total PFOS and PFOA	12.51

Station ID	OFPOL-MW-6
Sample Date	6/17/16
PFOS	**14800**
PFOA	**1460**
Total PFOS and PFOA	**16260**

Station ID	OF-MW24
Sample Date	7/11/16
PFOS	**3320**
PFOA	**309**
Total PFOS and PFOA	**3629**

OF-SOW-091L
03/08/17
ND

OF14-MW05
03/08/17
ND

Station ID	OF-SOW-091A
Sample Date	3/8/17
PFOS	4.18 U
PFOA	3.79 J
Total PFOS and PFOA	3.79 J

Station ID	OF-MW17	
Sample Date	12/22/15	6/21/16
PFOS	19	33.2
PFOA	17	29.8 J
Total PFOS and PFOA	36	63

Station ID	OF-SOW-091M
Sample Date	3/8/17
PFOS	**2350 J**
PFOA	**956**
Total PFOS and PFOA	**3306**

Station ID	OF-MW16	
Sample Date	12/22/15	6/20/16
PFOS	**74**	**108**
PFOA	6.8 J	7.12 J
Total PFOS and PFOA	**80.8**	**115.12**

Station ID	OFPOL-MW-3
Sample Date	6/17/16
PFOS	**18600**
PFOA	**5620**
Total PFOS and PFOA	**24220**

Station ID	OF14-MW06S	
Sample Date	12/21/15	6/20/16
PFOS	**170**	**245**
PFOA	**190**	**298**
Total PFOS and PFOA	**360**	**543**

Station ID	OFPOL-MW-2
Sample Date	6/17/16
PFOS	**12700**
PFOA	**1150**
Total PFOS and PFOA	**13850**

Station ID	OF14-MW07S	
Sample Date	12/21/15	6/20/16
PFOS	5.3	9.3
PFOA	**270**	**371**
Total PFOS and PFOA	**275.3**	**380.3**

OF-MW28
07/06/16
ND

Station ID	OF-MW12	
Sample Date	12/28/15	6/21/16
PFOS	**6300**	**4220**
PFOA	**72**	69.8
Total PFOS and PFOA	**6372**	**4289.8**

Station ID	OF-MW25
Sample Date	7/6/16
PFOS	6.1 J
PFOA	4.26 J
Total PFOS and PFOA	10.36

Station ID	OF-MW11	
Sample Date	12/28/15	6/17/16
PFOS	**3000**	**5320**
PFOA	**320**	**418**
Total PFOS and PFOA	**3320**	**5738**

Station ID	OF-MW10	
Sample Date	12/23/15	6/22/16
PFOS	**290**	**283**
PFOA	**140**	**151**
Total PFOS and PFOA	**430**	**434**

Station ID	OF-MW27
Sample Date	7/12/16
PFOS	4.2 U
PFOA	1.33 J
Total PFOS and PFOA	1.33

Station ID	OF-MW09	
Sample Date	12/28/15	6/22/16
PFOS	12	7.84
PFOA	1.5 J	1.09 J
Total PFOS and PFOA	13.5	8.93

Station ID	OF-MW14	
Sample Date	12/28/15	6/22/16
PFOS	2.7 U	3.97 J
PFOA	2 J	4.45 U
Total PFOS and PFOA	2	3.97

Station ID	OF17-MW04
Sample Date	6/1/17
PFOS	**44500 J**
PFOA	**3400**
Total PFOS and PFOA	**47900**

Station ID	OF-MW15	
Sample Date	12/23/15	6/20/16
PFOS	3 U	4.2 U
PFOA	**140**	**185**
Total PFOS and PFOA	**140**	**185**

Station ID	OF-MW08	
Sample Date	12/28/15	6/22/16
PFOS	**11000**	**11900**
PFOA	**320**	**514**
Total PFOS and PFOA	**11320**	**12414**

Station ID	OF17-MW01
Sample Date	6/1/17
PFOS	**14000**
PFOA	**1840**
Total PFOS and PFOA	**15840**

Station ID	OF17-MW03
Sample Date	5/31/17
PFOS	**10400**
PFOA	**2760**
Total PFOS and PFOA	**13160**

Station ID	OF17-MW02
Sample Date	5/31/17
PFOS	**8770**
PFOA	**816**
Total PFOS and PFOA	**9586**

Station ID	OF-MW29
Sample Date	7/14/16
PFOS	**2960**
PFOA	**832**
Total PFOS and PFOA	**3792**

	USEPA Lifetime Health Advisory
PFOS	70
PFOA	
Total PFOS + PFOA	

Station ID	OF-MW34
Sample Date	7/14/16
PFOS	6.15 J
PFOA	0.858 J
Total PFOS and PFOA	7.008

Station ID	OF-MW32
Sample Date	7/13/16
PFOS	3.94 U
PFOA	0.712 J
Total PFOS and PFOA	0.712 J

Station ID	OF-MW31
Sample Date	7/6/16
PFOS	1.6 J
PFOA	4.2 U
Total PFOS and PFOA	1.6

OF-MW30
7/13/16
ND

Site 17 Original

Site 17 Revised

Site 14

UST 20B

FENTRESS AIRFIELD RD

LONG RIDGE RD

BLACKWATER ROAD

Legend

- Newly Installed Monitoring Well Location
- Existing Monitoring Well Location
- UST 20B Well Location
- State Water Control Board Well Location
- Site Boundary
- Fentress Boundary
- Groundwater Potentiometric Surface
- Inferred Groundwater Potentiometric Surface
- Columbia/Surficial Groundwater Flow Direction

N

0 1,000 2,000 Feet

Imagery Source: ©2017 Esri

Figure 4-7

PFAS Concentrations and Groundwater Contours Measured in the Columbia/Surficial Aquifer- September 2016
Basewide Per- and Polyfluoroalkyl Substances Site Inspection Report
NALF Fentress, Chesapeake, Virginia

Notes:
All units are ng/l - nanograms per liter
Bolded text indicates exceedance of the USEPA Lifetime Health Advisory
ND - Not Detected
B - Analyte not detected above the level reported in blanks
J - Analyte present, value may or may not be accurate or precise
J- - Analyte present, value may be biased low, value may be higher
U - The material was analyzed for, but not detected

ch2m:

\\brooksidefiles\GIS_SHARE\ENBG\00_Proj\N\Navy\CLEAN\MIDLANT\NASOceana\MapFiles\Fentress\Basewide\647207_SI\Final_SI_Report\Figure 4-8 - PFAS Concentrations and GW Contours Columbia Aquifer May 2017.mxd10/4/2018AM038876

Station ID	OF-SOW-091D
Sample Date	3/8/17
PFOS	**1940**
PFOA	**740**
Total PFOS and PFOA	**2680**

Station ID	OFPOL-MW-4
Sample Date	6/17/16
PFOS	**31000**
PFOA	**1600**
Total PFOS and PFOA	**32600**

Station ID	OFPOL-MW-8
Sample Date	6/17/16
PFOS	**9020**
PFOA	**1280**
Total PFOS and PFOA	**10300**

Station ID	OF-MW13	
Sample Date	12/28/15	6/17/16
PFOS	**4300**	**4090**
PFOA	**880**	**657**
Total PFOS and PFOA	**5180**	**4747**

Station ID	OFPOL-MW-7
Sample Date	6/17/16
PFOS	**49300**
PFOA	**3600**
Total PFOS and PFOA	**52900**

Station ID	OF-SOW-091K
Sample Date	3/8/17
PFOS	9.98
PFOA	2.53
Total PFOS and PFOA	12.51

Station ID	OFPOL-MW-6
Sample Date	6/17/16
PFOS	**14800**
PFOA	**1460**
Total PFOS and PFOA	**16260**

Station ID	OF-MW24
Sample Date	7/11/16
PFOS	**3320**
PFOA	**309**
Total PFOS and PFOA	**3629**

OF-SOW-091L
03/08/17
ND

OF14-MW05
03/08/17
ND

Station ID	OF-SOW-091A
Sample Date	3/8/17
PFOS	4.18 U
PFOA	3.79 J
Total PFOS and PFOA	3.79 J

Station ID	OF-MW17	
Sample Date	12/22/15	6/21/16
PFOS	19	33.2
PFOA	17	29.8 J
Total PFOS and PFOA	36	63

Station ID	OF-SOW-091M
Sample Date	3/8/17
PFOS	**2350 J**
PFOA	**956**
Total PFOS and PFOA	**3306**

Station ID	OF-MW16	
Sample Date	12/22/15	6/20/16
PFOS	**74**	**108**
PFOA	6.8 J	7.12 J
Total PFOS and PFOA	**80.8**	**115.12**

Station ID	OFPOL-MW-3
Sample Date	6/17/16
PFOS	**18600**
PFOA	**5620**
Total PFOS and PFOA	**24220**

Station ID	OF14-MW06S	
Sample Date	12/21/15	6/20/16
PFOS	**170**	**245**
PFOA	**190**	**298**
Total PFOS and PFOA	**360**	**543**

Station ID	OFPOL-MW-2
Sample Date	6/17/16
PFOS	**12700**
PFOA	**1150**
Total PFOS and PFOA	**13850**

Station ID	OF14-MW07S	
Sample Date	12/21/15	6/20/16
PFOS	5.3	9.3
PFOA	**270**	**371**
Total PFOS and PFOA	**275.3**	**380.3**

OF-MW28
07/06/16
ND

Station ID	OF-MW12	
Sample Date	12/28/15	6/21/16
PFOS	**6300**	**4220**
PFOA	**72**	69.8
Total PFOS and PFOA	**6372**	**4289.8**

Station ID	OF-MW25
Sample Date	7/6/16
PFOS	6.1 J
PFOA	4.26 J
Total PFOS and PFOA	10.36

Station ID	OF-MW11	
Sample Date	12/28/15	6/17/16
PFOS	**3000**	**5320**
PFOA	**320**	**418**
Total PFOS and PFOA	**3320**	**5738**

Station ID	OF-MW27
Sample Date	7/12/16
PFOS	4.2 U
PFOA	1.33 J
Total PFOS and PFOA	1.33

Station ID	OF-MW10	
Sample Date	12/23/15	6/22/16
PFOS	**290**	**283**
PFOA	**140**	**151**
Total PFOS and PFOA	**430**	**434**

Station ID	OF-MW09	
Sample Date	12/28/15	6/22/16
PFOS	12	7.84
PFOA	1.5 J	1.09 J
Total PFOS and PFOA	13.5	8.93

Station ID	OF-MW14	
Sample Date	12/28/15	6/22/16
PFOS	2.7 U	3.97 J
PFOA	2 J	4.45 U
Total PFOS and PFOA	2	3.97

Station ID	OF17-MW04
Sample Date	6/1/17
PFOS	**44500 J**
PFOA	**3400**
Total PFOS and PFOA	**47900**

Station ID	OF-MW15	
Sample Date	12/23/15	6/20/16
PFOS	3 U	4.2 U
PFOA	**140**	**185**
Total PFOS and PFOA	**140**	**185**

Station ID	OF-MW08	
Sample Date	12/28/15	6/22/16
PFOS	**11000**	**11900**
PFOA	**320**	**514**
Total PFOS and PFOA	**11320**	**12414**

Station ID	OF17-MW01
Sample Date	6/1/17
PFOS	**14000**
PFOA	**1840**
Total PFOS and PFOA	**15840**

Station ID	OF17-MW03
Sample Date	5/31/17
PFOS	**10400**
PFOA	**2760**
Total PFOS and PFOA	**13160**

Station ID	OF17-MW02
Sample Date	5/31/17
PFOS	**8770**
PFOA	**816**
Total PFOS and PFOA	**9586**

Station ID	OF-MW29
Sample Date	7/14/16
PFOS	**2960**
PFOA	**832**
Total PFOS and PFOA	**3792**

	USEPA Lifetime Health Advisory
PFOS	70
PFOA	
Total PFOS + PFOA	

Station ID	OF-MW34
Sample Date	7/14/16
PFOS	6.15 J
PFOA	0.858 J
Total PFOS and PFOA	7.008

Station ID	OF-MW32
Sample Date	7/13/16
PFOS	3.94 U
PFOA	0.712 J
Total PFOS and PFOA	0.712 J

OF-MW30
7/13/16
ND

Station ID	OF-MW31
Sample Date	7/6/16
PFOS	1.6 J
PFOA	4.2 U
Total PFOS and PFOA	1.6

Site 17 Original

Site 17 Revised

Site 14

UST 20B

10'
7'
8'
7'
6'
5'
4'
2'
10'
7'
8'
7'
6'
5'
4'

FENTRESS AIRFIELD RD

LONG RIDGE RD

FENTRESS AIRFIELD RD

BLACKWATER ROAD

Legend

- Newly Installed Monitoring Well Location
- Existing Monitoring Well Location
- UST 20B Well Location
- State Water Control Board Well Location
- Site Boundary
- Fentress Boundary
- Groundwater Potentiometric Surface
- Inferred Groundwater Potentiometric Surface
- Columbia/Surficial Groundwater Flow Direction

N

0 1,000 2,000 Feet

Imagery Source: ©2017 Esri

Figure 4-8

PFAS Concentrations and Groundwater Contours Measured in the Columbia/Surficial Aquifer- May 2017
Basewide Per- and Polyfluoroalkyl Substances Site Inspection Report
NALF Fentress, Chesapeake, Virginia

Notes:
All units are ng/l - nanograms per liter
Bolded text indicates exceedance of the USEPA Lifetime Health Advisory
ND - Not Detected
B - Analyte not detected above the level reported in blanks
J - Analyte present, value may or may not be accurate or precise
J- - Analyte present, value may be biased low, value may be higher
U - The material was analyzed for, but not detected

ch2m

\\brooksidefiles\GIS_SHARE\ENBG\00_Proj\N\Navy\CLEAN\MIDLANT\NASOceana\MapFiles\Fentress\Basewide\647207_SI\Draft_SI_Report\Figure 4-9 - PFAS Concentrations and GW Contours Yorktown Aquifer DEEP Sept 2016.mxd10/4/2018AM038876

Station ID	OF-INF01		
Sample Date	12/30/15	05/10/16	5/19/2016*
PFOS	**540**	**1800**	**2300**
PFOA	**300**	**5300**	**5900**
Total PFOS and PFOA	**840**	**7100**	**8200**

Station ID	OF-MW12D	
Sample Date	12/30/15	6/21/16
PFOS	11	55.1
PFOA	7.9	2.77 J
Total PFOS and PFOA	18.9	57.87

Station ID	OF-MW11D	
Sample Date	01/12/16	6/21/16
PFOS	28	7.45 J
PFOA	1.7 J	0.839 J
Total PFOS and PFOA	29.7	8.289

Station ID	OF-MW10D	
Sample Date	01/11/16	6/22/16
PFOS	4.1	4.73 J
PFOA	2 U	4 U
Total PFOS and PFOA	4.1	4.73

Station ID	OF-MW09D	
Sample Date	12/28/15	6/22/16
PFOS	9.6	5.49 J
PFOA	1.6 J	3.88 U
Total PFOS and PFOA	11.2	5.49

Station ID	OF-MW08D
Sample Date	7/14/16
PFOS	**6880**
PFOA	61.1
Total PFOS and PFOA	**6941.1**

Station ID	OF-MW30D
Sample Date	7/13/16
PFOS	2.08 J
PFOA	2.65 J
Total PFOS and PFOA	4.73

Station ID	OF-MW32D
Sample Date	04/14/17
PFOS	2.1 J
PFOA	2.05 U
Total PFOS and PFOA	2.1 J

Station ID	OF-MW34D
Sample Date	4/14/17
No Detections	

Station ID	OF-MW13D	
Sample Date	01/11/16	6/21/16
PFOS	6.8	4.44
PFOA	6	4.5
Total PFOS and PFOA	12.8	8.94

Station ID	OF14-MW06D	
Sample Date	12/22/15	6/20/16
PFOS	3 U	4.07 U
PFOA	2 U	0.779 J
Total PFOS and PFOA	ND	0.779

Station ID	OF14-MW07D	
Sample Date	12/22/15	06/20/16
PFOS	3 U	3.94 U
PFOA	1.9 J	3.94 U
Total PFOS and PFOA	1.9	ND

Station ID	OF-MW28D
Sample Date	7/13/16
PFOS	6.9 J
PFOA	2.13 J
Total PFOS and PFOA	9.03

Station ID	OF-MW15D	
Sample Date	01/11/16	6/20/16
PFOS	6.6	2.19 J
PFOA	7.5	1.62 J
Total PFOS and PFOA	14.1	3.81

Station ID	OF-MW31D
Sample Date	7/14/16
PFOS	56.3
PFOA	4.54 J
Total PFOS and PFOA	60.84

Water Supply Well - North

Water Supply Well - South

UST 20B

Site 17 Original

Site 17 Revised

Site 14

MOUNT PLEASANT RD

BLACKWATER ROAD

FENTRESS AIRFIELD RD

LONG RIDGE RD

5.0

4.0

3.0

Notes:
All units are ng/l - nanograms per liter
Bolded text indicates exceedance of the USEPA Lifetime Health Advisory
ND - Not Detected
B - Analyte not detected above the level reported in blanks
J - Analyte present, value may or may not be accurate or precise
U - The material was analyzed for, but not detected
* Analysis of total oxidizable precursor PFCs

	USEPA Lifetime Health Advisory
PFOS	70
PFOA	
Total PFOS and PFOA	

Legend

- Newly Installed Monitoring Well Location
- Existing Monitoring Well Location
- On-Base Water Supply Well Location
- Water Treatment Plant
- Site Boundary
- Groundwater Potentiometric Surface
- Inferred Groundwater Potentiometric Surface
- Groundwater Flow Direction
- Fentress Boundary

N

0 1,000 2,000

Feet

Imagery Source: ©2017 Esri

Figure 4-9
PFAS Concentrations and Groundwater Contours
Measured in the Yorktown Aquifer- September 2016
Basewide Per- and Polyfluoroalkyl Substances Site Inspection Report
NALF Fentress, Chesapeake, Virginia

ch2m

\\brooksidefiles\GIS_SHARE\ENBG\00_Proj\N\Navy\CLEAN\MIDLANT\NASOceana\MapFiles\Fentress\Basewide\647207_SI\Draft_SI_Report\Figure 4-10 - PFAS Concentrations and GW Contours Yorktown Aquifer DEEP - May 2017.mxd10/4/2018AM038876

Station ID	OF-INF01		
Sample Date	12/30/15	05/10/16	5/19/2016*
PFOS	**540**	**1800**	**2300**
PFOA	**300**	**5300**	**5900**
Total PFOS and PFOA	**840**	**7100**	**8200**

Station ID	OF-MW12D	
Sample Date	12/30/15	6/21/16
PFOS	11	55.1
PFOA	7.9	2.77 J
Total PFOS and PFOA	18.9	57.87

Station ID	OF-MW11D	
Sample Date	01/12/16	6/21/16
PFOS	28	7.45 J
PFOA	1.7 J	0.839 J
Total PFOS and PFOA	29.7	8.289

Station ID	OF-MW10D	
Sample Date	01/11/16	6/22/16
PFOS	4.1	4.73 J
PFOA	2 U	4 U
Total PFOS and PFOA	4.1	4.73

Station ID	OF-MW09D	
Sample Date	12/28/15	6/22/16
PFOS	9.6	5.49 J
PFOA	1.6 J	3.88 U
Total PFOS and PFOA	11.2	5.49

Station ID	OF-MW08D
Sample Date	7/14/16
PFOS	**6880**
PFOA	61.1
Total PFOS and PFOA	**6941.1**

Station ID	OF-MW30D
Sample Date	7/13/16
PFOS	2.08 J
PFOA	2.65 J
Total PFOS and PFOA	4.73

Station ID	OF-MW32D
Sample Date	04/14/17
PFOS	2.1 J
PFOA	2.05 U
Total PFOS and PFOA	2.1 J

Station ID	OF-MW34D
Sample Date	4/14/17
No Detections	

Station ID	OF-MW13D	
Sample Date	01/11/16	6/21/16
PFOS	6.8	4.44
PFOA	6	4.5
Total PFOS and PFOA	12.8	8.94

Station ID	OF14-MW06D	
Sample Date	12/22/15	6/20/16
PFOS	3 U	4.07 U
PFOA	2 U	0.779 J
Total PFOS and PFOA	ND	0.779

Station ID	OF14-MW07D	
Sample Date	12/22/15	06/20/16
PFOS	3 U	3.94 U
PFOA	1.9 J	3.94 U
Total PFOS and PFOA	1.9	ND

Station ID	OF-MW28D
Sample Date	7/13/16
PFOS	6.9 J
PFOA	2.13 J
Total PFOS and PFOA	9.03

Station ID	OF-MW15D	
Sample Date	01/11/16	6/20/16
PFOS	6.6	2.19 J
PFOA	7.5	1.62 J
Total PFOS and PFOA	14.1	3.81

Station ID	OF-MW31D
Sample Date	7/14/16
PFOS	56.3
PFOA	4.54 J
Total PFOS and PFOA	60.84

Water Supply Well - North

Water Supply Well - South

UST 20B

Site 17 Original

Site 17 Revised

Site 14

MOUNT PLEASANT RD

BLACKWATER ROAD

FENTRESS AIRFIELD RD

LONG RIDGE RD

3.0

4.0

5.0

6.0

7.0

Notes:
All units are ng/l - nanograms per liter
Bolded text indicates exceedance of the USEPA Lifetime Health Advisory
ND - Not Detected
B - Analyte not detected above the level reported in blanks
J - Analyte present, value may or may not be accurate or precise
U - The material was analyzed for, but not detected
* Analysis of total oxidizable precursor PFCs

	USEPA Lifetime Health Advisory
PFOS	70
PFOA	
Total PFOS and PFOA	

Legend
- Newly Installed Monitoring Well Location
- Existing Monitoring Well Location
- On-Base Water Supply Well Location
- Water Treatment Plant
- Site Boundary
- Groundwater Potentiometric Surface
- Inferred Groundwater Potentiometric Surface
- Groundwater Flow Direction
- Fentress Boundary

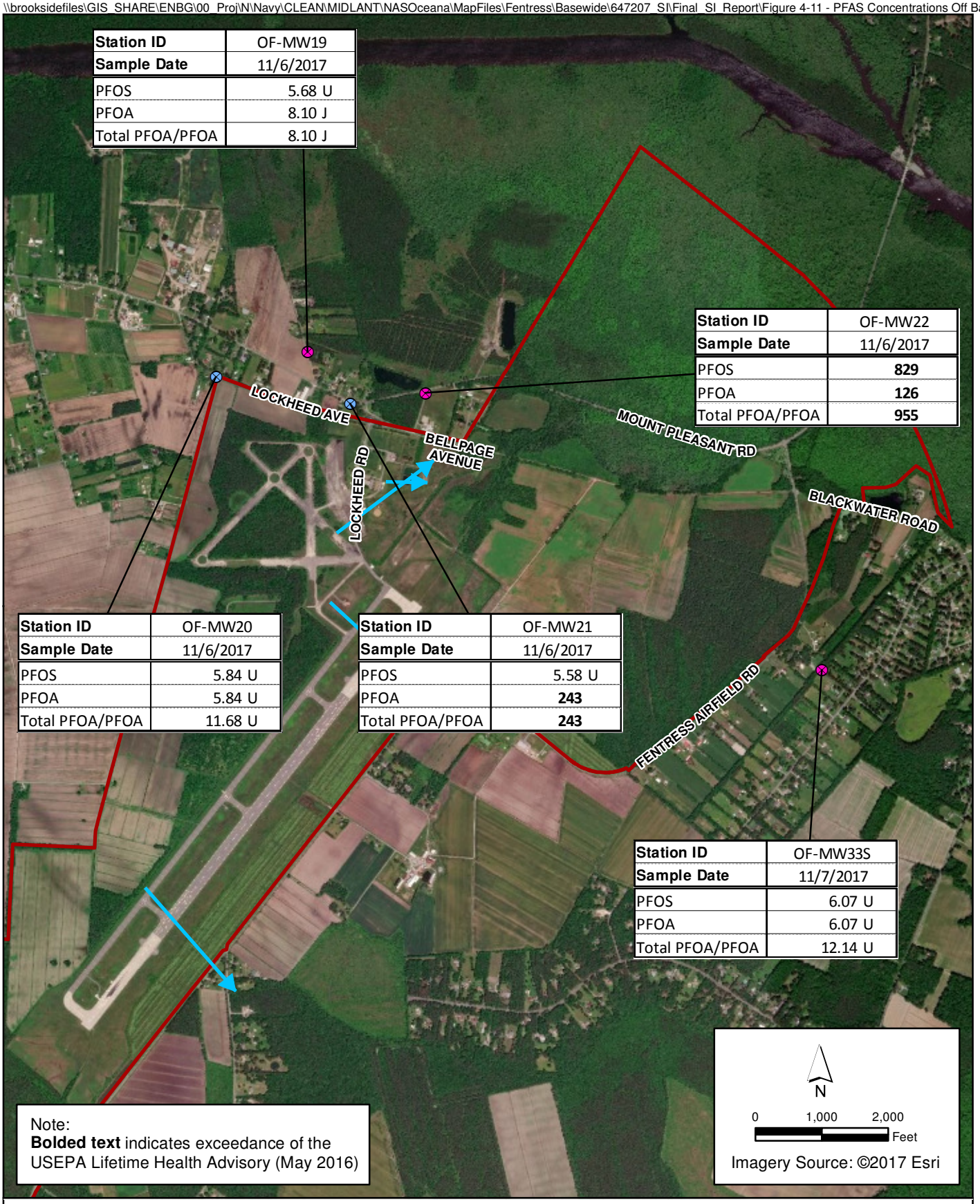
N

0 1,000 2,000 Feet

Imagery Source: ©2017 Esri

Figure 4-10
PFAS Concentrations and Groundwater Contours
Measured in the Yorktown Aquifer- May 2017
Basewide Per- and Polyfluoroalkyl Substances Site Inspection Report
NALF Fentress, Chesapeake, Virginia

ch2m



Legend

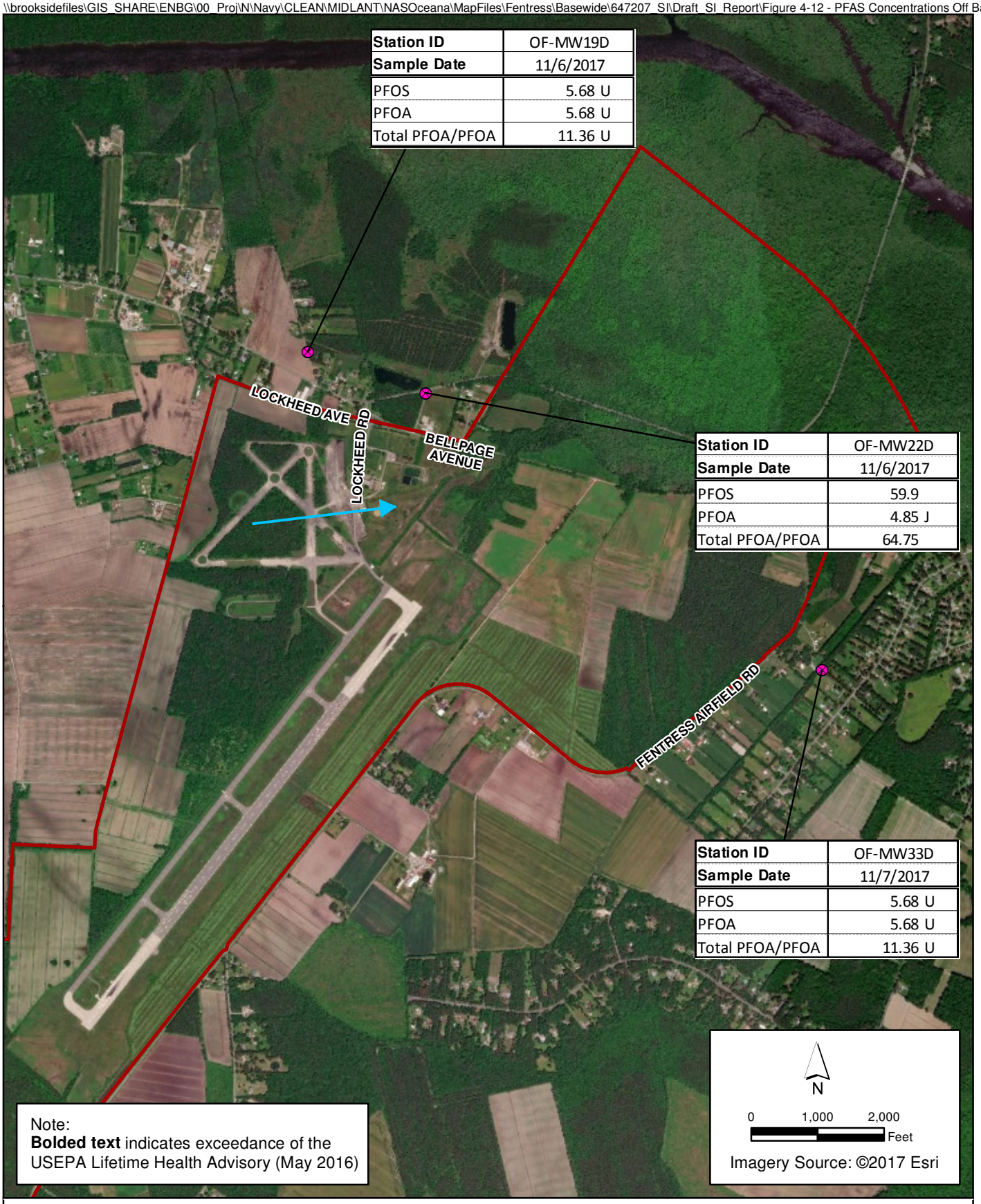
- Fentress Boundary

Monitoring Wells

- Shallow Only
- Shallow/Deep
- Columbia/Surficial Groundwater Flow Direction (May 2017)

Figure 4-11
Off-Base PFAS Concentrations in the Columbia/Surficial Aquifer- November 2017
Basewide Per- and Polyfluoroalkyl Substances Site Inspection Report
NALF Fentress, Chesapeake, Virginia

ch2m.



Legend

- Fentress Boundary

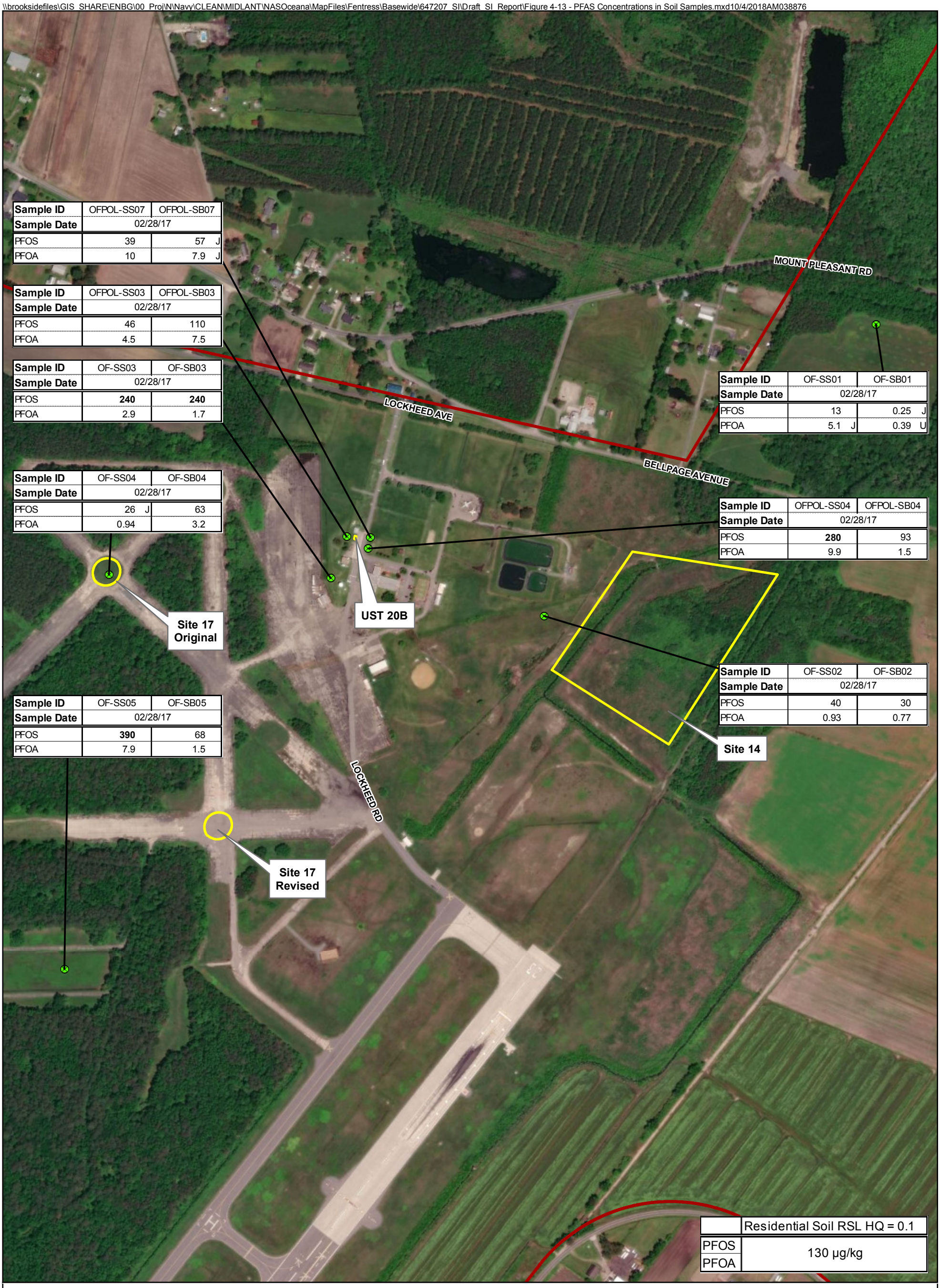
Monitoring Wells

- Shallow/Deep
- Yorktown Groundwater Flow Direction (May 2017)

Figure 4-12
Off-Base PFAS Concentrations in the Yorktown Aquifer- November 2017
Basewide Per- and Polyfluoroalkyl Substances Site Inspection Report
NALF Fentress, Chesapeake, Virginia

ch2m.

\\brooksidefiles\GIS_SHARE\ENBG\00_Proj\N\Navy\CLEAN\MIDLANT\NASOceana\MapFiles\Fentress\Basewide\647207_SI\Draft_SI_Report\Figure 4-13 - PFAS Concentrations in Soil Samples.mxd10/4/2018AM038876



Sample ID	OFPOL-SS07	OFPOL-SB07
Sample Date	02/28/17	
PFOS	39	57 J
PFOA	10	7.9 J

Sample ID	OFPOL-SS03	OFPOL-SB03
Sample Date	02/28/17	
PFOS	46	110
PFOA	4.5	7.5

Sample ID	OF-SS03	OF-SB03
Sample Date	02/28/17	
PFOS	**240**	**240**
PFOA	2.9	1.7

Sample ID	OF-SS01	OF-SB01
Sample Date	02/28/17	
PFOS	13	0.25 J
PFOA	5.1 J	0.39 U

Sample ID	OF-SS04	OF-SB04
Sample Date	02/28/17	
PFOS	26 J	63
PFOA	0.94	3.2

Sample ID	OFPOL-SS04	OFPOL-SB04
Sample Date	02/28/17	
PFOS	**280**	93
PFOA	9.9	1.5

Sample ID	OF-SS02	OF-SB02
Sample Date	02/28/17	
PFOS	40	30
PFOA	0.93	0.77

Sample ID	OF-SS05	OF-SB05
Sample Date	02/28/17	
PFOS	**390**	68
PFOA	7.9	1.5

	Residential Soil RSL HQ = 0.1
PFOS	130 µg/kg
PFOA	

Legend
- Soil Sample Location
- Site Boundary
- Fentress Boundary

N

0 225 450 Feet

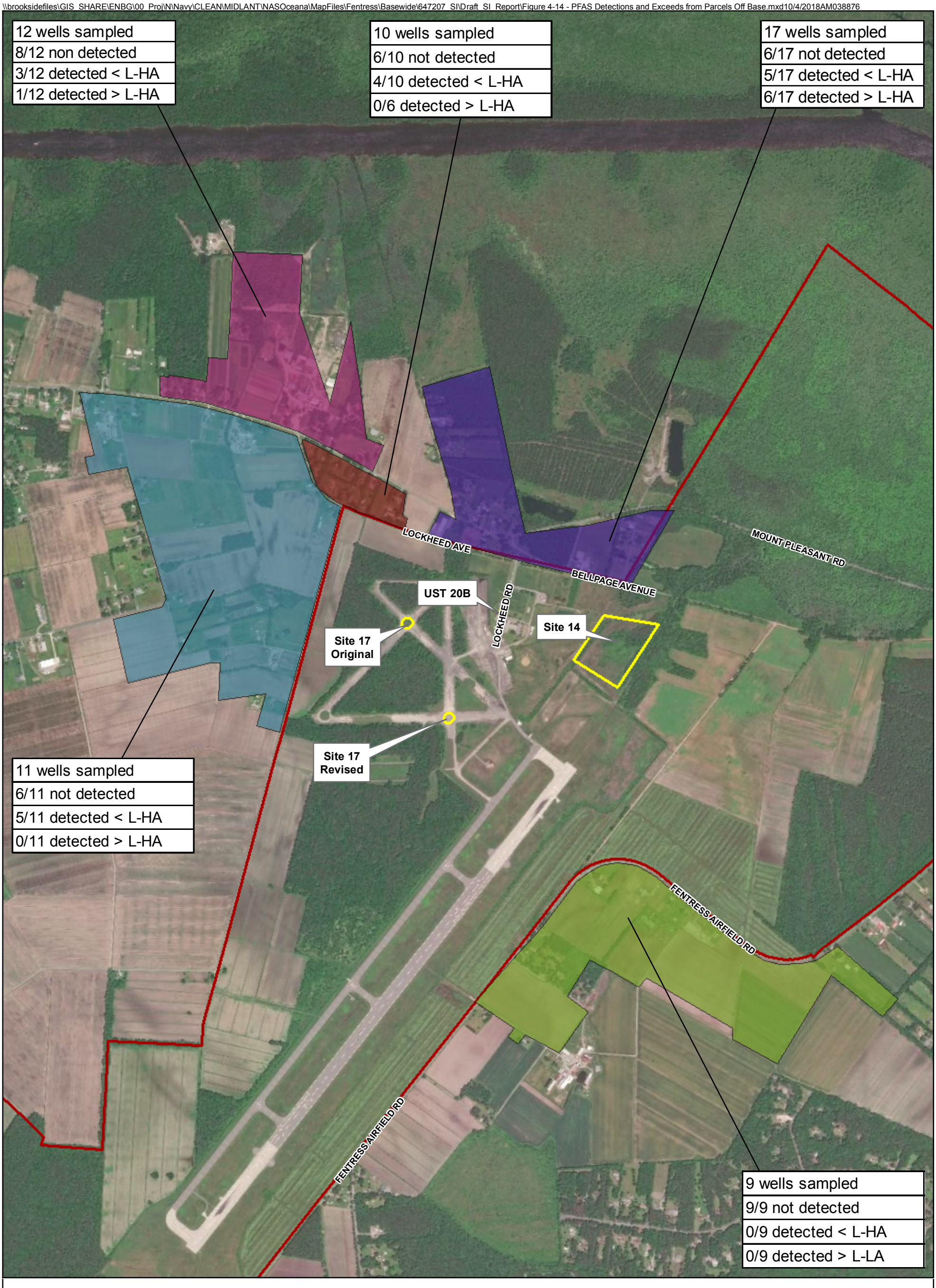
Imagery Source: ©2017 Esri

Figure 4-13
PFAS Concentrations in Soil Samples
Basewide Per- and Polyfluoroalkyl Substances Site Inspection Report
NALF Fentress, Chesapeake, Virginia

Notes:
All units are µg/kg - micrograms per kilogram
Bolded text indicates exceedance of Residential Soil RSLs HQ = 0.1
B - Analyte not detected above the level reported in blanks
J - Analyte present, value may or may not be accurate or precise
U - The material was analyzed for, but not detected

ch2m

\\brooksidefiles\GIS_SHARE\ENBG\00_Proj\N\Navy\CLEAN\MIDLANT\NASOceana\MapFiles\Fentress\Basewide\647207_SI\Draft_SI_Report\Figure 4-14 - PFAS Detections and Exceeds from Parcels Off Base.mxd10/4/2018AM038876



Legend
- Site Boundary
- Fentress Boundary

N

0 600 1,200 Feet

Imagery Source: ©2017 Esri

Figure 4-14
PFAS Detections and Exceedances from Parcels Located Off-Base
Basewide Per- and Polyfluoroalkyl Substances Site inspection Report
NALF Fentress, Chesapeake, Virginia

ch2m.

SECTION 5

Human Health Risk Screening

A human health risk screening (HHRS) evaluation was performed to assess potential human health risks associated with exposure to PFAS in groundwater and soil at NALF Fentress. The results of the HHRS provide a preliminary indication of potential risks from exposure to PFAS in groundwater and soil and are used to help evaluate whether future unrestricted use of the site is acceptable (i.e., residential, including potable use of groundwater), or if the site requires further evaluation. Human health risk-based levels based on potable use of groundwater and residential exposure to soil were used for the screening evaluation.

5.1 Data Evaluation

The groundwater samples collected at each of the potential PFAS source areas at NALF Fentress were assessed separately in the HHRS. The off-Base residential water supplies were evaluated together as one exposure area. Groundwater samples collected from Columbia/Surficial aquifer and Yorktown aquifer wells were evaluated separately. The following areas were evaluated in the HHRS:

- Crash Truck Test Area (Columbia/Surficial and Yorktown aquifer)
- Perimeter Wells North (Columbia/Surficial and Yorktown aquifer)
- Perimeter Wells South (Columbia/Surficial and Yorktown aquifer)
- Perimeter Wells East (Columbia/Surficial and Yorktown aquifer)
- Perimeter Wells West (Columbia/Surficial and Yorktown aquifer)
- UST 20B Site (Columbia/Surficial aquifer)
- Site 14 (Columbia/Surficial and Yorktown aquifer)
- Site 17 Original Columbia/Surficial and Yorktown aquifer)
- Site 17 Revised (Columbia/Surficial aquifer)
- New Irrigation Sprayfield (Columbia/Surficial aquifer)
- Old Irrigation Sprayfield (Columbia/Surficial aquifer)
- Off-Base Non-Potable Groundwater (Columbia/Surficial and Yorktown aquifer)
- Off-Base Residential Drinking Water
- On-Base Potable Water
- On-Base Soil

The groundwater evaluated as part of the HHRA are presented in **Figure 5-1**. All of the soil samples collected at the site were evaluated together as one exposure area (**Figure 4-13**). The PFAS data evaluated in the HHRS were validated. Validation of the data identified the following criteria for data usability:

- Estimated values flagged with a J qualifier were treated as unqualified detected concentrations.
- Values flagged with a B qualifier (indicating blank contamination) were considered non-detected values.
- Values flagged with a U qualifier indicate an analyte was not detected.

The maximum concentration between a primary and a duplicate sample was used as the sample concentration. If the analyte was only detected in one of the samples, the detected concentration was used as the sample concentration.

5.2 Human Health Risk Screening Methodology

The HHRS was conducted in two steps using the risk ratio technique described in *Overview of Screening, Risk Ratio, and Toxicological Evaluation. Procedures for Northern Division Human Health Risk Assessments* (Navy, 2000).

Step 1

The maximum detected PFAS concentrations in groundwater within each area were compared to the USEPA tap water RSLs from the current RSL table (USEPA, 2017) and the maximum detected PFAS concentrations in soil were compared to the USEPA resident soil RSL (USEPA, 2017). RSLs based on noncarcinogenic effects were based on an HQ of 0.1 to account for exposure to multiple constituents with the same target organ/target effect. RSLs based on carcinogenic endpoints were based on a carcinogenic risk of 1×10^{-6}. The tap water and resident soil RSLs for PFOA and PFOS were calculated using the USEPA Risk Screening Level Calculator (USEPA, 2017) since they are not included in the most recent RSL table (USEPA, 2017). RSL values are included in HHRS screening tables for PFBS, PFOA, and PFOS, the only PFAS with available toxicity values. As discussed in previous sections of the SI report, three additional PFAS (PFNA, PFHxS, PFHpA) were also analyzed for in the groundwater samples, however, as there are no current screening values or toxicity values for these PFAS they are not compared to human health risk-based concentrations. They were analyzed for comparison to screening levels that may be developed in the future.

If the maximum detected concentration exceeded the RSL, the constituent was identified as a Step 1 chemical of potential concern (COPC) and carried forward to Step 2. In addition to comparing the maximum detected concentration of PFOA and PFOS to the RSL, if the sum of the PFOA and PFOS concentrations exceeded the RSL, they were both identified as COPCs. This was done following the PFOA and PFOS drinking water health advisories (USEPA, 2016a, 2016b, 2016c) which indicate that the combined concentration of PFOA and PFOS should be compared to the health advisory.

The drinking water health advisories for PFOA and PFOS are also included on the Step 1 groundwater screening tables. The toxicity values presented in the PFOA and PFOS health advisories are those used in the RSL calculator to calculate the tap water RSL for PFOA and PFOS. Drinking water health advisories provide information on pollutants that can affect drinking water quality, but that are not regulated under the Safe Drinking Water Act. The health advisory levels are developed to provide a margin of protection against adverse health effects to the most sensitive population (fetuses during pregnancy and breastfed infants). The health advisory levels for PFOA and PFOS are calculated based on drinking water intake of lactating women and are based on exposure from drinking water ingestion only, and do not consider exposure from dermal contact or inhalation. The health advisory also factors in other sources of exposure (for example, food and soil). The toxicity values presented in the health advisories are those used in the RSL calculator to calculate the drinking water RSL for PFOA and PFOS. The difference between the tap water RSL values and the health advisory values for PFOA and PFOS are due to the different exposure assumptions used to calculate each, and the incorporation of the relative source contribution factor used in the calculation of the health advisory.

Step 2

A risk level was calculated for the constituents identified as COPCs in Step 1 following the approach discussed in *Overview of Screening, Risk Ratio, and Toxicological Evaluation. Procedures for Northern Division Human Health Risk Assessments* (Navy, 2000):

For carcinogenic chemicals identified as COPCs in Step 1, carcinogenic risk was calculated using the following equation:

$$\textit{Carcinogenic risk} = \frac{\textit{MDC x acceptable risk level}}{\textit{RSL}}$$

Where:

MDC = Maximum detected concentration (ng/L)
acceptable risk level = $1x10^{-6}$ (unitless)
RSL = USEPA Regional Screening Level based on carcinogenic risk of $1x10^{-6}$ (ng/L)

For non-carcinogenic chemicals identified as COPCs in Step 1, a hazard index (HI) was calculated using the following equation:

$$HI = \frac{MDC \times acceptable\ HI}{RSL}$$

Where:

MDC = Maximum detected concentration (ng/L)
acceptable HI = 1 (unitless)
RSL = USEPA Regional Screening Level based on HI of 1 (ng/L)

Both carcinogenic risk and non-carcinogenic HI were calculated for COPCs that act through carcinogenic and non-carcinogenic effects. The carcinogenic risks for each chemical within an area were summed to calculate the cumulative carcinogenic risk and the HIs for each area were summed to calculate the cumulative HI. A cumulative HI was also calculated for each target organ/effect. If the cumulative HI for a target organ/effect was greater than 0.5, or the cumulative carcinogenic risk was greater than 5×10^{-5} (the target hazard and risk levels presented in the Navy risk ratio guidance document [Navy, 2000]), the chemicals contributing to these values were identified as COPCs.

5.3 Human Health Risk Screening Results

The human health risk screening results for each area and media evaluated in the HHRS are presented in this section.

5.3.1 Crash Truck Test Area

Both Columbia/Surficial aquifer and Yorktown aquifer groundwater samples were collected at the Crash Truck Test Area (**Figure 5-1**).

Tables 5-1 and **5-1a** present the HHRS for Columbia/Surficial aquifer groundwater. The maximum detected concentration of PFOA and PFOS exceed the RSL, and therefore, PFOA and PFOS were evaluated in Step 2. Based on Step 2, PFOA and PFOS were identified as COPCs.

Tables 5-2 and **5-2a** present the HHRS for the Yorktown aquifer groundwater. The maximum detected concentration of PFOA and PFOS exceed the RSL, and therefore, PFOA and PFOS were evaluated in Step 2. Based on Step 2, PFOA and PFOS were identified as COPCs.

Potable use of groundwater from the Columbia/Surficial aquifer and Yorktown aquifer at the Crash Truck Test Area may result in potential unacceptable human health risks associated with PFOA and PFOS.

5.3.2 Perimeter Wells North

Both Columbia/Surficial aquifer and Yorktown aquifer groundwater samples were collected at the North Perimeter Wells (**Figure 5-1**).

Tables 5-3 and **5-3a** present the HHRS for the Columbia/Surficial aquifer groundwater. The maximum detected concentrations of PFOA and PFOS exceed the RSL, and therefore, PFOA and PFOS were evaluated in Step 2. Based on Step 2, PFOA and PFOS were identified as COPCs.

Table 5-4 presents the HHRS for Yorktown aquifer groundwater. The maximum detected concentrations of the PFAS are below the RSLs.

Potable use of groundwater from the Columbia/Surficial aquifer at the North Perimeter Wells may result in potential unacceptable human health risks associated with PFOA and PFOS. Potable use of the groundwater from the Yorktown aquifer at the North Perimeter Wells would not result in unacceptable human health risks associated with PFAS. It should be noted that the concentrations detected in the Columbia/Surficial aquifer

groundwater are two orders of magnitude higher than the concentrations detected in the Yorktown aquifer groundwater.

5.3.3 Perimeter Wells South

Both Columbia/Surficial aquifer and Yorktown aquifer groundwater samples were collected at the South Perimeter Wells (**Figure 5-1**).

Tables 5-5 and **5-5a** present the HHRS for Columbia/Surficial aquifer groundwater. The maximum detected concentrations of PFOA and PFOS exceed the RSL, and therefore, PFOA and PFOS were evaluated in Step 2. Based on Step 2, PFOA and PFOS were identified as COPCs.

Tables 5-6 and **5-6a** present the HHRS for Yorktown aquifer groundwater. The maximum detected concentration of PFOS and the combined maximum detected concentration of PFOA and PFOS exceed the RSL, and therefore, PFOA and PFOS were evaluated in Step 2. Based on Step 2, PFOA and PFOS were not identified as COPCs.

Potable use of groundwater from the Columbia/Surficial aquifer at the South Perimeter Wells may result in potential unacceptable human health risks associated with PFOA and PFOS. Potable use of the groundwater from the Yorktown aquifer at the South Perimeter Wells would not result in unacceptable human health risks associated with PFAS. It should be noted that the concentrations detected in the Columbia/Surficial aquifer groundwater are one to two orders of magnitude higher than the concentrations detected in the Yorktown aquifer groundwater.

5.3.4 Perimeter Wells East

Both Columbia/Surficial aquifer and Yorktown aquifer groundwater samples were collected at the East Perimeter Wells (**Figure 5-1**).

Tables 5-7 and **5-7a** present the HHRS for Columbia/Surficial aquifer groundwater. The maximum detected concentration of PFOA and the combined maximum detected concentration of PFOA and PFOS exceed the RSL, and therefore, both PFOA and PFOS were evaluated in Step 2. Based on Step 2, PFOA and PFOS were not identified as COPCs.

Table 5-8 presents the HHRS for Yorktown aquifer groundwater. The detected concentrations of the PFAS are below the RSLs.

Potable use of groundwater from the Columbia/Surficial aquifer and the Yorktown aquifer at the East Perimeter Wells would not result in unacceptable human health risks associated with PFAS.

5.3.5 Perimeter Wells West

Both Columbia/Surficial aquifer and Yorktown aquifer groundwater samples were collected at the West Perimeter Wells (**Figure 5-1**).

Tables 5-9 and **5-9a** present the HHRS for Columbia/Surficial aquifer groundwater. The maximum detected concentrations of PFOA and PFOS exceed the RSL, and therefore, PFOA and PFOS were evaluated in Step 2. Based on Step 2, PFOA and PFOS were identified as COPCs.

Table 5-10 presents the HHRS for Yorktown aquifer groundwater. The detected concentrations of the PFAS are below the RSLs.

Potable use of groundwater from the Columbia/Surficial aquifer at the West Perimeter Wells may result in potential unacceptable human health risks associated with PFOA and PFOS. Potable use of the groundwater from the Yorktown aquifer at the West Perimeter Wells would not result in unacceptable human health risks associated with PFAS. It should be noted that the concentrations detected in the Columbia/Surficial aquifer groundwater are one to two orders of magnitude higher than the concentrations detected in the Yorktown aquifer groundwater.

5.3.6 UST 20B Site

Columbia/Surficial aquifer groundwater samples were collected at the UST 20B Site (**Figure 5-1**).

Tables 5-11 and **5-11a** present the HHRS for the Columbia/Surficial aquifer groundwater. The maximum detected concentrations of PFOA and PFOS exceed the RSL, and therefore, PFOA and PFOS were evaluated in Step 2. Based on Step 2, PFOA and PFOS were identified as COPCs.

Potable use of groundwater from the Columbia/Surficial aquifer at the UST 20B Site may result in potential unacceptable human health risks associated with PFOA and PFOS.

5.3.7 Site 14

Both Columbia/Surficial aquifer and Yorktown aquifer groundwater samples were collected at Site 14 (**Figure 5-1**).

Tables 5-12 and **5-12a** present the HHRS for the Columbia/Surficial aquifer groundwater. The maximum detected concentrations of PFOA and PFOS exceed the RSL, and therefore, PFOA and PFOS were evaluated in Step 2. Based on Step 2, PFOA and PFOS were identified as COPCs.

Table 5-13 presents the HHRS for Yorktown aquifer groundwater. The maximum detected concentration of PFOA, the only PFAS detected, is below the RSL.

Potable use of groundwater from the Columbia/Surficial aquifer at Site 14 may result in potential unacceptable human health risks associated with PFOA and PFOS. Potable use of the groundwater from the Yorktown aquifer at Site 14 would not result in unacceptable human health risks associated with PFAS.

5.3.8 Site 17 Original

Both Columbia/Surficial aquifer and Yorktown aquifer groundwater samples were collected at Site 17 Original **(Figure 5-1).**

Tables 5-14 and **5-14a** present the HHRS for the Columbia/Surficial aquifer groundwater. The maximum detected concentrations of PFOA and PFOS exceed the RSL, and therefore, PFOA and PFOS were evaluated in Step 2. Based on Step 2, PFOA and PFOS were identified as COPCs.

Table 5-15 presents the HHRS for the Yorktown aquifer groundwater. The detected concentrations of the PFAS are below the RSLs.

Potable use of groundwater from the Columbia/Surficial aquifer at Site 17 Original may result in potential unacceptable human health risks associated with PFOA and PFOS. Potable use of the groundwater from the Yorktown aquifer at Site 17 Original would not result in unacceptable human health risks associated with PFAS. It should be noted that the concentrations detected in the Columbia/Surficial aquifer groundwater are one to two orders of magnitude higher than the concentrations detected in the Yorktown aquifer groundwater.

5.3.9 Site 17 Revised

Columbia/Surficial aquifer groundwater samples were collected at Site 17 Revised **(Figure 5-1).**

Tables 5-16 and **5-16a** present the HHRS for Columbia/Surficial aquifer groundwater. The maximum detected concentrations of PFOA and PFOS exceed the RSL, and therefore, PFOA and PFOS were evaluated in Step 2. Based on Step 2, PFOA and PFOS were identified as COPCs.

Potable use of groundwater from the Columbia/Surficial aquifer at Site 17 Revised may result in potential unacceptable human health risks associated with PFOA and PFOS.

5.3.10 New Irrigation Sprayfield

Columbia/Surficial aquifer groundwater samples were collected at the New Irrigation Sprayfield **(Figure 5-1).**

Tables 5-17 and **5-17a** present the HHRS for Columbia/Surficial aquifer groundwater. The maximum detected concentration of PFOS and the combined maximum detected concentration of PFOA and PFOS exceed the RSL, and therefore, both PFOA and PFOS were evaluated in Step 2. Based on Step 2, PFOA and PFOS were not identified as COPCs.

Potable use of groundwater from the Columbia/Surficial aquifer at the New Irrigation Sprayfield would not result in unacceptable human health risks associated with PFAS.

5.3.11 Old Irrigation Sprayfield

Columbia/Surficial aquifer groundwater samples were collected at the Old Irrigation Sprayfield **(Figure 5-1).**

Tables 5-18 and **5-18a** present the HHRS for Columbia/Surficial aquifer groundwater. The maximum detected concentration of PFOA and PFOS exceed the RSL, and therefore, PFOA and PFOS were evaluated in Step 2. Based on Step 2, PFOA and PFOS were identified as COPCs.

Potable use of groundwater from the Columbia/Surficial aquifer at the Old Irrigation Sprayfield may result in potential unacceptable human health risks associated with PFOA and PFOS.

5.3.12 Off-Base Non-Potable Groundwater Wells

Both Columbia/Surficial aquifer and Yorktown aquifer groundwater samples were collected at off-Base non-potable groundwater wells in November 2017 **(Figure 5-1).**

Tables 5-19 and **5-19a** present the HHRS for the Columbia/Surficial aquifer groundwater. The maximum detected concentrations of PFOA and PFOS exceed the RSL, and therefore, PFOA and PFOS were evaluated in Step 2. Based on Step 2, PFOA and PFOS were identified as COPCs.

Tables 5-20 and **5-20a** present the HHRS for the Yorktown aquifer groundwater. The maximum detected concentration of PFOS and the combined maximum detected concentration of PFOA and PFOS exceed the RSL, and therefore, both PFOA and PFOS were evaluated in Step 2. Based on Step 2, PFOA and PFOS were not identified as COPCs.

Potable use of groundwater from the Columbia/Surficial aquifer from the non-potable off-Base groundwater wells may result in potential unacceptable human health risks associated with PFOA and PFOS.

5.3.13 Off-Base Residential Wells

All residential well groundwater samples were collected from residential wells located off-Base **(Figure 4-12)**.

Tables 5-21 and **5-21a** present the HHRS for the residential wells. The detected concentrations of PFOA and PFOS exceeded the RSL, and therefore, PFOA and PFOS were evaluated in Step 2. Based on Step 2, PFOA and PFOS were identified as COPCs.

Potable use of groundwater from off-Base residential wells may result in potential unacceptable human health risks associated with PFOA and PFOS. Concentrations of PFAS at six of the residences sampled exceed the RSL for PFOA and /or PFOS. However, it is important to note that this risk was driven by a select few properties. Properties with exceedances of the L-HA, which drove unacceptable risk findings are being supplied with bottled water and/or have granular activated carbon systems in place for treatment.

5.3.14 On-Base Potable Water

On-base potable water samples were collected in December 2015 and in May 2016. The influent samples were collected from a spigot on a storage tank prior to treatment, where groundwater from both water supply wells is mixed.

Tables 5-22 and **5-22a** present the HHRS for the on-Base potable water. The detected concentrations of PFOA and PFOS exceeded the RSL, and therefore, PFOA and PFOS were evaluated in Step 2. Based on Step 2, PFOA and PFOS were identified as COPCs.

Potable use of groundwater from the influent to the water treatment plant prior to treatment would result in potential unacceptable human health risks associated with PFOA and PFOS. It is important to note that this risk is based on influent to the treatment plant, not the effluent from the plant.

5.3.15 On-Base Soil

Soil samples were collected across the Base in February 2017.

Tables 5-23 and **5-23a** present the HHRS for the soil. The maximum detected concentration of PFOS and the combined maximum detected concentration of PFOA and PFOS exceed the RSL, and therefore, both PFOA and PFOS were evaluated in Step 2. Based on Step 2, PFOA and PFOS were not identified as COPCs.

Exposure to soil would not result in unacceptable human health risks associated with PFAS.

5.4 Human Health Risk Screening Findings

The HHRS identified potential unacceptable risks associated with PFAS in groundwater for the following areas:

- Crash Truck Test Area, Columbia/Surficial aquifer and Yorktown aquifer
- Perimeter Wells North, Columbia/Surficial aquifer
- Perimeter Wells South, Columbia/Surficial aquifer
- Perimeter Wells West, Columbia/Surficial aquifer
- UST 20B Site, Columbia/Surficial aquifer
- Site 14, Columbia/Surficial aquifer
- Site 17 Original, Columbia/Surficial aquifer
- Site 17 Revised, Columbia/Surficial aquifer
- Old Irrigation Sprayfield, Columbia/Surficial aquifer
- Off-Base Non-Potable Wells, Columbia/Surficial aquifer
- Residential Wells
- On-Base Water Supply (prior to treatment)

Table 5-1. Occurrence, Distribution and Selection of Chemicals of Potential Concern

Fentress Basewide PFAS Evaluation, Crash Truck Test Area, Columbia Aquifer

Chesapeake, Virginia

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Point	CAS Number	Chemical	Minimum [1] Concentration Qualifier	Maximum [1] Concentration Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration [2] Used for Screening	Background [3] Value	Screening [4] Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for [5] Contaminant Deletion or Selection
Crash Truck Test Area Columbia Aquifer Groundwater	375-73-5	Perfluorobutanesulfonic acid (PFBS)	6.4E+02	1.6E+03	NG/L	OF-MW08-0616	2/2	N/A	1.6E+03	N/A	4.0E+04 N	N/A		NO	BSL
	375-85-9	Perfluoroheptanoic acid (PFHpA)	4.1E+02	5.6E+02	NG/L	OF-MW08P-0616	2/2	N/A	5.6E+02	N/A	N/A	N/A		NO	NTX
	355-46-4	Perfluorohexanesulfonic acid (PFHxS)	5.5E+03	8.4E+03	NG/L	OF-MW08-0616	2/2	N/A	8.4E+03	N/A	N/A	N/A		NO	NTX
	375-95-1	Perfluorononanoic acid (PFNA)	1.2E+01	1.5E+01	NG/L	OF-MW08P-1215	2/2	N/A	1.5E+01	N/A	N/A	N/A		NO	NTX
	1763-23-1	**Perfluorooctane Sulfonate (PFOS)**	**1.1E+04**	**1.2E+04**	**NG/L**	**OF-MW08P-0616**	**2/2**	**N/A**	**1.2E+04**	**N/A**	**4.0E+01 N**	**7.0E+01**	**HA**	**YES**	**ASL**
	335-67-1	**Perfluorooctanoic acid (PFOA)**	**3.2E+02**	**5.1E+02**	**NG/L**	**OF-MW08P-0616**	**2/2**	**N/A**	**5.1E+02**	**N/A**	**4.0E+01 N**	**7.0E+01**	**HA**	**YES**	**ASL**

[1] Minimum/Maximum detected concentrations (samples OF-MW08-1215, OF-MW08P-1215, OF-MW08-0616, and OF-MW08P-0616).

[2] Maximum detected concentration is used for screening.

[3] Background values not available

[4] Oak Ridge National Laboratory (ORNL). November 2017. Regional Screening Levels for Chemical Contaminants at Superfund Sites.
Tap Water RSLs (based on 10^{-6} for carcinogens and HQ of 0.1 for noncarcinogens).
RSL values for PFOS and PFOA were calculated using the RSL calculator tool.

[5] Rationale Codes
Selection Reason: Above Screening Levels (ASL)
Deletion Reason: Below Screening Level (BSL)
No toxicity value (NTX)

COPC = Chemical of Potential Concern
ARAR/TBC = Applicable or Relevant and Appropriate Requirement/
To Be Considered
J = Estimated Value
C = Carcinogenic
N = Noncarcinogenic
N/A = Not available
HA = USEPA Lifetime Health Advisory (May 2016)
NG/L = Nanograms/Liter

Table 5-1a. Risk Ratio Screening

Fentress Basewide PFAS Evaluation, Crash Truck Test Area, Columbia Aquifer

Chesapeake, Virginia

Analyte	Detection Frequency	Maximum Detected Concentration (Qualifier) (NG/L)	Sample Location of Maximum Detected Concentration	Carcinogenic Tap Water RSL (NG/L)	Acceptable Risk Level	Cancer Risk[a]	Non-carcinogenic Tap Water RSL (NG/L)	Acceptable Hazard Level	Hazard Index[b]	Target Organ	Retained for Further Consideration?
Perfluorooctane Sulfonate (PFOS)	2 / 2	1.2E+04	OF-MW08P-0616	N/A			4.0E+02	1	30	Developmental	Yes
Perfluorooctanoic acid (PFOA)	2 / 2	5.1E+02	OF-MW08P-0616	1.1E+03	1E-06	5E-07	4.0E+02	1	1	Developmental	
Cumulative Hazard Index[c]									**31**		
Cumulative Cancer Risk[d]						**5E-07**					
								Total Developmental HI =		**31**	

Notes:

[a] Cancer Risk equals maximum detected concentration divided by the RSL divided by the acceptable risk level.

[b] Hazard Index equals maximum detected concentration divided by the RSL divided by the acceptable hazard level.

[c] Cumulative Hazard Index equals sum of Hazard Indices for each constituent.

[d] Cumulative Cancer Risk equals sum of Cancer Risks for each constituent.

Constituent selected as COPC if it contributes to an overall Hazard Index by target organ greater than 0.5 or Cumulative Cancer Risk greater than 5E-05, otherwise, constituent not selected as COPC.

Constituents selected as COPCs are indicated by shading.

COPC = Constituent of Potential Concern

HI = Hazard Index

NG/L = Nanograms/Liter

N/A = Not available/not applicable

RSL = Regional Screening Level

Table 5-2. Occurrence, Distribution and Selection of Chemicals of Potential Concern

Fentress Basewide PFAS Evaluation, Crash Truck Test Area, Yorktown Aquifer

Chesapeake, Virginia

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Point	CAS Number	Chemical	Minimum [1] Concentration Qualifier	Maximum [1] Concentration Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration [2] Used for Screening	Background [3] Value	Screening [4] Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for [5] Contaminant Deletion or Selection
Crash Truck Test Area Yorktown Aquifer Groundwater	375-73-5	Perfluorobutanesulfonic acid (PFBS)	2.7E+01	2.7E+01	NG/L	OF-MW08D-0716	1/1	N/A	2.7E+01	N/A	4.0E+04 N	N/A		NO	BSL
	375-85-9	Perfluoroheptanoic acid (PFHpA)	9.9E+01	9.9E+01	NG/L	OF-MW08D-0716	1/1	N/A	9.9E+01	N/A	N/A	N/A		NO	NTX
	355-46-4	Perfluorohexanesulfonic acid (PFHxS)	5.1E+02	5.1E+02	NG/L	OF-MW08D-0716	1/1	N/A	5.1E+02	N/A	N/A	N/A		NO	NTX
	375-95-1	Perfluorononanoic acid (PFNA)	2.2E+01	2.2E+01	NG/L	OF-MW08D-0716	1/1	N/A	2.2E+01	N/A	N/A	N/A		NO	NTX
	1763-23-1	**Perfluorooctane Sulfonate (PFOS)**	**6.9E+03**	**6.9E+03**	**NG/L**	**OF-MW08D-0716**	**1/1**	**N/A**	**6.9E+03**	**N/A**	**4.0E+01 N**	**7.0E+01**	**HA**	**YES**	**ASL**
	335-67-1	**Perfluorooctanoic acid (PFOA)**	**6.2E+01**	**6.2E+01**	**NG/L**	**OF-MW08D-0716**	**1/1**	**N/A**	**6.2E+01**	**N/A**	**4.0E+01 N**	**7.0E+01**	**HA**	**YES**	**ASL**

[1] Minimum/Maximum detected concentration (sample OF-MW08D-0716).

[2] Maximum detected concentration is used for screening.

[3] Background values not available

[4] Oak Ridge National Laboratory (ORNL). November 2017. Regional Screening Levels for Chemical Contaminants at Superfund Sites.
Tap Water RSLs (based on 10^{-6} for carcinogens and HQ of 0.1 for noncarcinogens).
RSL values for PFOS and PFOA were calculated using the RSL calculator tool.

[5] Rationale Codes
Selection Reason: Above Screening Levels (ASL)
Deletion Reason: Below Screening Level (BSL)
No toxicity value (NTX)

COPC = Chemical of Potential Concern
ARAR/TBC = Applicable or Relevant and Appropriate Requirement/
To Be Considered
C = Carcinogenic
N = Noncarcinogenic
N/A = Not available
HA = USEPA Lifetime Health Advisory (May 2016)
NG/L = Nanograms/Liter

Table 5-2a. Risk Ratio Screening

Fentress Basewide PFAS Evaluation, Crash Truck Test Area, Yorktown Aquifer

Chesapeake, Virginia

Analyte	Detection Frequency	Maximum Detected Concentration (Qualifier) (NG/L)	Sample Location of Maximum Detected Concentration	Carcinogenic Tap Water RSL (NG/L)	Acceptable Risk Level	Cancer Risk[a]	Non-carcinogenic Tap Water RSL (NG/L)	Acceptable Hazard Level	Hazard Index[b]	Target Organ	Retained for Further Consideration?
Perfluorooctane Sulfonate (PFOS)	1 / 1	6.9E+03	OF-MW08D-0716	N/A			4.0E+02	1	17	Developmental	Yes
Perfluorooctanoic acid (PFOA)	1 / 1	6.2E+01	OF-MW08D-0716	1.1E+03	1E-06	6E-08	4.0E+02	1	0.2	Developmental	
Cumulative Hazard Index[c]									**17**		
Cumulative Cancer Risk[d]						**6E-08**					
								Total Developmental HI =	**17**		

Notes:

[a] Cancer Risk equals maximum detected concentration divided by the RSL divided by the acceptable risk level.

[b] Hazard Index equals maximum detected concentration divided by the RSL divided by the acceptable hazard level.

[c] Cumulative Hazard Index equals sum of Hazard Indices for each constituent.

[d] Cumulative Cancer Risk equals sum of Cancer Risks for each constituent.

Constituent selected as COPC if it contributes to an overall Hazard Index by target organ greater than 0.5 or Cumulative Cancer Risk greater than 5E-05, otherwise, constituent not selected as COPC.

Constituents selected as COPCs are indicated by shading.

COPC = Constituent of Potential Concern

HI = Hazard Index

NG/L = Nanograms/Liter

N/A = Not available/not applicable

RSL = Regional Screening Level

Table 5-3. Occurrence, Distribution and Selection of Chemicals of Potential Concern

Fentress Basewide PFAS Evaluation, Perimeter Wells North, Columbia Aquifer

Chesapeake, Virginia

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Point	CAS Number	Chemical	Minimum [1] Concentration Qualifier	Maximum [1] Concentration Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration [2] Used for Screening	Background [3] Value	Screening [4] Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for [5] Contaminant Deletion or Selection
Perimeter Wells North Columbia Aquifer Groundwater	375-73-5	Perfluorobutanesulfonic acid (PFBS)	4.8E+01 J	2.2E+02	NG/L	OF-MW13-1215	6/7	N/A	2.2E+02	N/A	4.0E+04 N	N/A		NO	BSL
	375-85-9	Perfluoroheptanoic acid (PFHpA)	3.3E+01 J	6.4E+01	NG/L	OF-MW13-1215	6/7	N/A	6.4E+01	N/A	N/A	N/A		NO	NTX
	355-46-4	Perfluorohexanesulfonic acid (PFHxS)	1.1E+00 J	3.3E+03	NG/L	OF-MW13-1215	7/7	N/A	3.3E+03	N/A	N/A	N/A		NO	NTX
	375-95-1	Perfluorononanoic acid (PFNA)	4.9E+00 J	1.1E+01	NG/L	OF-MW12-1215	6/7	N/A	1.1E+01	N/A	N/A	N/A		NO	NTX
	1763-23-1	**Perfluorooctane Sulfonate (PFOS)**	**1.9E+03**	**6.3E+03**	**NG/L**	**OF-MW12-1215**	**6/7**	**N/A**	**6.3E+03**	**N/A**	**4.0E+01 N**	**7.0E+01**	**HA**	**YES**	**ASL**
	335-67-1	**Perfluorooctanoic acid (PFOA)**	**7.0E+01**	**9.6E+02**	**NG/L**	**OF-SOW-091M-0317**	**6/7**	**N/A**	**9.6E+02**	**N/A**	**4.0E+01 N**	**7.0E+01**	**HA**	**YES**	**ASL**

[1] Minimum/Maximum detected concentrations (samples OF-MW12-1215, OF-MW12-0616, OF-MW13-1215, OF-MW13-0616, OF-MW28-0716, OF-SOW-091D-0317, OF-SOW-091DP-0317, and OF-SOW-091M-0317).

[2] Maximum detected concentration is used for screening.

[3] Background values not available

[4] Oak Ridge National Laboratory (ORNL). November 2017. Regional Screening Levels for Chemical Contaminants at Superfund Sites. Tap Water RSLs (based on 10^{-6} for carcinogens and HQ of 0.1 for noncarcinogens).
RSL values for PFOS and PFOA were calculated using the RSL calculator tool.

[5] Rationale Codes

Selection Reason: Above Screening Levels (ASL)
Deletion Reason: Below Screening Level (BSL)
No toxicity value (NTX)

COPC = Chemical of Potential Concern
ARAR/TBC = Applicable or Relevant and Appropriate Requirement/ To Be Considered
J = Estimated Value
C = Carcinogenic
N = Noncarcinogenic
N/A = Not available
HA = USEPA Lifetime Health Advisory (May 2016)
NG/L = Nanograms/Liter

Table 5-3a. Risk Ratio Screening

Fentress Basewide PFAS Evaluation, Perimeter Wells North, Columbia Aquifer

Chesapeake, Virginia

Analyte	Detection Frequency	Maximum Detected Concentration (Qualifier) (NG/L)	Sample Location of Maximum Detected Concentration	Carcinogenic Tap Water RSL (NG/L)	Acceptable Risk Level	Cancer Risk[a]	Non-carcinogenic Tap Water RSL (NG/L)	Acceptable Hazard Level	Hazard Index[b]	Target Organ	Retained for Further Consideration?
Perfluorooctane Sulfonate (PFOS)	6 / 7	6.3E+03	OF-MW12-1215	N/A			4.0E+02	1	16	Developmental	Yes
Perfluorooctanoic acid (PFOA)	6 / 7	9.6E+02	OF-SOW-091M-0317	1.1E+03	1E-06	9E-07	4.0E+02	1	2	Developmental	
Cumulative Hazard Index[c]									**18**		
Cumulative Cancer Risk[d]						**9E-07**					
								Total Developmental HI =	**18**		

Notes:

[a] Cancer Risk equals maximum detected concentration divided by the RSL divided by the acceptable risk level.

[b] Hazard Index equals maximum detected concentration divided by the RSL divided by the acceptable hazard level.

[c] Cumulative Hazard Index equals sum of Hazard Indices for each constituent.

[d] Cumulative Cancer Risk equals sum of Cancer Risks for each constituent.

Constituent selected as COPC if it contributes to an overall Hazard Index by target organ greater than 0.5 or Cumulative Cancer Risk greater than 5E-05, otherwise, constituent not selected as COPC.

Constituents selected as COPCs are indicated by shading.

COPC = Constituent of Potential Concern

HI = Hazard Index

NG/L = Nanograms/Liter

N/A = Not available/not applicable

RSL = Regional Screening Level

Table 5-4. Occurrence, Distribution and Selection of Chemicals of Potential Concern
Fentress Basewide PFAS Evaluation, Perimeter Wells North, Yorktown Aquifer
Chesapeake, Virginia

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Point	CAS Number	Chemical	Minimum [1] Concentration Qualifier	Maximum [1] Concentration Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration [2] Used for Screening	Background [3] Value	Screening [4] Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for [5] Contaminant Deletion or Selection	Retained for Further Consideration?
Perimeter Wells North Yorktown Aquifer Groundwater	375-85-9	Perfluoroheptanoic acid (PFHpA)	7.1E-01 J	5.5E+01	NG/L	OF-MW12D-0616	4/8	N/A	5.5E+01	N/A	N/A	N/A		NO	NTX	
	355-46-4	Perfluorohexanesulfonic acid (PFHxS)	1.3E+00 J	3.2E+01	NG/L	OF-MW12D-0616	7/8	N/A	3.2E+01	N/A	N/A	N/A		NO	NTX	
	375-95-1	Perfluorononanoic acid (PFNA)	1.0E+00 J	2.8E+00 J	NG/L	OF-MW12D-0616	2/8	N/A	2.8E+00	N/A	N/A	N/A		NO	NTX	No
	1763-23-1	Perfluorooctane Sulfonate (PFOS)	2.3E+00 J	1.1E+01	NG/L	OF-MW12D-1215	6/8	N/A	1.1E+01	N/A	4.0E+01 N	7.0E+01	HA	NO	BSL	
	335-67-1	Perfluorooctanoic acid (PFOA)	2.1E+00 J	7.9E+00	NG/L	OF-MW12D-1215	6/8	N/A	7.9E+00	N/A	4.0E+01 N	7.0E+01	HA	NO	BSL	

[1] Minimum/Maximum detected concentrations (samples OF-MW12D-1215, OF-MW12D-0616, OF-MW13D-0116, OF-MW13DP-0116, OF-MW13D-0616, OF-MW13DP-0616, OF-MW28D-0716, OF-SOW-091A-0317, OF-SOW-091K-0317, and OF-SOW-091L-0317).

[2] Maximum detected concentration is used for screening.

[3] Background values not available

[4] Oak Ridge National Laboratory (ORNL). November 2017. Regional Screening Levels for Chemical Contaminants at Superfund Sites. Tap Water RSLs (based on 10^{-6} for carcinogens and HQ of 0.1 for noncarcinogens).
RSL values for PFOS and PFOA were calculated using the RSL calculator tool.

[5] Rationale Codes

Selection Reason: Above Screening Levels (ASL)

Deletion Reason: Below Screening Level (BSL)
No toxicity value (NTX)

COPC = Chemical of Potential Concern
ARAR/TBC = Applicable or Relevant and Appropriate Requirement/ To Be Considered
J = Estimated Value
C = Carcinogenic
N = Noncarcinogenic
N/A = Not available
HA = USEPA Lifetime Health Advisory (May 2016)
NG/L = Nanograms/Liter

Table 5-5. Occurrence, Distribution and Selection of Chemicals of Potential Concern

Fentress Basewide PFAS Evaluation, Perimeter Wells South, Columbia Aquifer

Chesapeake, Virginia

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Point	CAS Number	Chemical	Minimum [1] Concentration Qualifier	Maximum [1] Concentration Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration [2] Used for Screening	Background [3] Value	Screening [4] Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for [5] Contaminant Deletion or Selection
Perimeter Wells South Columbia Aquifer Groundwater	375-73-5	Perfluorobutanesulfonic acid (PFBS)	4.8E+02	4.8E+02	NG/L	OF-MW29-0716	1/5	N/A	4.8E+02	N/A	4.0E+04 N	N/A		NO	BSL
	375-85-9	Perfluoroheptanoic acid (PFHpA)	3.4E+02	3.4E+02	NG/L	OF-MW29-0716	1/5	N/A	3.4E+02	N/A	N/A	N/A		NO	NTX
	355-46-4	Perfluorohexanesulfonic acid (PFHxS)	1.2E+00 J	4.8E+03	NG/L	OF-MW29-0716	3/5	N/A	4.8E+03	N/A	N/A	N/A		NO	NTX
	375-95-1	Perfluorononanoic acid (PFNA)	2.2E+01	2.2E+01	NG/L	OF-MW29-0716	1/5	N/A	2.2E+01	N/A	N/A	N/A		NO	NTX
	1763-23-1	**Perfluorooctane Sulfonate (PFOS)**	**1.6E+00 J**	**3.0E+03**	**NG/L**	**OF-MW29-0716**	**3/5**	**N/A**	**3.0E+03**	**N/A**	**4.0E+01 N**	**7.0E+01**	**HA**	**YES**	**ASL**
	335-67-1	**Perfluorooctanoic acid (PFOA)**	**7.1E-01 J**	**8.3E+02**	**NG/L**	**OF-MW29-0716**	**3/5**	**N/A**	**8.3E+02**	**N/A**	**4.0E+01 N**	**7.0E+01**	**HA**	**YES**	**ASL**

[1] Minimum/Maximum detected concentrations (samples OF-MW29-0716, OF-MW30-0716, OF-MW30P-0716, OF-MW31-0716, OF-MW32-0716, and OF-MW34-0716).

[2] Maximum detected concentration is used for screening.

[3] Background values not available

[4] Oak Ridge National Laboratory (ORNL). November 2017. Regional Screening Levels for Chemical Contaminants at Superfund Sites.
Tap Water RSLs (based on 10^{-6} for carcinogens and HQ of 0.1 for noncarcinogens).
RSL values for PFOS and PFOA were calculated using the RSL calculator tool.

[5] Rationale Codes
Selection Reason: Above Screening Levels (ASL)
Deletion Reason: Below Screening Level (BSL)
No toxicity value (NTX)

COPC = Chemical of Potential Concern
ARAR/TBC = Applicable or Relevant and Appropriate Requirement/
To Be Considered
J = Estimated Value
C = Carcinogenic
N = Noncarcinogenic
N/A = Not available
HA = USEPA Lifetime Health Advisory (May 2016)
NG/L = Nanograms/Liter

Table 5-5a. Risk Ratio Screening

Fentress Basewide PFAS Evaluation, Perimeter Wells South, Columbia Aquifer

Chesapeake, Virginia

Analyte	Detection Frequency	Maximum Detected Concentration (Qualifier) (NG/L)	Sample Location of Maximum Detected Concentration	Carcinogenic Tap Water RSL (NG/L)	Acceptable Risk Level	Cancer Risk[a]	Non-carcinogenic Tap Water RSL (NG/L)	Acceptable Hazard Level	Hazard Index[b]	Target Organ	Retained for Further Consideration?
Perfluorooctane Sulfonate (PFOS)	3 / 5	3.0E+03	OF-MW29-0716	N/A			4.0E+02	1	7	Developmental	Yes
Perfluorooctanoic acid (PFOA)	3 / 5	8.3E+02	OF-MW29-0716	1.1E+03	1E-06	7E-07	4.0E+02	1	2	Developmental	
Cumulative Hazard Index[c]									**9**		
Cumulative Cancer Risk[d]						**7E-07**					
								Total Developmental HI =	**9**		

Notes:

[a] Cancer Risk equals maximum detected concentration divided by the RSL divided by the acceptable risk level.

[b] Hazard Index equals maximum detected concentration divided by the RSL divided by the acceptable hazard level.

[c] Cumulative Hazard Index equals sum of Hazard Indices for each constituent.

[d] Cumulative Cancer Risk equals sum of Cancer Risks for each constituent.

Constituent selected as COPC if it contributes to an overall Hazard Index by target organ greater than 0.5 or Cumulative Cancer Risk greater than 5E-05, otherwise, constituent not selected as COPC.

Constituents selected as COPCs are indicated by shading.

COPC = Constituent of Potential Concern

HI = Hazard Index

NG/L = Nanograms/Liter

N/A = Not available/not applicable

RSL = Regional Screening Level

Table 5-6. Occurrence, Distribution and Selection of Chemicals of Potential Concern

Fentress Basewide PFAS Evaluation, Perimeter Wells South, Yorktown Aquifer

Chesapeake, Virginia

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Point	CAS Number	Chemical	Minimum [1] Concentration Qualifier	Maximum [1] Concentration Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration [2] Used for Screening	Background [3] Value	Screening [4] Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for [5] Contaminant Deletion or Selection
Perimeter Wells South Yorktown Aquifer Groundwater	375-85-9	Perfluoroheptanoic acid (PFHpA)	2.2E+00 J	3.9E+00 J	NG/L	OF-MW31D-0716	2/4	N/A	3.9E+00	N/A	N/A	N/A		NO	NTX
	355-46-4	Perfluorohexanesulfonic acid (PFHxS)	3.4E+00 J	3.4E+00 J	NG/L	OF-MW31D-0716	1/4	N/A	3.4E+00	N/A	N/A	N/A		NO	NTX
	375-95-1	Perfluorononanoic acid (PFNA)	1.1E+00 J	2.4E+00 J	NG/L	OF-MW31D-0716	2/4	N/A	2.4E+00	N/A	N/A	N/A		NO	NTX
	1763-23-1	**Perfluorooctane Sulfonate (PFOS)**	**2.1E+00 J**	**5.6E+01**	**NG/L**	**OF-MW31D-0716**	**3/4**	**N/A**	**5.6E+01**	**N/A**	**4.0E+01 N**	**7.0E+01**	**HA**	**YES**	**ASL**
	335-67-1	**Perfluorooctanoic acid (PFOA)**	**2.7E+00 J**	**4.5E+00 J**	**NG/L**	**OF-MW31D-0716**	**2/4**	**N/A**	**4.5E+00**	**N/A**	**4.0E+01 N**	**7.0E+01**	**HA**	**YES**	**PFOS+PFOA**

[1] Minimum/Maximum detected concentrations (samples OF-MW30D-0716, OF-MW31D-0716, OF-MW32D-0417, OF-MW32DP-0417, and OF-MW34D-0417).

[2] Maximum detected concentration is used for screening.

[3] Background values not available

[4] Oak Ridge National Laboratory (ORNL). November 2017. Regional Screening Levels for Chemical Contaminants at Superfund Sites.
Tap Water RSLs (based on 10^{-6} for carcinogens and HQ of 0.1 for noncarcinogens).
RSL values for PFOS and PFOA were calculated using the RSL calculator tool.

[5] Rationale Codes

Selection Reason: Above Screening Levels (ASL)
Combined concentration of PFOS and PFOA exceeds the RSL (PFOS+PFOA)

Deletion Reason: Below Screening Level (BSL)
No toxicity value (NTX)

COPC = Chemical of Potential Concern
ARAR/TBC = Applicable or Relevant and Appropriate Requirement/ To Be Considered
J = Estimated Value
C = Carcinogenic
N = Noncarcinogenic
N/A = Not available
HA = USEPA Lifetime Health Advisory (May 2016)
NG/L = Nanograms/Liter

Table 5-6a. Risk Ratio Screening

Fentress Basewide PFAS Evaluation, Perimeter Wells South, Yorktown Aquifer

Chesapeake, Virginia

Analyte	Detection Frequency	Maximum Detected Concentration (Qualifier) (NG/L)	Sample Location of Maximum Detected Concentration	Carcinogenic Tap Water RSL (NG/L)	Acceptable Risk Level	Cancer Risk[a]	Non-carcinogenic Tap Water RSL (NG/L)	Acceptable Hazard Level	Hazard Index[b]	Target Organ	Retained for Further Consideration?
Perfluorooctane Sulfonate (PFOS)	3 / 4	5.6E+01	OF-MW31D-0716	N/A	N/A	N/A	4.0E+02	1	0.1	Developmental	No
Perfluorooctanoic acid (PFOA)	2 / 4	4.5E+00 J	OF-MW31D-0716	1.1E+03	1E-06	4E-09	4.0E+02	1	0.01	Developmental	
Cumulative Hazard Index[c]									**0.2**		
Cumulative Cancer Risk[d]						**4E-09**					
								Total Developmental HI =		**0.2**	

Notes:

[a] Cancer Risk equals maximum detected concentration divided by the RSL divided by the acceptable risk level.

[b] Hazard Index equals maximum detected concentration divided by the RSL divided by the acceptable hazard level.

[c] Cumulative Hazard Index equals sum of Hazard Indices for each constituent.

[d] Cumulative Cancer Risk equals sum of Cancer Risks for each constituent.

Constituent selected as COPC if it contributes to an overall Hazard Index by target organ greater than 0.5 or Cumulative Cancer Risk greater than 5E-05, otherwise, constituent not selected as COPC.

Constituents selected as COPCs are indicated by shading.

COPC = Constituent of Potential Concern

HI = Hazard Index

NG/L = Nanograms/Liter

N/A = Not available/not applicable

RSL = Regional Screening Level

Table 5-7. Occurrence, Distribution and Selection of Chemicals of Potential Concern
Fentress Basewide PFAS Evaluation, Perimeter Wells East, Columbia Aquifer
Chesapeake, Virginia

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Point	CAS Number	Chemical	Minimum [1] Concentration Qualifier	Maximum [1] Concentration Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration [2] Used for Screening	Background [3] Value	Screening [4] Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for [5] Contaminant Deletion or Selection
Perimeter Wells East Columbia Aquifer Groundwater	375-85-9	Perfluoroheptanoic acid (PFHpA)	8.6E+00	1.1E+01	NG/L	OF-MW15-0616	2/4	N/A	1.1E+01	N/A	N/A	N/A		NO	NTX
	355-46-4	Perfluorohexanesulfonic acid (PFHxS)	4.9E+00 J	4.9E+00 J	NG/L	OF-MW25-0716	1/4	N/A	4.9E+00	N/A	N/A	N/A		NO	NTX
	1763-23-1	**Perfluorooctane Sulfonate (PFOS)**	**6.1E+00 J**	**6.1E+00 J**	**NG/L**	**OF-MW25-0716**	**1/4**	**N/A**	**6.1E+00**	**N/A**	**4.0E+01 N**	**7.0E+01**	**HA**	**YES**	**PFOS+PFOA**
	335-67-1	**Perfluorooctanoic acid (PFOA)**	**1.3E+00 J**	**1.9E+02**	**NG/L**	**OF-MW15-0616**	**4/4**	**N/A**	**1.9E+02**	**N/A**	**4.0E+01 N**	**7.0E+01**	**HA**	**YES**	**ASL**

[1] Minimum/Maximum detected concentrations (samples OF-MW15-1215, OF-MW15-0616, OF-MW25-0716, and OF-MW27-0716).
[2] Maximum detected concentration is used for screening.
[3] Background values not available
[4] Oak Ridge National Laboratory (ORNL). November 2017. Regional Screening Levels for Chemical Contaminants at Superfund Sites.
Tap Water RSLs (based on 10^{-6} for carcinogens and HQ of 0.1 for noncarcinogens).
RSL values for PFOS and PFOA were calculated using the RSL calculator tool.
[5] Rationale Codes

Selection Reason: Above Screening Levels (ASL)
Combined concentration of PFOS and PFOA exceeds the RSL (PFOS+PFOA)
Deletion Reason: Below Screening Level (BSL)
No toxicity value (NTX)

COPC = Chemical of Potential Concern
ARAR/TBC = Applicable or Relevant and Appropriate Requirement/
To Be Considered
J = Estimated Value
C = Carcinogenic
N = Noncarcinogenic
N/A = Not available
HA = USEPA Lifetime Health Advisory (May 2016)
NG/L = Nanograms/Liter

Table 5-7a. Risk Ratio Screening

Fentress Basewide PFAS Evaluation, Perimeter Wells East, Columbia Aquifer

Chesapeake, Virginia

Analyte	Detection Frequency	Maximum Detected Concentration (Qualifier) (NG/L)	Sample Location of Maximum Detected Concentration	Carcinogenic Tap Water RSL (NG/L)	Acceptable Risk Level	Cancer Risk[a]	Non-carcinogenic Tap Water RSL (NG/L)	Acceptable Hazard Level	Hazard Index[b]	Target Organ	Retained for Further Consideration?
Perfluorooctane Sulfonate (PFOS)	1 / 4	6.1E+00 J	OF-MW25-0716	N/A			4.0E+02	1	0.02	Developmental	No
Perfluorooctanoic acid (PFOA)	4 / 4	1.9E+02	OF-MW15-0616	1.1E+03	1E-06	2E-07	4.0E+02	1	0.5	Developmental	
Cumulative Hazard Index[c]									**0.5**		
Cumulative Cancer Risk[d]						**2E-07**					
								Total Developmental HI =	**0.5**		

Notes:

[a] Cancer Risk equals maximum detected concentration divided by the RSL divided by the acceptable risk level.

[b] Hazard Index equals maximum detected concentration divided by the RSL divided by the acceptable hazard level.

[c] Cumulative Hazard Index equals sum of Hazard Indices for each constituent.

[d] Cumulative Cancer Risk equals sum of Cancer Risks for each constituent.

Constituent selected as COPC if it contributes to an overall Hazard Index by target organ greater than 0.5 or Cumulative Cancer Risk greater than 5E-05, otherwise, constituent not selected as COPC.

Constituents selected as COPCs are indicated by shading.

COPC = Constituent of Potential Concern

HI = Hazard Index

NG/L = Nanograms/Liter

N/A = Not available/not applicable

RSL = Regional Screening Level

Table 5-8. Occurrence, Distribution and Selection of Chemicals of Potential Concern
Fentress Basewide PFAS Evaluation, Perimeter Wells East, Yorktown Aquifer
Chesapeake, Virginia

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Point	CAS Number	Chemical	Minimum [1] Concentration Qualifier	Maximum [1] Concentration Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration [2] Used for Screening	Background [3] Value	Screening [4] Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for [5] Contaminant Deletion or Selection	Retained for Further Consideration?
Perimeter Wells East Yorktown Aquifer Groundwater	375-85-9	Perfluoroheptanoic acid (PFHpA)	8.2E-01 J	8.2E-01 J	NG/L	OF-MW15D-0116	1/2	N/A	8.2E-01	N/A	N/A	N/A		NO	NTX	No
	355-46-4	Perfluorohexanesulfonic acid (PFHxS)	9.7E-01 J	9.7E-01 J	NG/L	OF-MW15D-0116	1/2	N/A	9.7E-01	N/A	N/A	N/A		NO	NTX	
	1763-23-1	Perfluorooctane Sulfonate (PFOS)	2.2E+00 J	6.6E+00	NG/L	OF-MW15D-0116	2/2	N/A	6.6E+00	N/A	4.0E+01 N	7.0E+01	HA	NO	BSL	
	335-67-1	Perfluorooctanoic acid (PFOA)	1.6E+00 J	7.5E+00	NG/L	OF-MW15D-0116	2/2	N/A	7.5E+00	N/A	4.0E+01 N	7.0E+01	HA	NO	BSL	

[1] Minimum/Maximum detected concentrations (samples OF-MW15D-0116 and OF-MW15D-0616).
[2] Maximum detected concentration is used for screening.
[3] Background values not available
[4] Oak Ridge National Laboratory (ORNL). November 2017. Regional Screening Levels for Chemical Contaminants at Superfund Sites.
Tap Water RSLs (based on 10^{-6} for carcinogens and HQ of 0.1 for noncarcinogens).
RSL values for PFOS and PFOA were calculated using the RSL calculator tool.
[5] Rationale Codes

Selection Reason: Above Screening Levels (ASL)
Deletion Reason: Below Screening Level (BSL)
No toxicity value (NTX)

COPC = Chemical of Potential Concern
ARAR/TBC = Applicable or Relevant and Appropriate Requirement/ To Be Considered
J = Estimated Value
C = Carcinogenic
N = Noncarcinogenic
N/A = Not available
HA = USEPA Lifetime Health Advisory (May 2016)
NG/L = Nanograms/Liter

Table 5-9. Occurrence, Distribution and Selection of Chemicals of Potential Concern

Fentress Basewide PFAS Evaluation, Perimeter Wells West, Columbia Aquifer

Chesapeake, Virginia

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Point	CAS Number	Chemical	Minimum [1] Concentration Qualifier	Maximum [1] Concentration Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration [2] Used for Screening	Background [3] Value	Screening [4] Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for [5] Contaminant Deletion or Selection
Perimeter Wells West Columbia Aquifer Groundwater	375-73-5	Perfluorobutanesulfonic acid (PFBS)	1.4E+00 J	8.2E+01	NG/L	OF-MW10-0616	3/4	N/A	8.2E+01	N/A	4.0E+04 N	N/A		NO	BSL
	375-85-9	Perfluoroheptanoic acid (PFHpA)	1.4E+02	1.4E+02	NG/L	OF-MW10-1215	2/4	N/A	1.4E+02	N/A	N/A	N/A		NO	NTX
	355-46-4	Perfluorohexanesulfonic acid (PFHxS)	9.1E+00	7.1E+02	NG/L	OF-MW10-1215	4/4	N/A	7.1E+02	N/A	N/A	N/A		NO	NTX
	375-95-1	Perfluorononanoic acid (PFNA)	1.1E+01	1.2E+01	NG/L	OF-MW10-0616	2/4	N/A	1.2E+01	N/A	N/A	N/A		NO	NTX
	1763-23-1	**Perfluorooctane Sulfonate (PFOS)**	**7.8E+00**	**2.9E+02**	**NG/L**	**OF-MW10-1215**	**4/4**	**N/A**	**2.9E+02**	**N/A**	**4.0E+01 N**	**7.0E+01**	**HA**	**YES**	**ASL**
	335-67-1	**Perfluorooctanoic acid (PFOA)**	**1.1E+00 J**	**1.5E+02**	**NG/L**	**OF-MW10-0616**	**4/4**	**N/A**	**1.5E+02**	**N/A**	**4.0E+01 N**	**7.0E+01**	**HA**	**YES**	**ASL**

[1] Minimum/Maximum detected concentrations (samples OF-MW09-1215, OF-MW09-0616, OF-MW10-1215, and OF-MW10-0616).

[2] Maximum detected concentration is used for screening.

[3] Background values not available

[4] Oak Ridge National Laboratory (ORNL). November 2017. Regional Screening Levels for Chemical Contaminants at Superfund Sites.
Tap Water RSLs (based on 10^{-6} for carcinogens and HQ of 0.1 for noncarcinogens).
RSL values for PFOS and PFOA were calculated using the RSL calculator tool.

[5] Rationale Codes
Selection Reason: Above Screening Levels (ASL)
Deletion Reason: Below Screening Level (BSL)
No toxicity value (NTX)

COPC = Chemical of Potential Concern
ARAR/TBC = Applicable or Relevant and Appropriate Requirement/
To Be Considered
J = Estimated Value
C = Carcinogenic
N = Noncarcinogenic
N/A = Not available
HA = USEPA Lifetime Health Advisory (May 2016)
NG/L = Nanograms/Liter

Table 5-9a. Risk Ratio Screening

Fentress Basewide PFAS Evaluation, Perimeter Wells West, Columbia Aquifer

Chesapeake, Virginia

Analyte	Detection Frequency	Maximum Detected Concentration (Qualifier) (NG/L)	Sample Location of Maximum Detected Concentration	Carcinogenic Tap Water RSL (NG/L)	Acceptable Risk Level	Cancer Risk[a]	Non-carcinogenic Tap Water RSL (NG/L)	Acceptable Hazard Level	Hazard Index[b]	Target Organ	Retained for Further Consideration?
Perfluorooctane Sulfonate (PFOS)	4 / 4	2.9E+02	OF-MW10-1215	N/A			4.0E+02	1	0.7	Developmental	Yes
Perfluorooctanoic acid (PFOA)	4 / 4	1.5E+02	OF-MW10-0616	1.1E+03	1E-06	1E-07	4.0E+02	1	0.4	Developmental	
Cumulative Hazard Index[c]									**1**		
Cumulative Cancer Risk[d]						**1E-07**					
								Total Developmental HI =	**1**		

Notes:

[a] Cancer Risk equals maximum detected concentration divided by the RSL divided by the acceptable risk level.

[b] Hazard Index equals maximum detected concentration divided by the RSL divided by the acceptable hazard level.

[c] Cumulative Hazard Index equals sum of Hazard Indices for each constituent.

[d] Cumulative Cancer Risk equals sum of Cancer Risks for each constituent.

Constituent selected as COPC if it contributes to an overall Hazard Index by target organ greater than 0.5 or Cumulative Cancer Risk greater than 5E-05, otherwise, constituent not selected as COPC.

Constituents selected as COPCs are indicated by shading.

COPC = Constituent of Potential Concern

HI = Hazard Index

NG/L = Nanograms/Liter

N/A = Not available/not applicable

RSL = Regional Screening Level

Table 5-10. Occurrence, Distribution and Selection of Chemicals of Potential Concern

Fentress Basewide PFAS Evaluation, Perimeter Wells West, Yorktown Aquifer

Chesapeake, Virginia

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Point	CAS Number	Chemical	Minimum [1] Concentration Qualifier	Maximum [1] Concentration Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration [2] Used for Screening	Background [3] Value	Screening [4] Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for [5] Contaminant Deletion or Selection	Retained for Further Consideration?
Perimeter Wells West Yorktown Aquifer Groundwater	355-46-4	Perfluorohexanesulfonic acid (PFHxS)	9.9E-01 J	3.5E+00 J	NG/L	OF-MW10D-0616	3/4	N/A	3.5E+00	N/A	N/A	N/A		NO	NTX	
	1763-23-1	Perfluorooctane Sulfonate (PFOS)	4.1E+00	9.6E+00	NG/L	OF-MW09D-0116	4/4	N/A	9.6E+00	N/A	4.0E+01 N	7.0E+01	HA	NO	BSL	No
	335-67-1	Perfluorooctanoic acid (PFOA)	1.6E+00 J	1.6E+00 J	NG/L	OF-MW09D-0116	1/4	N/A	1.6E+00	N/A	4.0E+01 N	7.0E+01	HA	NO	BSL	

[1] Minimum/Maximum detected concentrations (samples OF-MW09D-0116, OF-MW09D-0616, OF-MW10D-0116, and OF-MW10D-0616)

[2] Maximum detected concentration is used for screening.

[3] Background values not available

[4] Oak Ridge National Laboratory (ORNL). November 2017. Regional Screening Levels for Chemical Contaminants at Superfund Sites.
Tap Water RSLs (based on 10^{-6} for carcinogens and HQ of 0.1 for noncarcinogens).
RSL values for PFOS and PFOA were calculated using the RSL calculator tool.

[5] Rationale Codes

Selection Reason: Above Screening Levels (ASL)
Deletion Reason: Below Screening Level (BSL)
No toxicity value (NTX)

COPC = Chemical of Potential Concern
ARAR/TBC = Applicable or Relevant and Appropriate Requirement/
To Be Considered
J = Estimated Value
C = Carcinogenic
N = Noncarcinogenic
N/A = Not available
HA = USEPA Lifetime Health Advisory (May 2016)
NG/L = Nanograms/Liter

Table 5-11. Occurrence, Distribution and Selection of Chemicals of Potential Concern

Fentress Basewide PFAS Evaluation, UST 20B Site, Columbia Aquifer

Chesapeake, Virginia

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Point	CAS Number	Chemical	Minimum [1] Concentration Qualifier	Maximum [1] Concentration Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration [2] Used for Screening	Background [3] Value	Screening [4] Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for [5] Contaminant Deletion or Selection
UST 20B Site Columbia Aquifer Groundwater	375-73-5	Perfluorobutanesulfonic acid (PFBS)	1.7E+02	8.4E+02	NG/L	OFPOL-MW-7-0616	6/6	N/A	8.4E+02	N/A	4.0E+04 N	N/A		NO	BSL
	375-85-9	Perfluoroheptanoic acid (PFHpA)	1.8E+02	3.0E+03	NG/L	OFPOL-MW-7-0616	6/6	N/A	3.0E+03	N/A	N/A	N/A		NO	NTX
	355-46-4	Perfluorohexanesulfonic acid (PFHxS)	2.5E+03	9.8E+03	NG/L	OFPOL-MW-7-0616	6/6	N/A	9.8E+03	N/A	N/A	N/A		NO	NTX
	375-95-1	Perfluorononanoic acid (PFNA)	5.3E+01	7.6E+02	NG/L	OFPOL-MW-7-0616	6/6	N/A	7.6E+02	N/A	N/A	N/A		NO	NTX
	1763-23-1	**Perfluorooctane Sulfonate (PFOS)**	**9.0E+03**	**4.9E+04**	**NG/L**	**OFPOL-MW-7-0616**	**6/6**	**N/A**	**4.9E+04**	**N/A**	**4.0E+01 N**	**7.0E+01**	**HA**	**YES**	**ASL**
	335-67-1	**Perfluorooctanoic acid (PFOA)**	**1.2E+03**	**5.6E+03**	**NG/L**	**OFPOL-MW-3P-0616**	**6/6**	**N/A**	**5.6E+03**	**N/A**	**4.0E+01 N**	**7.0E+01**	**HA**	**YES**	**ASL**

[1] Minimum/Maximum detected concentrations (samples OFPOL-MW-2-0616, OFPOL-MW-3-0616, OFPOL-MW-3P-0616, OFPOL-MW-4-0616, OFPOL-MW-6-0616, OFPOL-MW-7-0616, and OFPOL-MW-8-0616).

[2] Maximum detected concentration is used for screening.

[3] Background values not available

[4] Oak Ridge National Laboratory (ORNL). November 2017. Regional Screening Levels for Chemical Contaminants at Superfund Sites. Tap Water RSLs (based on 10^{-6} for carcinogens and HQ of 0.1 for noncarcinogens).
RSL values for PFOS and PFOA were calculated using the RSL calculator tool.

[5] Rationale Codes

Selection Reason: Above Screening Levels (ASL)
Deletion Reason: Below Screening Level (BSL)
No toxicity value (NTX)

COPC = Chemical of Potential Concern
ARAR/TBC = Applicable or Relevant and Appropriate Requirement/ To Be Considered
C = Carcinogenic
N = Noncarcinogenic
N/A = Not available
HA = USEPA Lifetime Health Advisory (May 2016)
NG/L = Nanograms/Liter

Table 5-11a. Risk Ratio Screening

Fentress Basewide PFAS Evaluation, UST 20B Site, Columbia Aquifer

Chesapeake, Virginia

Analyte	Detection Frequency	Maximum Detected Concentration (Qualifier) (NG/L)	Sample Location of Maximum Detected Concentration	Carcinogenic Tap Water RSL (NG/L)	Acceptable Risk Level	Cancer Risk[a]	Non-carcinogenic Tap Water RSL (NG/L)	Acceptable Hazard Level	Hazard Index[b]	Target Organ	Retained for Further Consideration?
Perfluorooctane Sulfonate (PFOS)	6 / 6	4.9E+04	OFPOL-MW-7-0616	N/A			4.0E+02	1	123	Developmental	Yes
Perfluorooctanoic acid (PFOA)	6 / 6	5.6E+03	OFPOL-MW-3P-0616	1.1E+03	1E-06	5E-06	4.0E+02	1	14	Developmental	
Cumulative Hazard Index[c]									**137**		
Cumulative Cancer Risk[d]						**5E-06**					
								Total Developmental HI =		**137**	

Notes:

[a] Cancer Risk equals maximum detected concentration divided by the RSL divided by the acceptable risk level.

[b] Hazard Index equals maximum detected concentration divided by the RSL divided by the acceptable hazard level.

[c] Cumulative Hazard Index equals sum of Hazard Indices for each constituent.

[d] Cumulative Cancer Risk equals sum of Cancer Risks for each constituent.

Constituent selected as COPC if it contributes to an overall Hazard Index by target organ greater than 0.5 or Cumulative Cancer Risk greater than 5E-05, otherwise, constituent not selected as COPC.

Constituents selected as COPCs are indicated by shading.

COPC = Constituent of Potential Concern
HI = Hazard Index
NG/L = Nanograms/Liter
N/A = Not available/not applicable
RSL = Regional Screening Level

Table 5-12. Occurrence, Distribution and Selection of Chemicals of Potential Concern

Fentress Basewide PFAS Evaluation, Site 14, Columbia Aquifer

Chesapeake, Virginia

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Point	CAS Number	Chemical	Minimum [1] Concentration Qualifier	Maximum [1] Concentration Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration [2] Used for Screening	Background [3] Value	Screening [4] Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for [5] Contaminant Deletion or Selection
Site 14 Columbia Aquifer Groundwater	375-73-5	Perfluorobutanesulfonic acid (PFBS)	1.4E+01	7.8E+01	NG/L	OF14-MW07S-1215	4/7	N/A	7.8E+01	N/A	4.0E+04 N	N/A		NO	BSL
	375-85-9	Perfluoroheptanoic acid (PFHpA)	1.6E+01	2.7E+01	NG/L	OF14-MW07S-0616	4/7	N/A	2.7E+01	N/A	N/A	N/A		NO	NTX
	355-46-4	Perfluorohexanesulfonic acid (PFHxS)	7.8E+00 J	4.6E+02	NG/L	OF14-MW07S-0616	5/7	N/A	4.6E+02	N/A	N/A	N/A		NO	NTX
	375-95-1	Perfluorononanoic acid (PFNA)	8.7E-01 J	3.7E+00 J	NG/L	OF14-MW06S-0616	3/7	N/A	3.7E+00	N/A	N/A	N/A		NO	NTX
	1763-23-1	**Perfluorooctane Sulfonate (PFOS)**	**5.3E+00**	**2.5E+02**	**NG/L**	**OF14-MW06S-0616**	**4/7**	**N/A**	**2.5E+02**	**N/A**	**4.0E+01 N**	**7.0E+01**	**HA**	**YES**	**ASL**
	335-67-1	**Perfluorooctanoic acid (PFOA)**	**2.0E+00 J**	**3.7E+02**	**NG/L**	**OF14-MW07S-0616**	**7/7**	**N/A**	**3.7E+02**	**N/A**	**4.0E+01 N**	**7.0E+01**	**HA**	**YES**	**ASL**

[1] Minimum/Maximum detected concentrations (samples OF-MW14-1215, OF-MW14-0616, OF14-MW06S-1215, OF14-MW06S-0616, OF14-MW07S-1215, OF14-MW07S-0616, and OF14-GW05-0317).

[2] Maximum detected concentration is used for screening.

[3] Background values not available

[4] Oak Ridge National Laboratory (ORNL). November 2017. Regional Screening Levels for Chemical Contaminants at Superfund Sites. Tap Water RSLs (based on 10^{-6} for carcinogens and HQ of 0.1 for noncarcinogens).
RSL values for PFOS and PFOA were calculated using the RSL calculator tool.

[5] Rationale Codes

Selection Reason: Above Screening Levels (ASL)
Deletion Reason: Below Screening Level (BSL)
No toxicity value (NTX)

COPC = Chemical of Potential Concern
ARAR/TBC = Applicable or Relevant and Appropriate Requirement/ To Be Considered
J = Estimated Value
C = Carcinogenic
N = Noncarcinogenic
N/A = Not available
HA = USEPA Lifetime Health Advisory (May 2016)
NG/L = Nanograms/Liter

Table 5-12a. Risk Ratio Screening

Fentress Basewide PFAS Evaluation, Site 14, Columbia Aquifer

Chesapeake, Virginia

Analyte	Detection Frequency	Maximum Detected Concentration (Qualifier) (NG/L)	Sample Location of Maximum Detected Concentration	Carcinogenic Tap Water RSL (NG/L)	Acceptable Risk Level	Cancer Risk[a]	Non-carcinogenic Tap Water RSL (NG/L)	Acceptable Hazard Level	Hazard Index[b]	Target Organ	Retained for Further Consideration?
Perfluorooctane Sulfonate (PFOS)	4 / 7	2.5E+02	OF14-MW06S-0616	N/A			4.0E+02	1	0.6	Developmental	Yes
Perfluorooctanoic acid (PFOA)	7 / 7	3.7E+02	OF14-MW07S-0616	1.1E+03	1E-06	3E-07	4.0E+02	1	0.9	Developmental	
Cumulative Hazard Index[c]									**2**		
Cumulative Cancer Risk[d]						**3E-07**					
									Total Developmental HI =	**2**	

Notes:

[a] Cancer Risk equals maximum detected concentration divided by the RSL divided by the acceptable risk level.

[b] Hazard Index equals maximum detected concentration divided by the RSL divided by the acceptable hazard level.

[c] Cumulative Hazard Index equals sum of Hazard Indices for each constituent.

[d] Cumulative Cancer Risk equals sum of Cancer Risks for each constituent.

Constituent selected as COPC if it contributes to an overall Hazard Index by target organ greater than 0.5 or Cumulative Cancer Risk greater than 5E-05, otherwise, constituent not selected as COPC.

Constituents selected as COPCs are indicated by shading.

COPC = Constituent of Potential Concern

HI = Hazard Index

NG/L = Nanograms/Liter

N/A = Not available/not applicable

RSL = Regional Screening Level

Table 5-13. Occurrence, Distribution and Selection of Chemicals of Potential Concern

Fentress Basewide PFAS Evaluation, Site 14, Yorktown Aquifer

Chesapeake, Virginia

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Point	CAS Number	Chemical	Minimum [1] Concentration Qualifier	Maximum [1] Concentration Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration [2] Used for Screening	Background [3] Value	Screening [4] Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for [5] Contaminant Deletion or Selection	Retained for Further Consideration?
Site 14 Yorktown Aquifer Groundwater	335-67-1	Perfluorooctanoic acid (PFOA)	7.8E-01 J	1.9E+00 J	NG/L	OF14-MW07D-1215	2/4	N/A	1.9E+00	N/A	4.0E+01 N	7.0E+01	HA	NO	BSL	No

[1] Minimum/Maximum detected concentrations (samples OF14-MW06D-1215, OF14-MW06D-0616, OF14-MW07D-1215, and OF14-MW07D-0616).

[2] Maximum detected concentration is used for screening.

[3] Background values not available

[4] Oak Ridge National Laboratory (ORNL). November 2017. Regional Screening Levels for Chemical Contaminants at Superfund Sites.
Tap Water RSLs (based on 10^{-6} for carcinogens and HQ of 0.1 for noncarcinogens).
RSL values for PFOA was calculated using the RSL calculator tool.

[5] Rationale Codes

Selection Reason: Above Screening Levels (ASL)
Deletion Reason: Below Screening Level (BSL)
No toxicity value (NTX)

COPC = Chemical of Potential Concern
ARAR/TBC = Applicable or Relevant and Appropriate Requirement/ To Be Considered
J = Estimated Value
C = Carcinogenic
N = Noncarcinogenic
N/A = Not available
HA = USEPA Lifetime Health Advisory (May 2016)
NG/L = Nanograms/Liter

Table 5-14. Occurrence, Distribution and Selection of Chemicals of Potential Concern

Fentress Basewide PFAS Evaluation, Site 17 Original, Columbia Aquifer

Chesapeake, Virginia

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Point	CAS Number	Chemical	Minimum [1] Concentration Qualifier	Maximum [1] Concentration Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration [2] Used for Screening	Background [3] Value	Screening [4] Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for [5] Contaminant Deletion or Selection
Site 17 Location 1 Columbia Aquifer Groundwater	375-73-5	Perfluorobutanesulfonic acid (PFBS)	7.5E+02	1.4E+03	NG/L	OF-MW11-0616	2/2	N/A	1.4E+03	N/A	4.0E+04 N	N/A		NO	BSL
	375-85-9	Perfluoroheptanoic acid (PFHpA)	3.1E+02	4.0E+02	NG/L	OF-MW11-0616	2/2	N/A	4.0E+02	N/A	N/A	N/A		NO	NTX
	355-46-4	Perfluorohexanesulfonic acid (PFHxS)	4.8E+03	7.9E+03	NG/L	OF-MW11-0616	2/2	N/A	7.9E+03	N/A	N/A	N/A		NO	NTX
	375-95-1	Perfluorononanoic acid (PFNA)	2.1E+01	2.3E+01	NG/L	OF-MW11-1215	2/2	N/A	2.3E+01	N/A	N/A	N/A		NO	NTX
	1763-23-1	**Perfluorooctane Sulfonate (PFOS)**	**3.0E+03**	**5.3E+03**	**NG/L**	**OF-MW11-0616**	**2/2**	**N/A**	**5.3E+03**	**N/A**	**4.0E+01 N**	**7.0E+01**	**HA**	**YES**	**ASL**
	335-67-1	**Perfluorooctanoic acid (PFOA)**	**3.2E+02**	**4.2E+02**	**NG/L**	**OF-MW11-0616**	**2/2**	**N/A**	**4.2E+02**	**N/A**	**4.0E+01 N**	**7.0E+01**	**HA**	**YES**	**ASL**

[1] Minimum/Maximum detected concentrations (samples OF-MW11-1215 and OF-MW11-0616).

[2] Maximum detected concentration is used for screening.

[3] Background values not available

[4] Oak Ridge National Laboratory (ORNL). November 2017. Regional Screening Levels for Chemical Contaminants at Superfund Sites.
Tap Water RSLs (based on 10^{-6} for carcinogens and HQ of 0.1 for noncarcinogens).
RSL values for PFOS and PFOA were calculated using the RSL calculator tool.

[5] Rationale Codes
Selection Reason: Above Screening Levels (ASL)
Deletion Reason: Below Screening Level (BSL)
No toxicity value (NTX)

COPC = Chemical of Potential Concern
ARAR/TBC = Applicable or Relevant and Appropriate Requirement/
To Be Considered
J = Estimated Value
C = Carcinogenic
N = Noncarcinogenic
N/A = Not available
HA = USEPA Lifetime Health Advisory (May 2016)
NG/L = Nanograms/Liter

Table 5-14a. Risk Ratio Screening

Fentress Basewide PFAS Evaluation, Site 17 Original, Columbia Aquifer

Chesapeake, Virginia

Analyte	Detection Frequency	Maximum Detected Concentration (Qualifier) (NG/L)	Sample Location of Maximum Detected Concentration	Carcinogenic Tap Water RSL (NG/L)	Acceptable Risk Level	Cancer Risk[a]	Non-carcinogenic Tap Water RSL (NG/L)	Acceptable Hazard Level	Hazard Index[b]	Target Organ	Retained for Further Consideration?
Perfluorooctane Sulfonate (PFOS)	2 / 2	5.3E+03	OF-MW11-0616	N/A			4.0E+02	1	13	Developmental	Yes
Perfluorooctanoic acid (PFOA)	2 / 2	4.2E+02	OF-MW11-0616	1.1E+03	1E-06	4E-07	4.0E+02	1	1	Developmental	
Cumulative Hazard Index[c]									**14**		
Cumulative Cancer Risk[d]						**4E-07**					
								Total Developmental HI =		**14**	

Notes:

[a] Cancer Risk equals maximum detected concentration divided by the RSL divided by the acceptable risk level.

[b] Hazard Index equals maximum detected concentration divided by the RSL divided by the acceptable hazard level.

[c] Cumulative Hazard Index equals sum of Hazard Indices for each constituent.

[d] Cumulative Cancer Risk equals sum of Cancer Risks for each constituent.

Constituent selected as COPC if it contributes to an overall Hazard Index by target organ greater than 0.5 or Cumulative Cancer Risk greater than 5E-05, otherwise, constituent not selected as COPC.

Constituents selected as COPCs are indicated by shading.

COPC = Constituent of Potential Concern

HI = Hazard Index

NG/L = Nanograms/Liter

N/A = Not available/not applicable

RSL = Regional Screening Level

Table 5-15. Occurrence, Distribution and Selection of Chemicals of Potential Concern

Fentress Basewide PFAS Evaluation, Site 17 Original, Yorktown Aquifer

Chesapeake, Virginia

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Point	CAS Number	Chemical	Minimum [1] Concentration Qualifier	Maximum [1] Concentration Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration [2] Used for Screening	Background [3] Value	Screening [4] Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for [5] Contaminant Deletion or Selection	Retained for Further Consideration?
Site 17 Location 1 Yorktown Aquifer Groundwater	375-73-5	Perfluorobutanesulfonic acid (PFBS)	3.4E+00	3.4E+00	NG/L	OF-MW11D-0116	1/2	N/A	3.4E+00	N/A	4.0E+04 N	N/A		NO	BSL	No
	375-85-9	Perfluoroheptanoic acid (PFHpA)	1.5E+00 J	1.5E+00 J	NG/L	OF-MW11D-0116	1/2	N/A	1.5E+00	N/A	N/A	N/A		NO	NTX	
	355-46-4	Perfluorohexanesulfonic acid (PFHxS)	3.1E+00 J	2.4E+01	NG/L	OF-MW11D-0116	2/2	N/A	2.4E+01	N/A	N/A	N/A		NO	NTX	
	1763-23-1	Perfluorooctane Sulfonate (PFOS)	7.5E+00 J	2.8E+01	NG/L	OF-MW11D-0116	2/2	N/A	2.8E+01	N/A	4.0E+01 N	7.0E+01	HA	NO	BSL	
	335-67-1	Perfluorooctanoic acid (PFOA)	8.4E-01 J	1.7E+00 J	NG/L	OF-MW11D-0116	2/2	N/A	1.7E+00	N/A	4.0E+01 N	7.0E+01	HA	NO	BSL	

[1] Minimum/Maximum detected concentrations (samples OF-MW11D-0116 and OF-MW11D-0616).

[2] Maximum detected concentration is used for screening.

[3] Background values not available

[4] Oak Ridge National Laboratory (ORNL). November 2017. Regional Screening Levels for Chemical Contaminants at Superfund Sites.
Tap Water RSLs (based on 10^{-6} for carcinogens and HQ of 0.1 for noncarcinogens).
RSL values for PFOS and PFOA were calculated using the RSL calculator tool.

[5] Rationale Codes

Selection Reason: Above Screening Levels (ASL)

Deletion Reason: Below Screening Level (BSL)
No toxicity value (NTX)

COPC = Chemical of Potential Concern

ARAR/TBC = Applicable or Relevant and Appropriate Requirement/
To Be Considered

J = Estimated Value

C = Carcinogenic

N = Noncarcinogenic

N/A = Not available

HA = USEPA Lifetime Health Advisory (May 2016)

NG/L = Nanograms/Liter

Table 5-16. Occurrence, Distribution and Selection of Chemicals of Potential Concern

Fentress Basewide PFAS Evaluation, Site 17 Revised, Columbia Aquifer

Chesapeake, Virginia

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Point	CAS Number	Chemical	Minimum [1] Concentration Qualifier	Maximum [1] Concentration Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration [2] Used for Screening	Background [3] Value	Screening [4] Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for [5] Contaminant Deletion or Selection
Site 17 Location 2 Columbia Aquifer Groundwater	375-73-5	Perfluorobutanesulfonic acid (PFBS)	6.8E+01	7.4E+02	NG/L	OF17-MW03-0517	4/4	N/A	7.4E+02	N/A	4.0E+04 N	N/A		NO	BSL
	375-85-9	Perfluoroheptanoic acid (PFHpA)	6.7E+02	2.3E+03	NG/L	OF17-MW04-0617	4/4	N/A	2.3E+03	N/A	N/A	N/A		NO	NTX
	355-46-4	Perfluorohexanesulfonic acid (PFHxS)	3.8E+03	1.1E+04 J	NG/L	OF17-MW03-0517	4/4	N/A	1.1E+04	N/A	N/A	N/A		NO	NTX
	375-95-1	Perfluorononanoic acid (PFNA)	2.9E+02	7.1E+02	NG/L	OF17-MW03-0517	4/4	N/A	7.1E+02	N/A	N/A	N/A		NO	NTX
	1763-23-1	**Perfluorooctane Sulfonate (PFOS)**	**8.8E+03**	**4.5E+04 J**	**NG/L**	**OF17-MW04-0617**	**4/4**	**N/A**	**4.5E+04**	**N/A**	**4.0E+01 N**	**7.0E+01**	**HA**	**YES**	**ASL**
	335-67-1	**Perfluorooctanoic acid (PFOA)**	**8.2E+02**	**3.4E+03**	**NG/L**	**OF17-MW04-0617**	**4/4**	**N/A**	**3.4E+03**	**N/A**	**4.0E+01 N**	**7.0E+01**	**HA**	**YES**	**ASL**

[1] Minimum/Maximum detected concentrations (samples OF17-MW01-0617, OF17-MW01P-0617, OF17-MW02-0517, OF17-MW03-0517, and OF17-MW04-0617).

[2] Maximum detected concentration is used for screening.

[3] Background values not available

[4] Oak Ridge National Laboratory (ORNL). November 2017. Regional Screening Levels for Chemical Contaminants at Superfund Sites.
Tap Water RSLs (based on 10^{-6} for carcinogens and HQ of 0.1 for noncarcinogens).
RSL values for PFOS and PFOA were calculated using the RSL calculator tool.

[5] Rationale Codes
Selection Reason: Above Screening Levels (ASL)
Deletion Reason: Below Screening Level (BSL)
No toxicity value (NTX)

COPC = Chemical of Potential Concern
ARAR/TBC = Applicable or Relevant and Appropriate Requirement/
To Be Considered
J = Estimated Value
C = Carcinogenic
N = Noncarcinogenic
N/A = Not available
HA = USEPA Lifetime Health Advisory (May 2016)
NG/L = Nanograms/Liter

Table 5-16a. Risk Ratio Screening

Fentress Basewide PFAS Evaluation, Site 17 Revised, Columbia Aquifer

Chesapeake, Virginia

Analyte	Detection Frequency	Maximum Detected Concentration (Qualifier) (NG/L)	Sample Location of Maximum Detected Concentration	Carcinogenic Tap Water RSL (NG/L)	Acceptable Risk Level	Cancer Risk[a]	Non-carcinogenic Tap Water RSL (NG/L)	Acceptable Hazard Level	Hazard Index[b]	Target Organ	Retained for Further Consideration?
Perfluorooctane Sulfonate (PFOS)	4 / 4	4.5E+04 J	OF17-MW04-0617	N/A			4.0E+02	1	111	Developmental	Yes
Perfluorooctanoic acid (PFOA)	4 / 4	3.4E+03	OF17-MW04-0617	1.1E+03	1E-06	3E-06	4.0E+02	1	9	Developmental	
Cumulative Hazard Index[c]									**120**		
Cumulative Cancer Risk[d]						**3E-06**					
									Total Developmental HI =	**120**	

Notes:

[a] Cancer Risk equals maximum detected concentration divided by the RSL divided by the acceptable risk level.

[b] Hazard Index equals maximum detected concentration divided by the RSL divided by the acceptable hazard level.

[c] Cumulative Hazard Index equals sum of Hazard Indices for each constituent.

[d] Cumulative Cancer Risk equals sum of Cancer Risks for each constituent.

Constituent selected as COPC if it contributes to an overall Hazard Index by target organ greater than 0.5 or Cumulative Cancer Risk greater than 5E-05, otherwise, constituent not selected as COPC.

Constituents selected as COPCs are indicated by shading.

COPC = Constituent of Potential Concern

HI = Hazard Index

NG/L = Nanograms/Liter

N/A = Not available/not applicable

RSL = Regional Screening Level

Table 5-17. Occurrence, Distribution and Selection of Chemicals of Potential Concern

Fentress Basewide PFAS Evaluation, New Irrigation Sprayfield, Columbia Aquifer

Chesapeake, Virginia

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Point	CAS Number	Chemical	Minimum [1] Concentration Qualifier	Maximum [1] Concentration Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration [2] Used for Screening	Background [3] Value	Screening [4] Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for [5] Contaminant Deletion or Selection
New Irrigation Sprayfield Columbia Aquifer Groundwater	375-73-5	Perfluorobutanesulfonic acid (PFBS)	3.2E+00	9.7E+01	NG/L	OF-MW16-0616	4/4	N/A	9.7E+01	N/A	4.0E+04 N	N/A		NO	BSL
	375-85-9	Perfluoroheptanoic acid (PFHpA)	1.3E+00	2.6E+00	NG/L	OF-MW17-0616	3/4	N/A	2.6E+00	N/A	N/A	N/A		NO	NTX
	355-46-4	Perfluorohexanesulfonic acid (PFHxS)	3.5E+01	7.2E+02	NG/L	OF-MW16-0616	4/4	N/A	7.2E+02	N/A	N/A	N/A		NO	NTX
	375-95-1	Perfluorononanoic acid (PFNA)	9.9E-01 J	9.9E-01 J	NG/L	OF-MW17-1215	1/4	N/A	9.9E-01	N/A	N/A	N/A		NO	NTX
	1763-23-1	**Perfluorooctane Sulfonate (PFOS)**	**1.9E+01**	**1.1E+02**	**NG/L**	**OF-MW16-0616**	**4/4**	**N/A**	**1.1E+02**	**N/A**	**4.0E+01 N**	**7.0E+01**	**HA**	**YES**	**ASL**
	335-67-1	**Perfluorooctanoic acid (PFOA)**	**6.8E+00**	**3.0E+01**	**NG/L**	**OF-MW17-0616**	**4/4**	**N/A**	**3.0E+01**	**N/A**	**4.0E+01 N**	**7.0E+01**	**HA**	**YES**	**PFOS+PFOA**

[1] Minimum/Maximum detected concentrations (samples OF-MW16-1215, OF-MW16P-1215, OF-MW16-0616, OF-MW17-1215, and OF-MW17-0616).

[2] Maximum detected concentration is used for screening.

[3] Background values not available

[4] Oak Ridge National Laboratory (ORNL). November 2017. Regional Screening Levels for Chemical Contaminants at Superfund Sites.
Tap Water RSLs (based on 10^{-6} for carcinogens and HQ of 0.1 for noncarcinogens).
RSL values for PFOS and PFOA were calculated using the RSL calculator tool.

[5] Rationale Codes

Selection Reason: Above Screening Levels (ASL)
Combined concentration of PFOS and PFOA exceeds the RSL (PFOS+PFOA)

Deletion Reason: Below Screening Level (BSL)
No toxicity value (NTX)

COPC = Chemical of Potential Concern
ARAR/TBC = Applicable or Relevant and Appropriate Requirement/
To Be Considered
J = Estimated Value
C = Carcinogenic
N = Noncarcinogenic
N/A = Not available
HA = USEPA Lifetime Health Advisory (May 2016)
NG/L = Nanograms/Liter

Table 5-17a. Risk Ratio Screening

Fentress Basewide PFAS Evaluation, New Irrigation Sprayfield, Columbia Aquifer

Chesapeake, Virginia

Analyte	Detection Frequency	Maximum Detected Concentration (Qualifier) (NG/L)	Sample Location of Maximum Detected Concentration	Carcinogenic Tap Water RSL (NG/L)	Acceptable Risk Level	Cancer Risk[a]	Non-carcinogenic Tap Water RSL (NG/L)	Acceptable Hazard Level	Hazard Index[b]	Target Organ	Retained for Further Consideration?
Perfluorooctane Sulfonate (PFOS)	4 / 4	1.1E+02	OF-MW16-0616	N/A	N/A	N/A	4.0E+02	1	0.3	Developmental	No
Perfluorooctanoic acid (PFOA)	4 / 4	3.0E+01	OF-MW17-0616	1.1E+03	1E-06	3E-08	4.0E+02	1	0.07	Developmental	
Cumulative Hazard Index[c]									**0.3**		
Cumulative Cancer Risk[d]						**3E-08**					
								Total Developmental HI =		**0.3**	

Notes:

[a] Cancer Risk equals maximum detected concentration divided by the RSL divided by the acceptable risk level.

[b] Hazard Index equals maximum detected concentration divided by the RSL divided by the acceptable hazard level.

[c] Cumulative Hazard Index equals sum of Hazard Indices for each constituent.

[d] Cumulative Cancer Risk equals sum of Cancer Risks for each constituent.

Constituent selected as COPC if it contributes to an overall Hazard Index by target organ greater than 0.5 or Cumulative Cancer Risk greater than 5E-05, otherwise, constituent not selected as COPC.

Constituents selected as COPCs are indicated by shading.

COPC = Constituent of Potential Concern

HI = Hazard Index

NG/L = Nanograms/Liter

N/A = Not available/not applicable

RSL = Regional Screening Level

Table 5-18. Occurrence, Distribution and Selection of Chemicals of Potential Concern

Fentress Basewide PFAS Evaluation, Old Irrigation Sprayfield, Columbia Aquifer

Chesapeake, Virginia

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Point	CAS Number	Chemical	Minimum [1] Concentration Qualifier	Maximum [1] Concentration Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration [2] Used for Screening	Background [3] Value	Screening [4] Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for [5] Contaminant Deletion or Selection
Old Irrigation Sprayfield Columbia Aquifer Groundwater	375-73-5	Perfluorobutanesulfonic acid (PFBS)	1.1E+02	1.1E+02	NG/L	OF-MW24-0716	1/1	N/A	1.1E+02	N/A	4.0E+04 N	N/A		NO	BSL
	375-85-9	Perfluoroheptanoic acid (PFHpA)	5.8E+01	5.8E+01	NG/L	OF-MW24-0716	1/1	N/A	5.8E+01	N/A	N/A	N/A		NO	NTX
	355-46-4	Perfluorohexanesulfonic acid (PFHxS)	1.7E+03	1.7E+03	NG/L	OF-MW24-0716	1/1	N/A	1.7E+03	N/A	N/A	N/A		NO	NTX
	375-95-1	Perfluorononanoic acid (PFNA)	8.6E+00 J	8.6E+00 J	NG/L	OF-MW24-0716	1/1	N/A	8.6E+00	N/A	N/A	N/A		NO	NTX
	1763-23-1	**Perfluorooctane Sulfonate (PFOS)**	**3.3E+03**	**3.3E+03**	**NG/L**	**OF-MW24-0716**	**1/1**	**N/A**	**3.3E+03**	**N/A**	**4.0E+01 N**	**7.0E+01**	**HA**	**YES**	**ASL**
	335-67-1	**Perfluorooctanoic acid (PFOA)**	**3.1E+02**	**3.1E+02**	**NG/L**	**OF-MW24-0716**	**1/1**	**N/A**	**3.1E+02**	**N/A**	**4.0E+01 N**	**7.0E+01**	**HA**	**YES**	**ASL**

[1] Minimum/Maximum detected concentrations (sample OF-MW24-0716).

[2] Maximum detected concentration is used for screening.

[3] Background values not available

[4] Oak Ridge National Laboratory (ORNL). November 2017. Regional Screening Levels for Chemical Contaminants at Superfund Sites. Tap Water RSLs (based on 10^{-6} for carcinogens and HQ of 0.1 for noncarcinogens).
RSL values for PFOS and PFOA were calculated using the RSL calculator tool.

[5] Rationale Codes
Selection Reason: Above Screening Levels (ASL)
Deletion Reason: Below Screening Level (BSL)
No toxicity value (NTX)

COPC = Chemical of Potential Concern
ARAR/TBC = Applicable or Relevant and Appropriate Requirement/ To Be Considered
J = Estimated Value
C = Carcinogenic
N = Noncarcinogenic
N/A = Not available
HA = USEPA Lifetime Health Advisory (May 2016)
NG/L = Nanograms/Liter

Table 5-18a. Risk Ratio Screening

Fentress Basewide PFAS Evaluation, Old Irrigation Sprayfield, Columbia Aquifer

Chesapeake, Virginia

Analyte	Detection Frequency	Maximum Detected Concentration (Qualifier) (NG/L)	Sample Location of Maximum Detected Concentration	Carcinogenic Tap Water RSL (NG/L)	Acceptable Risk Level	Cancer Risk[a]	Non-carcinogenic Tap Water RSL (NG/L)	Acceptable Hazard Level	Hazard Index[b]	Target Organ	Retained for Further Consideration?
Perfluorooctane Sulfonate (PFOS)	1 / 1	3.3E+03	OF-MW24-0716	N/A			4.0E+02	1	8	Developmental	Yes
Perfluorooctanoic acid (PFOA)	1 / 1	3.1E+02	OF-MW24-0716	1.1E+03	1E-06	3E-07	4.0E+02	1	0.8	Developmental	
Cumulative Hazard Index[c]									**9**		
Cumulative Cancer Risk[d]						**3E-07**					
									Total Developmental HI =	**9**	

Notes:

[a] Cancer Risk equals maximum detected concentration divided by the RSL divided by the acceptable risk level.

[b] Hazard Index equals maximum detected concentration divided by the RSL divided by the acceptable hazard level.

[c] Cumulative Hazard Index equals sum of Hazard Indices for each constituent.

[d] Cumulative Cancer Risk equals sum of Cancer Risks for each constituent.

Constituent selected as COPC if it contributes to an overall Hazard Index by target organ greater than 0.5 or Cumulative Cancer Risk greater than 5E-05, otherwise, constituent not selected as COPC.

Constituents selected as COPCs are indicated by shading.

COPC = Constituent of Potential Concern

HI = Hazard Index

NG/L = Nanograms/Liter

N/A = Not available/not applicable

RSL = Regional Screening Level

Table 5-19. Occurrence, Distribution and Selection of Chemicals of Potential Concern

Fentress Basewide PFAS Evaluation, Off-Base Non-Potable, Columbia Aquifer

Chesapeake, Virginia

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Point	CAS Number	Chemical	Minimum [1] Concentration Qualifier	Maximum [1] Concentration Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration [2] Used for Screening	Background [3] Value	Screening [4] Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for [5] Contaminant Deletion or Selection
Off-Base Non-Potable Columbia Aquifer Groundwater	375-73-5	Perfluorobutanesulfonic acid (PFBS)	2.5E+00	4.0E+01	NG/L	OF-MW21-1117	3/5	N/A	4.0E+01	N/A	4.0E+04 N	N/A		NO	BSL
	375-85-9	Perfluoroheptanoic acid (PFHpA)	9.2E+00 J	1.6E+01	NG/L	OF-MW21-1117	2/5	N/A	1.6E+01	N/A	N/A	N/A		NO	NTX
	355-46-4	Perfluorohexanesulfonic acid (PFHxS)	1.4E+01	1.4E+03	NG/L	OF-MW21-1117	3/5	N/A	1.4E+03	N/A	N/A	N/A		NO	NTX
	375-95-1	Perfluorononanoic acid (PFNA)	1.1E+00 J	1.1E+00 J	NG/L	OF-MW21-1117	1/5	N/A	1.1E+00	N/A	N/A	N/A		NO	NTX
	1763-23-1	**Perfluorooctane Sulfonate (PFOS)**	**8.3E+02**	**8.3E+02**	**NG/L**	**OF-MW22-1117**	**1/5**	**N/A**	**8.3E+02**	**N/A**	**4.0E+01 N**	**7.0E+01**	**HA**	**YES**	**ASL**
	335-67-1	**Perfluorooctanoic acid (PFOA)**	**8.1E+00 J**	**2.4E+02**	**NG/L**	**OF-MW21-1117**	**3/5**	**N/A**	**2.4E+02**	**N/A**	**4.0E+01 N**	**7.0E+01**	**HA**	**YES**	**ASL**
	307-24-4	Perfluorohexanoic Acid (PFHxA)	4.5E+01	9.6E+01	NG/L	OF-MW21-1117	2/5	N/A	9.6E+01	N/A	N/A	N/A		NO	NTX

[1] Minimum/Maximum detected concentrations (samples OF-MW19-1117, OF-MW20-1117, OF-MW20P-1117, OF-MW21-1117, OF-MW22-1117, and OF-MW33-1117).

[2] Maximum detected concentration is used for screening.

[3] Background values not available

[4] Oak Ridge National Laboratory (ORNL). November 2017. Regional Screening Levels for Chemical Contaminants at Superfund Sites.
Tap Water RSLs (based on 10^{-6} for carcinogens and HQ of 0.1 for noncarcinogens).
RSL values for PFOS and PFOA were calculated using the RSL calculator tool.

[5] Rationale Codes

Selection Reason: Above Screening Levels (ASL)
Combined concentration of PFOS and PFOA exceeds the RSL (PFOS+PFOA)

Deletion Reason: Below Screening Level (BSL)
No toxicity value (NTX)

COPC = Chemical of Potential Concern
ARAR/TBC = Applicable or Relevant and Appropriate Requirement/ To Be Considered
J = Estimated Value
C = Carcinogenic
N = Noncarcinogenic
N/A = Not available
HA = USEPA Lifetime Health Advisory (May 2016)
NG/L = Nanograms/Liter

Table 5-19a. Risk Ratio Screening

Fentress Basewide PFAS Evaluation, Off-Base Non-Potable, Columbia Aquifer

Chesapeake, Virginia

Analyte	Detection Frequency	Maximum Detected Concentration (Qualifier) (NG/L)	Sample Location of Maximum Detected Concentration	Carcinogenic Tap Water RSL (NG/L)	Acceptable Risk Level	Cancer Risk[a]	Non-carcinogenic Tap Water RSL (NG/L)	Acceptable Hazard Level	Hazard Index[b]	Target Organ	Retained for Further Consideration?
Perfluorooctane Sulfonate (PFOS)	1 / 5	8.3E+02	OF-MW22-1117	N/A			4.0E+02	1	2	Developmental	Yes
Perfluorooctanoic acid (PFOA)	3 / 5	2.4E+02	OF-MW21-1117	1.1E+03	1E-06	2E-07	4.0E+02	1	0.6	Developmental	
Cumulative Hazard Index[c]									**3**		
Cumulative Cancer Risk[d]						**2E-07**					
									Total Developmental HI =	**3**	

Notes:

[a] Cancer Risk equals maximum detected concentration divided by the RSL divided by the acceptable risk level.

[b] Hazard Index equals maximum detected concentration divided by the RSL divided by the acceptable hazard level.

[c] Cumulative Hazard Index equals sum of Hazard Indices for each constituent.

[d] Cumulative Cancer Risk equals sum of Cancer Risks for each constituent.

Constituent selected as COPC if it contributes to an overall Hazard Index by target organ greater than 0.5 or Cumulative Cancer Risk greater than 5E-05, otherwise, constituent not selected as COPC.

Constituents selected as COPCs are indicated by shading.

COPC = Constituent of Potential Concern

HI = Hazard Index

NG/L = Nanograms/Liter

N/A = Not available/not applicable

RSL = Regional Screening Level

Table 5-20. Occurrence, Distribution and Selection of Chemicals of Potential Concern

Fentress Basewide PFAS Evaluation, Off-Base Non-Potable, Yorktown Aquifer

Chesapeake, Virginia

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Point	CAS Number	Chemical	Minimum [1] Concentration Qualifier	Maximum [1] Concentration Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration [2] Used for Screening	Background [3] Value	Screening [4] Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for [5] Contaminant Deletion or Selection
Off-Base Non-Potable Yorktown Aquifer Groundwater	355-46-4	Perfluorohexanesulfonic acid (PFHxS)	1.5E+01	1.5E+01	NG/L	OF-MW22D-1117	1/2	N/A	1.5E+01	N/A	N/A	N/A		NO	NTX
	1763-23-1	**Perfluorooctane Sulfonate (PFOS)**	**6.0E+01**	**6.0E+01**	**NG/L**	**OF-MW22D-1117**	**1/2**	**N/A**	**6.0E+01**	**N/A**	**4.0E+01 N**	**7.0E+01**	**HA**	**YES**	**ASL**
	335-67-1	**Perfluorooctanoic acid (PFOA)**	**4.9E+00 J**	**4.9E+00 J**	**NG/L**	**OF-MW22D-1117**	**1/2**	**N/A**	**4.9E+00**	**N/A**	**4.0E+01 N**	**7.0E+01**	**HA**	**YES**	**PFOS+PFOA**

[1] Minimum/Maximum detected concentrations (samples OF-MW19D-1117, OF-MW22D-1117, and OF-MW33D-1117).

[2] Maximum detected concentration is used for screening.

[3] Background values not available

[4] Oak Ridge National Laboratory (ORNL). November 2017. Regional Screening Levels for Chemical Contaminants at Superfund Sites.
Tap Water RSLs (based on 10^{-6} for carcinogens and HQ of 0.1 for noncarcinogens).
RSL values for PFOS and PFOA were calculated using the RSL calculator tool.

[5] Rationale Codes

Selection Reason: Above Screening Levels (ASL)
Combined concentration of PFOS and PFOA exceeds the RSL (PFOS+PFOA)

Deletion Reason: Below Screening Level (BSL)
No toxicity value (NTX)

COPC = Chemical of Potential Concern
ARAR/TBC = Applicable or Relevant and Appropriate Requirement/ To Be Considered
J = Estimated Value
C = Carcinogenic
N = Noncarcinogenic
N/A = Not available
HA = USEPA Lifetime Health Advisory (May 2016)
NG/L = Nanograms/Liter

Table 5-20a. Risk Ratio Screening

Fentress Basewide PFAS Evaluation, Off-Base Non-Potable, Yorktown Aquifer

Chesapeake, Virginia

Analyte	Detection Frequency	Maximum Detected Concentration (Qualifier) (NG/L)	Sample Location of Maximum Detected Concentration	Carcinogenic Tap Water RSL (NG/L)	Acceptable Risk Level	Cancer Risk[a]	Non-carcinogenic Tap Water RSL (NG/L)	Acceptable Hazard Level	Hazard Index[b]	Target Organ	Retained for Further Consideration?
Perfluorooctane Sulfonate (PFOS)	1 / 2	6.0E+01	OF-MW22D-1117	N/A			4.0E+02	1	0.1	Developmental	No
Perfluorooctanoic acid (PFOA)	1 / 2	4.9E+00 J	OF-MW22D-1117	1.1E+03	1E-06	4E-09	4.0E+02	1	0.01	Developmental	
Cumulative Hazard Index[c]									**0.2**		
Cumulative Cancer Risk[d]						**4E-09**					
								Total Developmental HI =		**0.2**	

Notes:

[a] Cancer Risk equals maximum detected concentration divided by the RSL divided by the acceptable risk level.

[b] Hazard Index equals maximum detected concentration divided by the RSL divided by the acceptable hazard level.

[c] Cumulative Hazard Index equals sum of Hazard Indices for each constituent.

[d] Cumulative Cancer Risk equals sum of Cancer Risks for each constituent.

Constituent selected as COPC if it contributes to an overall Hazard Index by target organ greater than 0.5 or Cumulative Cancer Risk greater than 5E-05, otherwise, constituent not selected as COPC.

Constituents selected as COPCs are indicated by shading.

COPC = Constituent of Potential Concern

HI = Hazard Index

NG/L = Nanograms/Liter

N/A = Not available/not applicable

RSL = Regional Screening Level

Table 5-21. Occurrence, Distribution and Selection of Chemicals of Potential Concern

Fentress Basewide PFAS Evaluation, Residential Wells

Chesapeake, Virginia

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Point	CAS Number	Chemical	Minimum [1] Concentration Qualifier	Maximum [1] Concentration Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration [2] Used for Screening	Background [3] Value	Screening [4] Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for [5] Contaminant Deletion or Selection
Residential Wells Groundwater	375-73-5	Perfluorobutanesulfonic acid (PFBS)	5.2E-01 J	6.2E+01	NG/L	OF-RW42B-0216	25/66	N/A	6.2E+01	N/A	4.0E+04 N	N/A		NO	BSL
	375-85-9	Perfluoroheptanoic acid (PFHpA)	4.6E-01 J	2.8E+01	NG/L	OF-RW44P-0216	18/66	N/A	2.8E+01	N/A	N/A	N/A		NO	NTX
	355-46-4	Perfluorohexanesulfonic acid (PFHxS)	4.4E-01 J	7.0E+02 J	NG/L	OF-RW42B-0216	28/66	N/A	7.0E+02	N/A	N/A	N/A		NO	NTX
	375-95-1	Perfluorononanoic acid (PFNA)	3.7E-01 J	6.5E+00	NG/L	OF-RW44P-0216	14/66	N/A	6.5E+00	N/A	N/A	N/A		NO	NTX
	1763-23-1	**Perfluorooctane Sulfonate (PFOS)**	**3.2E-01 J**	**1.2E+03**	**NG/L**	**OF-RW44P-0216**	**23/66**	**N/A**	**1.2E+03**	**N/A**	**4.0E+01 N**	**7.0E+01**	**HA**	**YES**	**ASL**
	335-67-1	**Perfluorooctanoic acid (PFOA)**	**4.1E-01 J**	**4.6E+02**	**NG/L**	**OF-RW44P-0216**	**21/66**	**N/A**	**4.6E+02**	**N/A**	**4.0E+01 N**	**7.0E+01**	**HA**	**YES**	**ASL**

[1] Minimum/Maximum detected concentrations. All of-site residential well samples included in data set

[2] Maximum detected concentration is used for screening.

[3] Background values not available

[4] Oak Ridge National Laboratory (ORNL). November 2017. Regional Screening Levels for Chemical Contaminants at Superfund Sites.
Tap Water RSLs (based on 10^{-6} for carcinogens and HQ of 0.1 for noncarcinogens).
RSL values for PFOS and PFOA were calculated using the RSL calculator tool.

[5] Rationale Codes

Selection Reason: Above Screening Levels (ASL)
Combined concentration of PFOS and PFOA exceeds the RSL (PFOS+PFOA)

Deletion Reason: Below Screening Level (BSL)
No toxicity value (NTX)

COPC = Chemical of Potential Concern
ARAR/TBC = Applicable or Relevant and Appropriate Requirement/
To Be Considered
J = Estimated Value
C = Carcinogenic
N = Noncarcinogenic
N/A = Not available
HA = USEPA Lifetime Health Advisory (May 2016)
NG/L = Nanograms/Liter

Table 5-21a. Risk Ratio Screening

Fentress Basewide PFAS Evaluation, Residential Wells

Chesapeake, Virginia

Analyte	Detection Frequency	Maximum Detected Concentration (Qualifier) (NG/L)	Sample Location of Maximum Detected Concentration	Carcinogenic Tap Water RSL (NG/L)	Acceptable Risk Level	Cancer Risk[a]	Non-carcinogenic Tap Water RSL (NG/L)	Acceptable Hazard Level	Hazard Index[b]	Target Organ	Retained for Further Consideration?
Perfluorooctane Sulfonate (PFOS)	23 / 66	1.2E+03	OF-RW44P-0216	N/A			4.0E+02	1	3	Developmental	Yes
Perfluorooctanoic acid (PFOA)	21 / 66	4.6E+02	OF-RW44P-0216	1.1E+03	1E-06	4E-07	4.0E+02	1	1	Developmental	
Cumulative Hazard Index[c]									**4**		
Cumulative Cancer Risk[d]						**4E-07**					
								Total Developmental HI =	**4**		

Notes:

[a] Cancer Risk equals maximum detected concentration divided by the RSL divided by the acceptable risk level.

[b] Hazard Index equals maximum detected concentration divided by the RSL divided by the acceptable hazard level.

[c] Cumulative Hazard Index equals sum of Hazard Indices for each constituent.

[d] Cumulative Cancer Risk equals sum of Cancer Risks for each constituent.

Constituent selected as COPC if it contributes to an overall Hazard Index by target organ greater than 0.5 or Cumulative Cancer Risk greater than 5E-05, otherwise, constituent not selected as COPC.

Constituents selected as COPCs are indicated by shading.

COPC = Constituent of Potential Concern

HI = Hazard Index

NG/L = Nanograms/Liter

N/A = Not available/not applicable

RSL = Regional Screening Level

Table 5-22. Occurrence, Distribution and Selection of Chemicals of Potential Concern
Fentress Basewide PFAS Evaluation, On-Base Potable Water
Chesapeake, Virginia

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Point	CAS Number	Chemical	Minimum [1] Concentration Qualifier	Maximum [1] Concentration Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration [2] Used for Screening	Background [3] Value	Screening [4] Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for [5] Contaminant Deletion or Selection
On-Base Potable Water Groundwater	375-73-5	Perfluorobutanesulfonic acid (PFBS)	1.20E+01	3.50E+01	NG/L	OF-INF01-0516	2/2	N/A	3.5E+01	N/A	4.0E+04 N	N/A		NO	BSL
	375-85-9	Perfluoroheptanoic acid (PFHpA)	1.00E+01	9.80E+01	NG/L	OF-INF01-0516	2/2	N/A	9.8E+01	N/A	N/A	N/A		NO	NTX
	355-46-4	Perfluorohexanesulfonic acid (PFHxS)	2.60E+02	1.00E+03	NG/L	OF-INF01-0516	2/2	N/A	1.0E+03	N/A	N/A	N/A		NO	NTX
	375-95-1	Perfluorononanoic acid (PFNA)	1.80E+00 J	1.80E+00 J	NG/L	OF-INF01-1215	1/2	N/A	1.8E+00	N/A	N/A	N/A		NO	NTX
	1763-23-1	**Perfluorooctane Sulfonate (PFOS)**	**5.40E+02**	**1.80E+03**	**NG/L**	**OF-INF01-0516**	**2/2**	**N/A**	**1.8E+03**	**N/A**	**4.0E+01 N**	**7.0E+01**	**HA**	**YES**	**ASL**
	335-67-1	**Perfluorooctanoic acid (PFOA)**	**3.00E+02**	**5.30E+03**	**NG/L**	**OF-INF01-0516**	**2/2**	**N/A**	**5.3E+03**	**N/A**	**4.0E+01 N**	**7.0E+01**	**HA**	**YES**	**ASL**

[1] Minimum/Maximum detected concentrations (samples OF-INF01-1215, OF-INF01-0516, and OF-INF01-PT-0516).
[2] Maximum detected concentration is used for screening.
[3] Background values not available
[4] Oak Ridge National Laboratory (ORNL). November 2017. Regional Screening Levels for Chemical Contaminants at Superfund Sites.
Tap Water RSLs (based on 10^{-6} for carcinogens and HQ of 0.1 for noncarcinogens).
RSL values for PFOS and PFOA were calculated using the RSL calculator tool.
[5] Rationale Codes
Selection Reason: Above Screening Levels (ASL)
Combined concentration of PFOS and PFOA exceeds the RSL (PFOS+PFOA)
Deletion Reason: Below Screening Level (BSL)
No toxicity value (NTX)

COPC = Chemical of Potential Concern
ARAR/TBC = Applicable or Relevant and Appropriate Requirement/
To Be Considered
J = Estimated Value
C = Carcinogenic
N = Noncarcinogenic
N/A = Not available
HA = USEPA Lifetime Health Advisory (May 2016)
NG/L = Nanograms/Liter

Table 5-22a. Risk Ratio Screening

Fentress Basewide PFAS Evaluation, On-Base Potable Water

Chesapeake, Virginia

Analyte	Detection Frequency	Maximum Detected Concentration (Qualifier) (NG/L)	Sample Location of Maximum Detected Concentration	Carcinogenic Tap Water RSL (NG/L)	Acceptable Risk Level	Cancer Risk[a]	Non-carcinogenic Tap Water RSL (NG/L)	Acceptable Hazard Level	Hazard Index[b]	Target Organ	Retained for Further Consideration?
Perfluorooctane Sulfonate (PFOS)	2 / 2	1.8E+03	OF-INF01-0516	N/A			4.0E+02	1	5	Developmental	Yes
Perfluorooctanoic acid (PFOA)	2 / 2	5.3E+03	OF-INF01-0516	1.1E+03	1E-06	5E-06	4.0E+02	1	13	Developmental	
Cumulative Hazard Index[c]									**18**		
Cumulative Cancer Risk[d]						**5E-06**					
								Total Developmental HI =	**18**		

Notes:

[a] Cancer Risk equals maximum detected concentration divided by the RSL divided by the acceptable risk level.

[b] Hazard Index equals maximum detected concentration divided by the RSL divided by the acceptable hazard level.

[c] Cumulative Hazard Index equals sum of Hazard Indices for each constituent.

[d] Cumulative Cancer Risk equals sum of Cancer Risks for each constituent.

Constituent selected as COPC if it contributes to an overall Hazard Index by target organ greater than 0.5 or Cumulative Cancer Risk greater than 5E-05, otherwise, constituent not selected as COPC.

Constituents selected as COPCs are indicated by shading.

COPC = Constituent of Potential Concern

HI = Hazard Index

NG/L = Nanograms/Liter

N/A = Not available/not applicable

RSL = Regional Screening Level

Table 5-23. Occurrence, Distribution and Selection of Chemicals of Potential Concern

Fentress Basewide PFAS Evaluation, On-Base Soil

Chesapeake, Virginia

Scenario Timeframe: Current
Medium: Surface and Subsurface Soil
Exposure Medium: Surface and Subsurface Soil

Exposure Point	CAS Number	Chemical	Minimum [1] Concentration Qualifier	Maximum [1] Concentration Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration [2] Used for Screening	Background [3] Value	Screening [4] Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for [5] Contaminant Deletion or Selection
Surface and Subsurface Soil	375-73-5	Perfluorobutanesulfonic acid (PFBS)	1.2E-01 J	1.5E+00	UG/KG	OF-SS05-0217	9/16	0.34 - 0.46	1.5E+00	N/A	1.3E+05 N	N/A		NO	BSL
	375-85-9	Perfluoroheptanoic acid (PFHpA)	1.5E-01 J	1.5E+01	UG/KG	OF-SS05-0217	15/16	0.34 - 0.46	1.5E+01	N/A	N/A	N/A		NO	NTX
	355-46-4	Perfluorohexanesulfonic acid (PFHxS)	2.4E-01 J	3.0E+01	UG/KG	OF-SS05-0217	16/16	0.34 - 0.46	3.0E+01	N/A	N/A	N/A		NO	NTX
	375-95-1	Perfluorononanoic acid (PFNA)	3.1E-01 J	9.6E+00	UG/KG	OFPOL-SS04-0217	15/16	0.34 - 0.46	9.6E+00	N/A	N/A	N/A		NO	NTX
	1763-23-1	**Perfluorooctane Sulfonate (PFOS)**	**2.5E-01 J**	**3.9E+02**	**UG/KG**	**OF-SS05-0217**	**16/16**	**0.34 - 0.46**	**3.9E+02**	**N/A**	**1.3E+02 N**	**N/A**		**YES**	**ASL**
	335-67-1	**Perfluorooctanoic acid (PFOA)**	**5.1E-01 J**	**1.0E+01**	**UG/KG**	**OFPOL-SS07-0217**	**15/16**	**0.34 - 0.46**	**1.0E+01**	**N/A**	**1.3E+02 N**	**N/A**		**YES**	**PFOS+PFOA**

[1] Minimum/Maximum detected concentrations.

[2] Maximum concentration is used for screening.

[3] Background values not available

[4] Oak Ridge National Laboratory (ORNL). November 2017. Regional Screening Levels for Chemical Contaminants at Superfund Sites. Resident RSLs (based on 10^{-6} for carcinogens and HQ of 0.1 for noncarcinogens).
RSL values for PFOS and PFOA were calculated using the RSL calculator tool.

[5] Rationale Codes

Selection Reason: Above Screening Levels (ASL)
Combined concentration of PFOS and PFOA exceeds the RSL (PFOS+PFOA)

Deletion Reason: No Toxicity Information (NTX)
Below Screening Level (BSL)

COPC = Chemical of Potential Concern
ARAR/TBC = Applicable or Relevant and Appropriate Requirement/ To Be Considered
J = Estimated Value
C = Carcinogenic
N = Noncarcinogenic
N/A = Not available
UG/KG = Microgram per kilogram
RSL = Regional Screening Level

Table 5-23a. Risk Ratio Screening

Fentress Basewide PFAS Evaluation, On-Base Soil

Chesapeake, Virginia

Analyte	Detection Frequency	Maximum Detected Concentration (Qualifier) (UG/KG)	Sample Location of Maximum Detected Concentration	Carcinogenic Residential Soil RSL (UG/KG)	Acceptable Risk Level	Cancer Risk[a]	Non-carcinogenic Residential Soil RSL (HI = 1) (UG/KG)	Acceptable Hazard Level	Hazard Index[b]	Target Organ
Perfluorooctane Sulfonate (PFOS)	16 / 16	3.9E+02	OF-SS05-0217	N/A			1.3E+03	1	0.3	Developmental
Perfluorooctanoic acid (PFOA)	15 / 16	1.0E+01	OFPOL-SS07-0217	7.8E+03	1E-06	1E-09	1.3E+03	1	0.008	Developmental
Cumulative Hazard Index[c]									**0.3**	
Cumulative Cancer Risk[d]						**1E-09**				
								Total Developmental HI =	**0.3**	

Notes:

[a] Cancer Risk equals maximum detected concentration divided by the RSL divided by the acceptable risk level.

[b] Hazard Index equals maximum detected concentration divided by the RSL divided by the acceptable hazard level.

[c] Cumulative Hazard Index equals sum of Hazard Indices for each constituent.

[d] Cumulative Cancer Risk equals sum of Cancer Risks for each constituent.

Constituent selected as COPC if it contributes to an overall Hazard Index by target organ greater than 0.5 or Cumulative Cancer Risk greater than 5E-05, otherwise, constituent not selected as COPC.

Constituents selected as COPCs are indicated by shading.

COPC = Constituent of Potential Concern

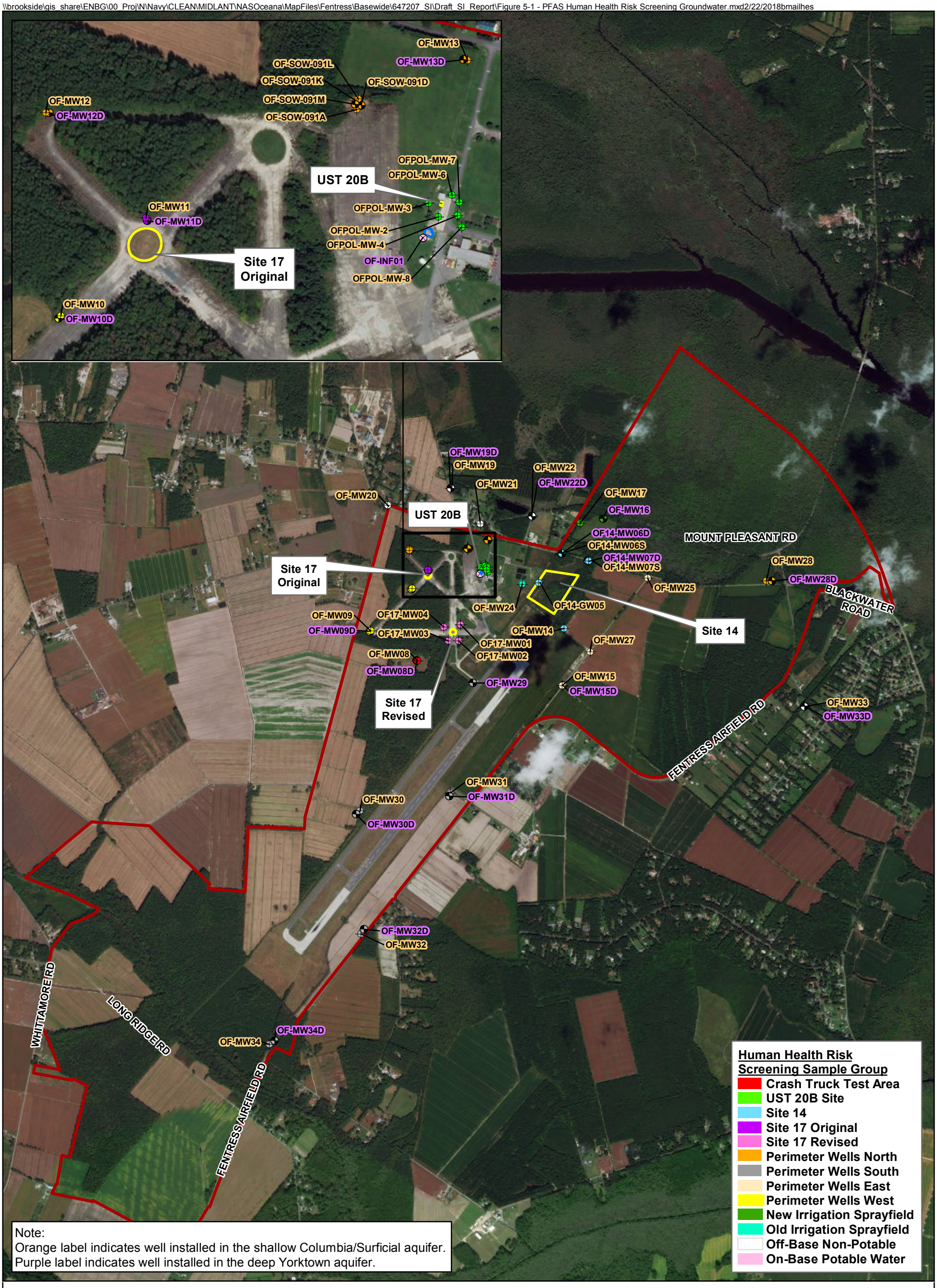
HI = Hazard Index

UG/KG = Microgram per kilogram

N/A = Not available/not applicable

RSL = Regional Screening Level

\\brookside\gis_share\ENBG\00_Proj\N\Navy\CLEAN\MIDLANT\NASOceana\MapFiles\Fentress\Basewide\647207_SI\Draft_SI_Report\Figure 5-1 - PFAS Human Health Risk Screening Groundwater.mxd2/22/2018bmailhes



Legend

- Columbia Aquifer Monitoring Well
- Yorktown Aquifer Monitoring Well
- Site Boundary
- Water Treatment Plant
- Fentress Boundary

N

0 1,000 2,000

Feet

Imagery Source: ©2017 Esri

Figure 5-1
Human Health Risk Screening for PFAS in Groundwater
Basewide Per- and Polyfluoroalkyl Substances Site Inspection Report
NALF Fentress, Chesapeake, Virginia

ch2m

SECTION 6

Conclusions and Recommendations

This section summarizes the major conclusions of the Basewide PFAS SI conducted at NALF Fentress, which have been drawn from the findings and results presented and evaluated in earlier sections of this report. It also presents proposed recommendations to address the PFAS occurrence at the installation.

6.1 Conclusions

Table 6-1 provides the conclusions of the investigation as measured against the objectives:

Table 6-1. Fentress PFAS SI Investigation Objectives and Conclusions

Primary Objective	Secondary Objective (as applicable)	Conclusion
Determine if PFAS are present in the Base water supply.	--	PFAS were determined to be present in the Base water supply at levels exceeding the L-HA.
Determine the groundwater flow direction, gradient, and velocity, to allow the better assessment of fate and transport at the site.	--	Groundwater flow in the Columbia/Surficial aquifer was determined to be radial, with a stronger component of flow to the north and east toward the Intracoastal Waterway. Groundwater flow in the Yorktown aquifer is primarily to the north and east toward the Intracoastal Waterway. The groundwater velocity in the Columbia/Surficial aquifer at NALF Fentress is estimated to be 0.0468 ft/day or approximately 17.07 ft/year. The groundwater velocity in the Yorktown aquifer at NALF Fentress is estimated to be 0.0778 ft/day or approximately 28.38 ft/year.
Determine if PFAS are present in suspected source areas at NALF Fentress.	Determine the possible presence of soil contamination remaining on-Base if PFAS are detected in groundwater at levels of concern and summarize the conclusions	PFAS were identified at levels greater than the L-HA in samples from Site 14, Site 17 (original) and Site 17 (Revised), the Current Crash Truck Test Area, the UST 20B site, and both irrigation sprayfields. While no deep monitoring wells were installed in some of the identified source areas (e.g., UST 20B site, Site 17 [Revised], or either irrigation sprayfields), exceedances of the L-HA occurred in the vicinity of the Current Crash Truck Test Area and in water supply wells in the Yorktown aquifer, which are near the UST 20B Site, indicating migration into the deeper aquifer has occurred in some source areas. PFAS were also detected in soils in all areas analyzed, including potential secondary source areas, such as irrigation sprayfields and area in the vicinity of the water supply wells where fire-fighting water may have been discharged to the ground surface. While many soil concentrations were less than screening levels for direct exposure and potential unacceptable risks were not identified, there may be continuing impacts from potential for leaching to groundwater at levels of concern. Soil concentrations were highest in the UST 20B area and near the Current Crash Truck Test Area. The soil sampling data set is limited and some potential source areas were not evaluated (e.g., Site 17 [Revised]).
Determine whether PFAS are present at levels posing potentially unacceptable human health risks in groundwater at NALF Fentress.	--	Concentrations in groundwater pose potential unacceptable risk across much of the site, including off-Base private drinking water wells. While risks are acceptable in many of the Yorktown aquifer perimeter wells, it is important to note that wells drilled through the confining unit into the Yorktown aquifer off-Base pose unacceptable risk, indicating preferential pathways are created during private well installation.

Table 6-1. Fentress PFAS SI Investigation Objectives and Conclusions

Primary Objective	Secondary Objective (as applicable)	Conclusion
Determine the potential for off-Base migration of PFAS at NALF Fentress.	--	Contaminants were confirmed to have migrated off-Base at levels posing potential unacceptable risks.

6.2 Recommendations

An Expanded SI is recommended to refine understanding of the conceptual site model. Specifically, the following actions are proposed:

1. Installation of additional shallow and deep monitoring wells off-Base at NALF Fentress to better assess potential migration in both the Columbia/Surficial aquifer and Yorktown/ deep aquifer; these wells should be focused to the north and east of the facility in the directions of groundwater flow.
2. Installation of additional deep monitoring wells in locations on-Base with L-HA exceedances in the Columbia/Surficial aquifer, but without existing deep wells (e.g., Site 17 [revised], UST 20B, and within the irrigation sprayfields), and at a deeper depth interval than existing well OF-MW08D to delineate the vertical extent of PFAS levels exceeding the L-HAs in the vicinity of the Crash Truck Test Area.
3. Collection of additional soil samples to assess source areas which were not evaluated during the initial soil sampling effort (e.g., Site 17 [revised]).
4. Continued refinement and monitoring of vertical and horizontal distribution and migration of potential PFAS in the Columbia and Yorktown aquifers including installation of additional wells around identified source areas (e.g., Site 17 and the Crash Truck Test Area).
5. Continued assessment of toxicity data for human and ecological receptors to complete an RI.

SECTION 7

References

Baker Environmental, Inc. (Baker). *1992. Site Inspection report, Site 14- Fentress Landfill, Site 17- Firefighting Training Area, Naval Auxiliary Landing Fentress, Virginia.* July

Baker. 1993. Supplemental Site Investigation Report, Site 14 - Fentress Landfill and Site 17 - Firefighting Training Area, Naval Auxiliary Landing Field, Fentress, Virginia. October.

Baker. 1994. Site Characterization Report, Underground Storage Tank 20B, Naval Auxiliary Landing Field Fentress, Chesapeake, Virginia.

Bouwer, H. and R.C. Rice. 1976. *A Slug Test for Determining Hydraulic Conductivity of Unconfined Aquifers with Completely or Partially Penetrating Wells*. Water Resources Research 12:423-28.

CH2M HILL, Inc. (CH2M). 1986. *Progress Report. Round 1 Verification Step, Naval Air Station Oceana, Virginia Beach, Virginia.* October.

CH2M. 1991. *Environmental Investigation of the Landfill and Firefighting Training Area, Naval Auxiliary Landing Fentress, Chesapeake, Virginia.* March.

CH2M. 1992. *RCRA Facility Investigation Work Plan, Naval Air Station Oceana, Virginia Beach, Virginia.* June.

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

CH2M. 2016b*. Bench-Scale Treatability Study Results: Granular Activated Carbon Testing to Remove PFOA and PFOS in Wastewater, Naval Auxiliary Landing Field Fentress, Chesapeake, Virginia*.

CH2M. 2016c. *Bench-Scale Treatability Study Results: Granular Activated Carbon Testing to Remove PFOA and PFOS in Drinking Water, Naval Auxiliary Landing Field Fentress, Chesapeake, Virginia*.

CH2M. 2016d*. Pilot Test Work Plan: Granular Activated Carbon System Installation on Residential Drinking Water Systems to Remove PFOA and PFOS, Naval Auxiliary Landing Field Fentress, Chesapeake, Virginia.*

CH2M. 2016e. *Final SAP, Basewide Perfluorinated Compound Site Investigation, Naval Auxiliary Landing Field Fentress, Chesapeake, Virginia.* August.

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

City of Chesapeake. 2017. Parks, Recreation & Tourism division. http://www.visitchesapeake.com/visitors/weather/. Accessed July 2017.

Driscoll, Fletcher G. 1986. *Groundwater and Wells: Second Edition*.

Earth Technology Corporation (EarthTech). 1989*. Resource Conservation and Recovery Act (RCRA) Facility Assessment Revised Phase II Report, Oceana Naval Air Station, Virginia Beach, Virginia.* March.

Foster Wheeler (FWI). 1994a. *Engineering Evaluation/ Cost Analysis, Site 17- Firefighting Training Area, Naval Auxiliary Landing Fentress, Virginia.* July

FWI. 1994b. *Decision Document. Site 17 – Fire Fighting Training Area, Naval Auxiliary Landing Fentress, Virginia.* July.

Freeze and Cherry*.* 1979*. Groundwater.*

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

Malcolm Pirnie, Inc. 2008. *Final Preliminary Assessment, Naval Air Station Oceana, Dam Neck Annex, and Naval Auxiliary Landing Fentress, Virginia.* October.

Naval Energy and Environmental Support Activity (NEESA). 1984. *Initial Assessment Study, Naval Air Station, Oceana, Virginia Beach, Virginia.* December.

United States Environmental Protection Agency (USEPA). 2016a. *Fact Sheet: PFOA and PFOS Drinking Water Health Advisories*. EPA 800-F-16-003. November.

USEPA. 2016b. *Drinking Water Health Advisory for PFOA*. EPA-822-R-16-005. May.

USEPA. 2016c. *Drinking Water Health Advisory for PFOS*. EPA-822-R-16-004. May.

USEPA. 2017. *Regional Screening Levels for Chemicals at Superfund Sites*. November.

U.S. Geological Survey (USGS), 2006. The *Virginia Coastal Plain Hydrogeologic Framework Professional Paper 1731.*

U.S. Navy (Navy). 1995. Personal communication (letter) to Virginia Department of Environmental Quality (VDEQ). *5090 Ser 186/0255*. February 14.

Navy. 1996a. Personal communication (letter) to VDEQ. *5090 Ser 186/0035*. January 9.

Navy. 1996b. Personal communication (letter) to VDEQ. *5090 Ser 186/660.* April 9.

Navy. 1999. Personal communication (letter) to VDEQ. *UST 20B.* February 4.

Navy. 2000. *Overview of Screening, Risk Ratio, and Toxicological Evaluation. Procedures for Northern Division Human Health Risk Assessments*. May.

Appendix A
NALF Fentress Fire Department Interviews

RECORD OF MEETING

Interview to Evaluate Use of Aqueous Film-Forming Foam Use at NALF Fentress

MEETING DATE: November 2, 2015

In November, 2015, NAVFAC and CH2M interviewed Captain of Naval Auxiliary Landing Field (NALF) Fentress and Assistant Fire Chief of Naval Air Station (NAS) Oceana about use of Aqueous Film-Forming Foams (AFFFs) in firefighter training and emergency operations at NALF Fentress.

AFFF Use at NALF Fentress

Firefighter training activities at NALF Fentress are currently conducted only using water; no AFFF is currently used in training. AFFF is currently used only in crash trucks at Fentress in preparation for emergency use; no automated fire suppression systems are charged with AFFF.

AFFF is ordered at NAS Oceana following current military specifications. Only 3-percent AFFF is used. 3M and Ansul brands have been used previously, but headquarters is using primarily Chemguard brand now. At NALF Fentress, AFFF was stored in Building 20 until recently; it is now stored in Building 106 (**Figure 1**). A maximum of 540 gallons is stored in 108 five-gallon cans. To load the crash trucks, the trucks are brought to Building 20 (previously and now Building 106), AFFF is replenished by hand from the 5-gallon cans, and empty AFFF cans are disposed of as Hazardous Materials (at Building 1114 at NAS Oceana).

In addition to the five-gallon cans in storage, three 200-gallon tanks of AFFF (600 gallons total) are kept filled at NALF Fentress – two are loaded in trucks and one spare tank is kept in Building 106. The trucks are parked in the fire station. Tanks are not cleaned out when AFFF is expended. Vehicles are washed at the fire station. Valves are only cleaned if there is a problem with the metering valve; this maintenance, which is rare, is performed by the Public Works and Transportation Department at NAS Oceana.

Spray tests are performed at the current crash truck equipment test area (**Figure 1**). This site has been approved for spray testing and has been in use since about 2010. The spray test involves checking the roof turret, pumper turret, and hand lines under the truck nozzles to ensure the foam is the right consistency and to test the distance and width of the spray pattern. Plans for spray testing are coordinated in advance, and spray testing is not conducted if it is raining or if rain is predicted within the new few days.

AFFF has not been used at NALF Fentress for emergencies in the recent past. Captain and Chief did not believe that AFFF has been sprayed at NALF Fentress in the past 20 years for any emergency, including fuel releases, historical crashes or fires, or emergency runway landings.

R:\USNavFacEngCom405450\NASOceana\MapFiles\Fentress\431287_FireDeptInterviews\Figure 1 - Potential Release Areas.mxd4/29/2016BMailhes_ch2mhillenv



Legend
Fentress Boundary

N
W E
S

0 500 1,000
Feet

1 inch = 1,000 feet

Imagery Source: ©2016 Esri

Figure 1
Potential Release Areas
NALF Fentress, Chesapeake, Virginia

ch2m

Location	Name Of Manufacture	Date Of Manufacture	LOT/BATCH NUMBER	Type Of Containers	AMOUNT IN CONTAINERS	Number Of Containers	Total Amount	manufacturer spec's	READINGS FOR RAW	date tested
Oceana	ANSULITE	Apr-09	X02906	55GAL DRUMS	55	28	1540	1.3630-(MIL SPEC)		
Oceana	CHEMGUARD C301D	May-12	530123	55 GAL GRUMS	55		0	1.3630-(MIL SPEC)		
Oceana	NATIONAL FOAM	May-10	LO5294	55GAL DRUMS	55	28	1540			
Location	Name Of Manufacture	Date Of Manufacture	LOT/BATCH NUMBER	Type Of Containers	AMOUNT IN CONTAINERS	Number Of Containers	Total Amount	manufacturer spec's	READINGS FOR RAW	date tested
Oceana	CHEMGUARD	Apr-12	430122	5 Gal CNS	5	3	15	1.3630-(MIL SPEC)		
Oceana	MINN	Dec-90	601	5 GAL CNS	5	51	255	1.3630-(MIL SPEC)		
Oceana	CHEMGUARD class A	Feb-14	313141	5 Gal CNS	5		0			
Oceana	CHEMGUARD class A	Jan-14	115142	5 Gal CNS	5		0			
Oceana	CHEMGUARD class A	Feb-14	210143	5 Gal CNS	5		0			
TOTAL AMOUNT OF STORED FOAM FOR NASO							3350			

Location	Name Of Manufacture	Date Of Manufacture	LOT/BATCH NUMBER	Type Of Containers	AMOUNT IN CONTAINERS	Number Of Containers	Total Amount	manufacturer spec's	READINGS FOR RAW/SOLUTION	date tested
NALF	CHEMGUARD	9/28/2015	928151	5 Gal CNS	5	108	540			

TOTAL AMOUNT OF STORED FOAM FOR NALF	540

TOTAL AMOUNT OF FOAM AVAILABLE FOR DISTRICT 3	3890

LOCATION	USN ID	YEAR	TYPE	CALL SIGN	FOAM (GALS) ON VEHICLE	DRY POWDER ON VEHICLE	HALON ON VEHICLE
FENTRESS	71-03127	2001	OSKKOSH 1500	C-6	200	450	500
FENTRESS	71-03154	2001	OSKKOSH 1500	C-8	200	450	
NASO	71-03299	2010	E-ONE 3000	C-2	405	450	
NASO	71-03184	2004	OSHKOSH 1500	C-3	200	450	
NASO	71-03257	2009	OSKOSH TI-1500	C-4	210	450	
NASO	71-03258	2009	OSKOSH TI-1500	C-5	210	450	
THIS IS WHAT WE HAVE ON VEHICLES					1425	2700	500

REMARKS;

Company 2 resupplied with 110 gallons. Lot # 0430122 used.
Company 8 resupplied with 10 gallons. Lot # 601 used.
Company 5 resupplied with 10 gallons. Lot # 601 used.
Company 4 resupplied with 10 gallons. Lot # 601 used.

9/23/2015

foam sent to support Little Creek	
4-55 gals drums (x2906)	220
7- 5 gals containers (601)	35
11- 5 gals containers filled from 1- 55 gal conter (x2906)	55
TOTAL SENT	310

FENTRESS	71-02743	1987	OSKKOSH 1000	C-9	130	450	

NALF	MINN	Apr-91	618	5 GAL CNS	5	96	480	
NALF	3M	Apr-90	580	5 GAL CNS	5	14	70	INPUT BY V JACKSON 10/23/15

3.1.4 Fire Extinguishing Agent Supply Requirements

Each ARFF organization shall maintain a minimum ready stock of one vehicle/equipment load of AFFF, PKP, and Halon 1211 (total tank capacity) for each manned ARFF vehicle assigned. The minimum ready stock shall exclude the initial load of agent in the tank and agent necessary to satisfy firefighting training requirements. Supply departments for air activities should maintain an equal amount of agent.

* Does not include hangars
Kinetik is the hangar contractor.

UPDATED 9/23/15 BY
Captain Jackson

Appendix B
Soil Boring Logs

	PROJECT NUMBER	BORING NUMBER
ch2m.	669783.FI.WI.01	MW08

SOIL BORING LOG

PROJECT : NALF Fentress Site 17 GW Investigation LOCATION : NALF Fentress

DRILLING CONTRACTOR : Parratt Wolff

DRILLING METHOD AND EQUIPMENT USED : IRA300

WATER LEVELS : Start: 12/10/15 09:50 End: 12/10/15 11:10 LOGGER : D. Brown

DEPTH BELOW SURFACE (FT)	INTERVAL (FT)	RECOVERY (FT)	SAMPLE #/TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N')	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	USCS	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION. DRILLING ACTIONS/DRILLER COMMENTS. PID Readings: Breathing Zone: Above Hole:
	0/5	5/5	HA		0.0-2.0' SILTY SAND (SM), light gray (N7), moist, loose, very fine grained sand, some tree roots.	SM	0
					2.0-4.0' SANDY SILT (ML), light gray (N7), moist, stiff, some fine grained sand.	ML	0
5					4.0-5.0' SAND (SP), yellowish brown (10YR 5/6), moist, medium dense, medium grained sand.	SP	0
	5/10	3/5	DPT-1		5.0-8.0' Same as 4.0-5.0'	SP	0
					8.0-10.0' No Recovery		
10							
	10/15	5/5	DPT-2		10.0-13.0' Same as 4.0-5.0' except color is light gray (N7) and wet.	SP	0
					13.0-15.0' SAND (SP), gray (N5), wet, loose, fine to coarse grained sand, some silt, some coarse sand nodules and fine gravel.	SP	0
15							
	15/20	5/5	DPT-3				0
					15.0-23.0' SAND (SP), gray (N5), wet, loose, fine to medium grained.	SP	
20							

	20/25	3/5	DPT-4				0
25					23.0-25.0' No Recovery		
	25/30	5/5	DPT-5		25.0-29.0' CLAYEY SAND (SC), gray (N5), moist, loose, some fine grained clay.	SC	0
30					29.0-30.0' CLAY (CH), olive gray (5Y 3/2), wet, stiff.	CH	30' bgs end of log

	PROJECT NUMBER	BORING NUMBER
ch2m: SM	674204.SI.SI	MW8D

SOIL BORING LOG

PROJECT : NALF Fentress Site 17 GW Investigation LOCATION : Adjacent to MW8S at track area.

DRILLING CONTRACTOR : Parratt Wolff

DRILLING METHOD AND EQUIPMENT USED : CME Drill Rig, 6" drag bit, mud rotary, 4' acetate lined core barrels.

WATER LEVELS : Start: 07/08/2016 End: 07/09/2016 LOGGER : B. Rahe

DEPTH BELOW SURFACE (FT)	INTERVAL (FT)	RECOVERY (FT)	SAMPLE #/TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N')	SOIL DESCRIPTION SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	USCS	COMMENTS DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION. DRILLING ACTIONS/DRILLER COMMENTS PID Readings: Breathing Zone: Above Hole:
35	32 - 36'	CB1	3.8'	----	32 - 33', **CLAY**, (CL), grey (5YR 5/1), dry, stiff. 33 - 34', **CLAYEY SAND**, (SC), grey (5YR 5/1), moist, medium dense, poorly graded fine quartz sand. 34 - 36', **SAND**, (SP), grey (5YR 5/1), wet, dense, poorly graded fine quartz sand, subrounded.	CL SC SP	Surface casing previously installed to 32' bgs on 6/23/2016. PID: 0 ppm O2: 20.9% LEL: 0%
40	36 - 40'	CB2	2.2'	----	36 - 40', As logged 34 - 36', (SP)	SP	PID: 0 ppm
45	40 - 44'	CB3	4.0'	----	40 - 44', As logged 34 - 40', (SP)	SP	PID: 0 ppm
	44 - 48'	CB4	1.2'	----	44 - 48', As logged 34 - 44', (SP)	SP	PID: 0 ppm
50	48 - 52'	CB5	3.1'	----	48 - 49', As logged 34 - 48', (SP) 49 - 52', **SAND**, (SW), grey (5YR 5/1), wet, dense, well graded fint to medium quartz sand, subrounded.	SP SW	PID: 0 ppm
55	52 - 56'	CB6	4.0'	----	52 - 55', As logged 49 - 52', (SW) 55 - 56', **CLAY**, (CL), dark reddish grey (5YR 4/2), dry, stiff.	SW CL	PID: 0 ppm Set screen at 45 - 55' bgs.
60							

	PROJECT NUMBER	BORING NUMBER
ch2m.	669783.FI.WI.01	MW09/09D

SOIL BORING LOG

PROJECT : NALF Fentress Site 17 GW Investigation LOCATION : NALF Fentress

DRILLING CONTRACTOR : Parratt Wolff

DRILLING METHOD AND EQUIPMENT USED : IRA 300

WATER LEVELS : Start: 12/7/15 14:00 End: 12/7/15 17:00 LOGGER : D. Brown

DEPTH BELOW SURFACE (FT)	INTERVAL (FT)	RECOVERY (FT)	SAMPLE #/TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N')	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	USCS	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION. DRILLING ACTIONS/DRILLER COMMENTS. PID Readings: Breathing Zone: Above Hole:
	0/5	4/5	HA		0.0-2.0' SILTY SAND (SM), yellowish brown (10YR 5/4), dry, hard, very fine grained, some tree roots.	SM	0
					2.0-4.0' SILTY CLAY (CL), brown (5YR 3/2), moist, stiff, some fine grained sand.	CL	0
5					4.0-5.0' No Recovery		
	5/10	4/5	DPT-1		5.0-9.0' SAND (SP), dark yellow orange (10YA 6/6), moist, loose, medium grains.	SP	0
10					9.0-10.0' No Recovery		
	10/15	4.5/5.0	DPT-2		10.0-12.0' Same as 5-9'.	SP	0
					12.0-14.5' SAND (SW), medium gray (N5), trace silt and gravel, wet, loose, fine to coarse grained sand.	SW	0
15					14.5-15.0' No Recovery		
	15/20	4/5	DPT-3		15.0-19.0' Same as 12-14.5' except color is medium gray (5R).	SW	0
20					19.0-20.0' No Recovery		

	20/25	3.5/5	DPT-4		20.0-23.5' SANDY CLAY (CL), olive gray (5Y 3/2), moist, stiff, trace amounts of fine grained sand.	CL	0
25					23.5-25.0' No Recovery		
	25/30	3.5/5	DPT-5		25.0-27.0' same as 20.0-23.5'	CL	0
					27.0-28.5' CLAY (CH), olive gray (5Y 3/2), wet, stiff, soft at end of core.	CH	
30					28.5-30' No Recovery		

	PROJECT NUMBER	BORING NUMBER
ch2m.	669783.FI.WI.01	MW09/09D

SOIL BORING LOG

PROJECT : NALF Fentress Site 17 GW Investigation LOCATION : NALF Fentress

DRILLING CONTRACTOR : Parratt Wolff

DRILLING METHOD AND EQUIPMENT USED : IRA 300

WATER LEVELS : Start: 12/7/15 14:00 End: 12/7/15 17:00 LOGGER : D. Brown

DEPTH BELOW SURFACE (FT)	INTERVAL (FT)	RECOVERY (FT)	SAMPLE #/TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N')	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	USCS	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION. DRILLING ACTIONS/DRILLER COMMENTS. PID Readings: Breathing Zone: Above Hole:
	30/35	5/5	DPT-6		30.0-35.0' CLAY (CH) olive (5Y 3/2), wet, stiff, pure clay.	CH	0
5							
	35/40	4/5	DPT-7		35.0-39.0' SANDY CLAY (CL), olive gray (5Y 3/2), moist, stiff, trace amounts of fine grained sand.	CL	0
					39.0-40.0' No Recovery.		
10							
	40/45	4/5	DPT-8		40.0-42.0' Same as 35.0-39.0'	CL	0
					42.0-44.0' SILTY SAND (SM), medium gray (N5), wet, loose, medium grain size.	SM	0
15					44.0-45.0' No Recovery		
	45/50	0/5	DPT-9		45.0-50.0' No Recovery, core stuck in rod.		
20							

	50/55	4/5	DPT-10		50.0-54.0' Same as 42.0-44.0'	SM	0
25					54.0-55.0' No Recovery		
					End of boring at 55.0' bgs		
30							

	PROJECT NUMBER	BORING NUMBER
ch2m.	669783.FI.WI.01	MW10/10D

SOIL BORING LOG

PROJECT : NALF Fentress Site 17 GW Investigation LOCATION : NALF Fentress

DRILLING CONTRACTOR : Parratt Wolff

DRILLING METHOD AND EQUIPMENT USED : DPT 5'

WATER LEVELS : 5.0' bgs Start: 12/14/15 13:20 End: 12/14/15 17:00 LOGGER : M. Ost

DEPTH BELOW SURFACE (FT)	INTERVAL (FT)	RECOVERY (FT)	SAMPLE #/TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N')	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	USCS	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION. DRILLING ACTIONS/DRILLER COMMENTS. PID Readings: Breathing Zone: Above Hole:
					0.0-0.5' Cement		
	0/5	2/5	DPT-1		0.5-2.0' CLAY (CL), gray (2.5Y 5/1), moist, soft plasticity.	CL	0
					2.0- 5.0' No Recovery		
5							
	5/10	3/5	DPT-2		5.0-6.0' CLAYEY SILT (ML), gray (2.5Y 5/1), loose, soft.	ML	Wet at 5.0' bgs
					6.0-8.0' SAND (SP), white (2.5Y 8/1), wet, loose, medium grain size, some iron staining.	SP	0
					8.0-10.0' No Recovery		
10							
	10/15	5/5	DPT-3		10.0-15.0' Same as above except no iron staining.	SP	0
15							
	15/20	5/5	DPT-4		15.0-20.0' SAND (SP), light gray (2.5Y 7/1), wet, loose, medium grain size.	SP	0
20							

	20/25	5/5	DPT-5		20.0-24.0' Same as above.	SP	0
25					24.0-25.0' SANDY CLAY (SC), gray (2.5 Y 5/1), wet,soft plasticity.	SC	0
	25/30	3/5	DPT-6		25.0-27.0' Same as above. 27.0-28.0' SAND (SP), gray (2.5Y 6/1), wet, loose, no fines.	SC	0
30					No Recovery		

	PROJECT NUMBER	BORING NUMBER
ch2m	669783.FI.WI.01	MW10D

SOIL BORING LOG

PROJECT : NALF Fentress Site 17 GW Investigation LOCATION : NALF Fentress

DRILLING CONTRACTOR : Parratt Wolff

DRILLING METHOD AND EQUIPMENT USED : DPT 5'

WATER LEVELS : 5.0' bgs Start: 12/14/15 13:20 End: 12/14/15 17:00 LOGGER : M. Ost

DEPTH BELOW SURFACE (FT)	INTERVAL (FT)	RECOVERY (FT)	SAMPLE #/TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N')	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	USCS	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION. DRILLING ACTIONS/DRILLER COMMENTS. PID Readings: Breathing Zone: Above Hole:
5	30/35	5/5	DPT-7		30.0-35.0 CLAY (CL), gray (2.5Y 5/1), wet, medium stiffness, plastic.	CL	0 Place case at 30-35' bgs
	35/40	5/5	DPT-8		35.0-40.0' Same as above.	CL	0
10	40/45	5/5	DPT-9		40.0-43.5' Same as above.	CL	0
					43.5-45.0' SAND (SP), gray (2.5Y 7/1), wet, dense, medium grain size.	SP	0
15	45/50	5/5	DPT-10		45.0'-50.0' SAND (SP), gray (2.5Y 7/1), wet, dense, medium grain size.	SP	0
20							

25	50/55	5/5	DPT-11		50.0-55.0' Same as above	SP	0
30	55/60	5/5	DPT-12		55.0-60.0' Same as above.	SP	0 Place bottom of screen at 55.0' bgs

	PROJECT NUMBER	BORING NUMBER
ch2m	669783.FI.WI.01	MW11/11D

SOIL BORING LOG

PROJECT : NALF Fentress Site 17 GW Investigation LOCATION : NALF Fentress

DRILLING CONTRACTOR : Parratt Wolff

DRILLING METHOD AND EQUIPMENT USED : CME 850 Truck Mount 5' Macrocore Acetate Augers

WATER LEVELS : Start: 12/14/15 14:00 End: 12/14/15 16:55 LOGGER : T. Stewart

DEPTH BELOW SURFACE (FT)	INTERVAL (FT)	RECOVERY (FT)	SAMPLE #/TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N')	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	USCS	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION. DRILLING ACTIONS/DRILLER COMMENTS. PID Readings: Breathing Zone: Above Hole:
					0-1' Concrete / Runway Line		
	0/5	3.6/5.0	MC1		1.0'-3.6' SANDY CLAY (SC), grayish brown (10YR 5/2), moist, stiff, medium to high plasticity, fine to medium grain size, trace yellowish brown (10YR 5/8) mottling.	SC	0
5					3.6'-5.0' No Recovery		
	5/10	2.6/5	MC2		5.0'-6.0' SILTLY SAND (SM), greenish gray (5BG 6/1), wet, very fine sand, non to low placticity fines, dense.	ML	0
					6.0'-7.6' SAND (SW), light gray (N/7) grading to yellow (10YR 7/8) at 6.5', medium to coarse grains with some pebble gravel, wet.	SW	0
10					7.6'-10.0' No Recovery		14:40 Light rain starts
	10/15	5/5	MC3		10.0'-10.4' SAND (SW) light gray (N/7), very loose, wet, nonplastic, coarse, angular, translucent, few dark gray/ lavendar minerals.	SW	0
					10.4'-13.5' SAND (SW) light gray (N/7), wet, loose, fine to medium grain size, nonplastic.	SW	0
15					13.5'-15.0' No Recovery		
	15/20	5/5	MC4		15.0'-25.0' SAND (SW-SM), light gray (N/7), wet, loose, fine to medium grain size, nonplastic, <1" thick dark greenish gray clay lenses at 15.9', 17.3', 21.4', 24.2', and 25', coarse from 22-23.7' bgs with trace fine pebble gravel, grades to below.	SW-SM	0
20							
	20/25	5/5	MC5				
25							

30	25/30	5/5	MC6		25.0'-30.0' SILTY SAND (SM) dark greenish gray (10G 4/1), wet, very loose, nonplastic, very fine to medium grain size, high silt content, 2-3" clay lenses 25-26' bgs.	SM	0 15:10 Currently advancing 30' to 35' core run

ch2m	669783.FI.WI.01	MW11/11D
	SOIL BORING LOG	

PROJECT : NALF Fentress Site 17 GW Investigation LOCATION : NALF Fentress

DRILLING CONTRACTOR : Parratt Wolff

DRILLING METHOD AND EQUIPMENT USED : CME 850 Truck Mount 5' Macrocore Acetate Augers

WATER LEVELS : Start: 12/14/15 14:00 End: 12/14/15 16:55 LOGGER : T. Stewart

DEPTH BELOW SURFACE (FT)	INTERVAL (FT)	RECOVERY (FT)	SAMPLE #/TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6"-6" (N')	SOIL DESCRIPTION COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	USCS	COMMENTS DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION. DRILLING ACTIONS/DRILLER COMMENTS
							PID Readings: Breathing Zone: Above Hole:
30					30.0'-32.0' CLAY (CL), very dark gray (5Y 3/1), wet, soft to stiff, low plasticity, cohesive, trace organic / root layer at 31.6' bgs..	CL	0
	30/35	5/5	MC1		32.0'-35.0' CLAY with SILT and SAND (CL), greenish gray (10G 5/1), wet, very fine to fine grain size, nonplastic, high silt and sand content, borderline SM with clay.	CL	15:45 Rain starts
35							15:50 advancing 40-45" core run
	35/40	5/5	MC2		35.0'-41.3' CLAY with SILT (CL), greenish gray (10BG - 5B 5/1), moist, medium soft to stiff, medium plasticity, trace very fine to fine sand stringer at 39.8' bgs (<1/2" thick)	CL	0
40							
					41.3'-42.6' CLAY (CL), very dark gray (5Y 3/1), moist, stiff, low to medium plasticity.	CL	0
	40/45	5/5	MC3		42.6'-43.3' SILTY SAND to SAND (SM-SW), dark gray, wet, fine to coarse sands, nonplastic fines, dense.	SM-SW	16:05 rain stops
					43.3-45.0" CLAY with SILT (CL), very dark gray (5Y 3/1), moist, organic to 10% as 2" thick layers, root fragments, trace very fine to fine sand lenses, medium plasticity.	CL	0
45							

50	45/50	5/5	MC4		45.0'-60.0' SILTY SAND to SAND (SM-SP), dark to very dark gray (5Y 4-3/1), wet, loose, fine to very fine grain size, nonplastic fines, trace coarse (~1/2") root fragments from 45-46', trace very dark gray laminated sands from 49-50', medium grain sands 53-55', apparant very dark gray laminations 57-60' bgs.	SM-SP	0
55	50/55	5/5	MC5				16:38 pulling out 55-60' core run
60	55/60	5/5	MC6		End of boring at 60.0'		0

	PROJECT NUMBER	BORING NUMBER
ch2m.	669783.FI.WI.01	MW12D

SOIL BORING LOG

PROJECT : NALF Fentress Site 17 GW Investigation LOCATION : NALF Fentress

DRILLING CONTRACTOR : Parratt Wolff

DRILLING METHOD AND EQUIPMENT USED : DPT 5'

WATER LEVELS : 6.0' bgs Start: 12/15/15 14:45 End: 12/15/15 17:00 LOGGER : M. Ost

DEPTH BELOW SURFACE (FT)	INTERVAL (FT)	RECOVERY (FT)	SAMPLE #/TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N')	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	USCS	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION. DRILLING ACTIONS/DRILLER COMMENTS. PID Readings: Breathing Zone: Above Hole:
	0/5	2/5	DPT-1		0.0-2.0 CLAY (CH), light gray (2.5Y 3/2), dry, stiff.	CH	0
					No Recovery		
5					5.0-5.5' SILT (ML), Gray (2.5Y 7/1), moist, loose.	ML	0
	5/10	5/5	DPT-2		5.5-10.0' SAND (SP), gray (2.5Y 7/1), moist, loose, medium grain size grading to fine at bottom.	SP	Wet at 6.0' bgs 0
10							
	10/15	5/5	DPT-3		10.0-15.0' SAND (SP), light gray (2.5Y 7/1), wet, loose, fine grain size.	SP	0
15							
	15/20	5/5	DPT-4		15.0-20.0' Same as above.	SP	0
20							

	20/25	5/5	DPT-5		20.0-23.0' SAND (SP), gray (2.5Y 5/1), wet, loose, fine grain size.	SP	0
25					23.0-25.0' CLAYEY SAND (SC), gray (2.5Y 5/1), wet, loose.	SC	0
	25/30	5/5	DPT-6		25.0-30.0' SANDY CLAY (SC), dark gray (2.5Y 4/1), wet, very loose, low plasticity.	SC	0
30							

	PROJECT NUMBER	BORING NUMBER
ch2m.	669783.FI.WI.01	MW12D

SOIL BORING LOG

PROJECT : NALF Fentress Site 17 GW Investigation LOCATION : NALF Fentress

DRILLING CONTRACTOR : Parratt Wolff

DRILLING METHOD AND EQUIPMENT USED : DPT 5'

WATER LEVELS : 6.0' bgs Start: 12/15/15 14:45 End: 12/15/15 17:00 LOGGER : M. Ost

DEPTH BELOW SURFACE (FT)	INTERVAL (FT)	RECOVERY (FT)	SAMPLE #/TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N')	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	USCS	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION. DRILLING ACTIONS/DRILLER COMMENTS. PID Readings: Breathing Zone: Above Hole:
5	30/35	5/5	DPT-7		30.0-35.0' CLAY (CH), greenish gray (GLEY 1 5/10Y), wet, soft.	CH	0
10	35/40	5/5	DPT-8		35.0-40.0' SANDY CLAY (SC), greenish gray (GLEY 1 5/10Y), moist, medium stiff, mostly clay with very fine sands.	SC	0
	40/45	5/5	DPT-9		40.0-43.0' SANDY CLAY (SC), gray (GLEY 1 5/N), wet, loose, low plasticity.	SC	0
15					43.0-45.0' SAND (SP) gray (GLEY 1 5/N), wet, dense.	SP	
	45/50	5/5	DPT-10		45.0-50.0' Same as above.	SP	0
20							

	50/55	5/5	DPT-11		50.0-55.0' Same as above.	SP	0
25						SC	0
	55/60	5/5	DPT-12		55.0-60.0' SAND (SP), gray (2.5Y 5/1), wet, dense, medium grain size.	SP	0
30							60.0' bgs end of boring. Place deep well 45-55' bgs.

	PROJECT NUMBER	BORING NUMBER
ch2m.	669783.FI.WI.01	MW13/13D

SOIL BORING LOG

PROJECT : NALF Fentress Site 17 GW Investigation LOCATION : NALF Fentress

DRILLING CONTRACTOR : Parratt Wolff

DRILLING METHOD AND EQUIPMENT USED : CME 850 5' macrocore acetate liners

WATER LEVELS : 5.0' bgs Start: 12/15/15 14:50 End: 12/15/15 17:00 LOGGER : T. Stewart

DEPTH BELOW SURFACE (FT)	INTERVAL (FT)	RECOVERY (FT)	SAMPLE #/TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N')	SOIL DESCRIPTION SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	USCS	COMMENTS DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION. DRILLING ACTIONS/DRILLER COMMENTS PID Readings: Breathing Zone: Above Hole:
					0.0-0.2' Topsoil / Roots		
	0/5	5/5	DPT-1		0.2'-3.8' SANDY CLAY (CL), yellowish brown (10YR 5/8), dry to moist, stiff to very stiff, lowt to medium plasticity, medium grain size.	CL	0
					3.8-4.2' CLAYEY SAND (SC), olive yellow (2.5Y 6/6), moist, medium dense, low to medium plasticity, trace very fine grains.	SC	0
5					4.2-5.6' SILTY SAND (SM), pale brown (2.5Y 7/4), wet at 5.0' bgs,loose, fine to medium grain size, nonplastic.	SM	Wet at 5.0' bgs 0
	5/10	5/5	DPT-2		5.6-8.2' SAND (SP), white (2.5Y 8/1),wet, loose to very loose, medium grain size, trace nonplastic fines.	SP	0
					8.2-10.0' No Recovery		
10							
	10/15	5/5	DPT-3		10.0-16.0' SAND (SP), pale yellow (5Y 8/2), wet, very loose, medium grain size, trace nonplastic fines. 11.5-12.3' contains 30% pebble gravel (fine, subrounded, varigated mineral assemblage).	SP	0
15							
	15/20	5/5	DPT-4		16.0-20.0' Same as above except color is very pale brown (10YR 8/4).	SP	0
20							

					20.0-22.0' Same as above except color is yellow (10YR 7/6).	SP	0
	20/25	5/5	DPT-5		22.0-25.0' SILTY SAND (SM-SP), gray to dark gray (4-5/N), wet, loose, fine to medium grain size, nonplastic fines, trace organic rich laminations (<1/4" thick) from 22.5-25.0' bgs.	SM-SP	0
25							
	25/30	5/5	DPT-6		25.0-29.3' CLAY with SAND and SILT (CL), greenish gray (10GY 5/1), wet, very soft to soft, fine to medium grain size, nonplastic, grades to a silty sand with clay (medium grain size) at 27.2'.	CL	0
30					29.3-35.0' CLAY (CL)	CL	0

	PROJECT NUMBER	BORING NUMBER
ch2m.	669783.FI.WI.01	MW13/13D

SOIL BORING LOG

PROJECT : NALF Fentress Site 17 GW Investigation LOCATION : NALF Fentress

DRILLING CONTRACTOR : Parratt Wolff

DRILLING METHOD AND EQUIPMENT USED : CME 850 5' macrocore acetate liners

WATER LEVELS : 5.0' bgs Start: 12/15/15 14:50 End: 12/15/15 17:00 LOGGER : T. Stewart

DEPTH BELOW SURFACE (FT)	INTERVAL (FT)	RECOVERY (FT)	SAMPLE #/TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N')	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	USCS	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION. DRILLING ACTIONS/DRILLER COMMENTS. PID Readings: Breathing Zone: Above Hole:
5	30/35	5/5	DPT-7		29.3-35.0' CLAY (CL), very dark gray (5Y 3/1), moist, soft to medium stiff, cohesive, nonplastic, silt, trace medium sands 29.3-31.0', grades to dark bluish gray at 32.8' bgs (10B 4/1), trace black mottling at 34.0-35.0'.	CL	0
	35/40	5/5	DPT-8		35.0-39.2' CLAY (CL), greenish gray (10GY 5/1), moist, soft to mediums stiff, nonplastic, cohesive, trace silt, silt lense (1" thick) at 38.4' bgs.	CL	0
10	40/45	5/5	DPT-9		39.2-50.0' SILTY SAND (SM), greenish gray (10GY 5/1), moist-wet, loose, medium density, fine to mediums sands grading to medium to coarse, well graded sands with silt, nonplastic.	SM	0
15	45/50	5/5	DPT-10				
20							

25					End of boring at 50.0' bgs		
30							

	PROJECT NUMBER	BORING NUMBER
ch2m.	669783.FI.WI.01	MW14

SOIL BORING LOG

PROJECT : NALF Fentress Site 17 GW Investigation LOCATION : NALF Fentress

DRILLING CONTRACTOR : Parratt Wolff

DRILLING METHOD AND EQUIPMENT USED : CME 850 Truck Mount 5' Macrocore Acetate Sleeves

WATER LEVELS : 2.0' bgs Start: 12/15/15 08:45 End: 12/15/15 09:30 LOGGER : T. Stewart

DEPTH BELOW SURFACE (FT)	INTERVAL (FT)	RECOVERY (FT)	SAMPLE #/TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N')	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	USCS	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION. DRILLING ACTIONS/DRILLER COMMENTS PID Readings: Breathing Zone: Above Hole:
					0.0-0.3' Topsoil / Roots		
	0/5	3.6/5.0	MC1		0.3-3.6' SAND (SP), brownish yellow (10YR 6/6) from 0.3 - 1.3', very pale yellow (2.5 Y 9/2) from 1.3-3.6', wet at 2.0' bgs, loose, nonplastic fines, fine to mediums sands.	SP	0 Wet at 2.0' bgs
5					3.6-5.0' No Recovery		
	5/10	5/5	MC2		5.0-11.3' SAND (SW), pale brown (2.5Y 8/2) from 5.0-6.3' bgs, wet, loose, fine to coarse grain size, nonplastic, very pale yellow 10.5- 11.3'.	SW	0
10							
	10/15	3.8/5.0	MC3		11.3-13.8' SILTY SAND (SM), dark gray (N/4), wet, loose, nonplastic fines, very fine to medium grain size, some clay stringers <1/2" thick.	SM	0
15					13.8-15.0' No Recovery		
	15/20	3.3/5	MC4		15.0-18.3' SILTY SAND (SM) greenish gray (SG4-10GY 5/1), wet, loose, fine to medium grain size, nonplastic fines, trace clay stringers <1/2" thick.	SM	0
					18.3-20.0' No Recovery		
20							

25	20/25	5/5	MC5		20.0-27.1' SILTY SAND (SM), very dark greenish gray (5GY 3/1), wet, loose,medium sized grains, nonplastic, 2" thick clay lenses at 24.6', clay lense from 26.8-27.0' with sand pockets.	SM	0
	25/30	4.3/5	MC6		27.1-29.3' CLAY (CL), very dark gray (3/N), moist, medium stiff to stiff, medium to high plasticity, some sand lenses, trace organics.	CL	0
30					29.3-30.0' No Recovery		End of boring at 30' bgs

	PROJECT NUMBER	BORING NUMBER
ch2m.	669783.FI.WI.01	MW15/15D

SOIL BORING LOG

PROJECT : NALF Fentress Site 17 GW Investigation LOCATION : NALF Fentress

DRILLING CONTRACTOR : Parratt Wolff

DRILLING METHOD AND EQUIPMENT USED : IRA300

WATER LEVELS : Start: 12/8/15 08:30 End: 12/8/15 15:00 LOGGER : D. Brown

DEPTH BELOW SURFACE (FT)	INTERVAL (FT)	RECOVERY (FT)	SAMPLE #/TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N')	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	USCS	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION. DRILLING ACTIONS/DRILLER COMMENTS. PID Readings: Breathing Zone: Above Hole:
	0/5	5/5	HA		0.0-2.0' SILTY SAND (SM), light gray (N7), moist, loose, very fine grained sand, tree roots.	SM	0
					2.0-5.0' SILTY SAND (SM), yellowish orange (10YR 6/6), moist, medium dense, medium grained, some tree roots.	SM	0
5							
	5/10	4/5	DPT-1		5.0-9.0' SAND (SP), yellowish orange (10YR 6/6), moist, loose, fine to medium grained.	SP	0
					9.0-10.0' No Recovery		
10							
	10/15	4/5	DPT-2		10.0-12.0' Same as 5-9'.	SP	0
					12.0-14.0' SAND (SP), medium gray (N5), wet, loose, medium grained.	SP	0
15					14.0-15.0' No Recovery		
	15/20	4/5	DPT-3		15.0-19.0' Same as 12.0-14.0'	SP	0
					19.0-20.0' No Recovery		
20							

	20/25	4/5	DPT-4		20.0-24.0' Same as 12.0-14.0'	SP	0
25					24.0-25.0' No Recovery		
	25/30	5/5	DPT-5		25.0-30.9' SILTY SAND (SM), dark gray (N5), wet, loose, fine grained, some silt.	SM	0
30							

	PROJECT NUMBER	BORING NUMBER
ch2m.	669783.FI.WI.01	MW15/15D

SOIL BORING LOG

PROJECT : NALF Fentress Site 17 GW Investigation LOCATION : NALF Fentress

DRILLING CONTRACTOR : Parratt Wolff

DRILLING METHOD AND EQUIPMENT USED : IRA300

WATER LEVELS : Start: 12/8/15 08:30 End: 12/8/15 15:00 LOGGER : D. Brown

DEPTH BELOW SURFACE (FT)	INTERVAL (FT)	RECOVERY (FT)	SAMPLE #/TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N')	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	USCS	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION. DRILLING ACTIONS/DRILLER COMMENTS. PID Readings: Breathing Zone: Above Hole:
	30/35	2/5	DPT-6		30.0-32.0' CLAY (CH), olive gray (5Y 3/2), wet, stiff.	CH	0
					32.0-35.0' No Recovery		
5	35/40	5/5	DPT-7		35.0-40.0' Same as 30.0-32.0'	CH	0
10	40/45	5/5	DPT-8		40.0-42.0' Same as 30.0-32.0'	CH	0
					42.0-45.0' SANDY CLAY (SC), olive gray (5Y 3/2), moist, medium stiff, some fine grained sand.	SC	0
15	45/50	5/5	DPT-9		45.0-47.0' Same as 42.0-45.0'	SC	0
					47.0-50.0' CLAYEY SAND (SC), dark gray (N7), moist, loose, fine grained sand with trace amounts of clay.	SC	o
20							

25	50/55	5/5	DPT-10		50.0-55.0' SAND (SW), gray (N5), moist, loose, medium grained.	SW	0
30	55/60	5/5	DPT-11		55.0-60.0' Same as 50.0-55.0' 60' bgs end of log	SW	0

	PROJECT NUMBER	BORING NUMBER
ch2m: SM	674204.FI.WI	MW24

SOIL BORING LOG

PROJECT : NALF Fentress Site 17 GW Investigation LOCATION : 100-ft south of storage ponds

DRILLING CONTRACTOR : Parratt Wolff

DRILLING METHOD AND EQUIPMENT USED : CME Drill Rig, Hollow Stem Augers (8.25-in OD)

WATER LEVELS : Start: 06/21/2016 End: 06/21/2016 LOGGER : B. Rahe

DEPTH BELOW SURFACE (FT)	INTERVAL (FT)	RECOVERY (FT)	SAMPLE #/TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N')	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	USCS	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION. DRILLING ACTIONS/DRILLER COMMENTS
							PID Readings: Breathing Zone: Above Hole:
	0 - 4	4.0	CB1	----	0 - 3.5', **SILTY CLAY**, (CL), olive grey (5Y 4/3), dry, stiff, trace roots. 3.5 - 4.0', **SILTY SAND**, (SM), olive (5Y 5/3), dry, medium dense	CL SM	
5	4 - 8	3.0	CB2	----	4 - 5', As logged 3.5 - 4.0', (SM) 5 - 8', **SAND**, (SP), pink (5YR 7/3), moist to wet, medium dense, poorly graded fine subrounded quartz sand.	SM SP	Wet at 6.5-ft bgs PID: 0 ppm O2: 20.9% LEL: 0%
10	8 - 12	3.5	CB3	----	8 - 12', As logged 5 - 8', (SP), reddish grey (5YR 5/2), wet, trace fine gravel.	SP	PID: 0 ppm O2: 20.9% LEL: 0 %
15	12 - 16	3.4	CB4	----	12 - 16', As logged 5 - 12', (SP), wet	SP	PID: 0 ppm O2: 20.9% LEL: 0 %
20	16 - 20	4.0	CB5	----	16 - 20', As logged 5 - 16', (SP), wet, fine to medium quartz sand.	SP	PID: 0 ppm O2: 20.9% LEL: 0 %
	20 - 24	4.0	CB6	----	20 - 24', As logged 5 - 20', (SP).	SP	PID: 0 ppm
25	24 - 28	2.5	CB7	----	24 - 27', As logged 5 - 24', (SP) 27 - 28', **CLAYEY SAND**, (SC), reddish grey (5YR 5/2), medium dense, poorly graded quartz sand, fine to medium, subrounded.	SP SC	PID: 0 ppm Low recovery
30	28 - 32	4.0	CB8	----	28 - 29', As logged 27 - 28', (SC) 29 - 32', **CLAY**, (CL), grey (5YR 5/1), dry, stiff, trace black organic material.	SC CL	Set Screen 19 - 29' bgs Filter Pack: 16.5 - 29' bgs Bentonie Seal: 14.5 - 16.5' bgs

32	28 - 32	4.0	CB8	----	See previous page		
					Sampled with 4-ft long core barrels to 32-ft bgs Drilled with hollow-stem augers to 29-ft bgs to facilitate well installation.		
35							
40							
45							
50							
55							
60							

	PROJECT NUMBER	BORING NUMBER
ch2m: SM	674204.FI.WI	MW25

SOIL BORING LOG

PROJECT : NALF Fentress Site 17 GW Investigation LOCATION : 0.25 mile east of Gate 2

DRILLING CONTRACTOR : Parratt Wolff

DRILLING METHOD AND EQUIPMENT USED : CME Drill Rig, Hollow Stem Augers (8.25-in OD)

WATER LEVELS : Start: 06/25/2016 End: 6/26/2016 LOGGER : B. Rahe

DEPTH BELOW SURFACE (FT)	INTERVAL (FT)	RECOVERY (FT)	SAMPLE #/TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N')	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	USCS	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION. DRILLING ACTIONS/DRILLER COMMENTS
							PID Readings: Breathing Zone: Above Hole:
	0 - 4	4.0'	CB1	----	0 - 0.5', **ROAD BASE and ASPHALT** 0.5 - 4.0', **SILTY CLAY**, (CL), yellowish red (5YR 4/6), dry, stiff	CL	
5	4 - 8	3.4'	CB2	----	4 - 8', **SAND**, (SP), yellowish red (5YR 4/6), dry, loose, poorly graded very fine subrounded quartz sand.	SP	PID: 0 ppm
10	8 - 12	3.1'	CB3	----	8 - 12', As logged 4 - 8', (SP), (5YR 5/8), wet at 10.5' bgs	SP	PID: 0 ppm Wet at 10.5-ft bgs
15	12 - 16	4.0'	CB4	----	12 - 16', As logged 4 - 12', (SP), (5YR 5/8), 10% fine quartz sand, iron staining 15 - 15.2' bgs.	SP	PID: 0 ppm
20	16 - 20	4.0'	CB5	----	16 - 20, As logged 4 - 16', (SP), (5YR 4/6), iron staining and 0.25" thick clay stringers at 18 - 18.5' bgs.	SP	PID: 0 ppm
	20 - 24	4.0'	CB6	----	20 - 23', As logged 4 - 20', (SP), (5YR 4/6). 23 - 24', **SILTY SAND**, (SM), dark gray (5YR 4/1), wet, poorly graded very fine subrounded quartz sand.	SP SM	PID: 0 ppm 06/25/2016: Stop at 1705. 06/26/2016: Resumt at 0800
25	24 - 28	4.0'	CB7	----	24 - 27', As logged 23 - 24', (SM) 27 - 28', C**LAYEY SAND**, (SC), dark gray (5YR 4/1), wet, poorly graded fine quartz sand, shell fragments at 27.5' bgs.	SM SC	PID: 0 ppm O2: 20.9% LEL: 0 ppm
30	28 - 32	4.0'	CB8	----	28 - 28.5', As logged 27 - 28', (SC) 28.5 - 32', **CLAY**, (CL), dark gray (5YR 4/1), dry, stiff.	SC CL	PID: 0 ppm Screen set 18.5 - 28.5 bgs Sampled to 32'; Drilled out to 29' bgs.

32	28 - 32			----			
35							
40							
45							
50							
55							
60							

	PROJECT NUMBER	BORING NUMBER
ch2m: SM	674204.FI.WI	MW27

SOIL BORING LOG

PROJECT : NALF Fentress Site 17 GW Investigation LOCATION : 0.25 milenorth of Gate 4.

DRILLING CONTRACTOR : Parratt Wolff

DRILLING METHOD AND EQUIPMENT USED : CME Drill Rig, Hollow Stem Augers (8.25-in OD)

WATER LEVELS : Start: 07/07/2016 End: 07/07/2016 LOGGER : B. Rahe

DEPTH BELOW SURFACE (FT)	INTERVAL (FT)	RECOVERY (FT)	SAMPLE #/TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N')	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	USCS	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION. DRILLING ACTIONS/DRILLER COMMENTS
							PID Readings: Breathing Zone: Above Hole:
	0 - 4	4.0'	CB1	----	0 - 1', **ROAD BASE** 1 - 4', **SILTY CLAY**, (CL), yellowish red (5YR 5/6), dry, stiff to hard.	CL	
5	4 - 8	3.3'	CB2	----	4 - 5', **CLAYEY SAND**, (SC), light reddish brown (5YR 6/3), dry, medium dense, well graded fine quartz sand. 5 - 8', **SAND**, (SP), light reddish brown (5YR 6/3), wet, dense, poorly graded fine quartz sand, subrounded.	SC SP	PID: 0 ppm Wet at 7' bgs.
10	8 - 12	4.0'	CB3	----	8 - 10', As logged 5 - 8', (SP) 10 - 12', **SAND**, (SW), reddish yellow (5YR 6/8), wet, dense, well graded fine to coarse quartz sand, subrounded.	SP SW	PID: 0 ppm
15	12 - 16	4.0'	CB4	----	12 - 16', **SAND**, (SP), yellowish red (5YR 5/6), wet, dense, poorly graded fine quartz sand, subrounded.	SP	PID: 0 ppm
20	16 - 20	3.3'	CB5	----	16 - 20', As logged 12 - 16', (SP).	SP	PID: 0 ppm
	20 - 24	4.0'	CB6	----	20 - 24', As logged 12 - 16', (SP), grey (5YR 5/1)	SP	PID: 0 ppm
25	24 - 28	4.0'	CB7	----	24 - 28', As logged 12 - 24', (SP), grey (5YR 5/1)	SP	PID: 0 ppm
30	28 - 32	4.0'	CB8	----	28 - 29', As logged 12 - 28', (SP) 29 - 31.5', CLAYEY SAND, (SC), grey (5YR 5/1), moist, medium dense.	SP SC	PID: 0 ppm Screen set 22 - 32' bgs Sampled to 32'.

32	28 - 32	4.0'	CB8	----	31.5 - 32', CLAY, (CL), grey (5YR 5/1), dry, stiff.	CL	
					Drilled out to 32' bgs		
35							
40							
45							
50							
55							
60							

	PROJECT NUMBER	BORING NUMBER
ch2m SM	674204.FI.WI	MW28/28D

SOIL BORING LOG

PROJECT : NALF Fentress Site 17 GW Investigation LOCATION : 200-=ft west of Gate 3/Fentress Airfield Rd.

DRILLING CONTRACTOR : Parratt Wolff

DRILLING METHOD AND EQUIPMENT USED : CME Drill Rig, Hollow Stem Augers (8.25-in OD)

WATER LEVELS : Start: 06/22/2016 End: 06/22/2016 LOGGER : B. Rahe

DEPTH BELOW SURFACE (FT)	INTERVAL (FT)	RECOVERY (FT)	SAMPLE #/TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N')	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	USCS	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION. DRILLING ACTIONS/DRILLER COMMENTS PID Readings: Breathing Zone: Above Hole:
	0 - 4	1.1	CB1	----	0 - 3', **CLAY with SILT**, (CL), dark reddish brown (5YR 3/4), dry, stiff. 3 - 4', **CLAY with SILT**, (CL), red (5YR 5/6), dry, firm.	CL	
5	4 - 8	3.6	CB2	----	5 - 8, **SAND**, (SP), light red (5YR 6/6), moist to wet, medium dense, poorly graded subrounded fine quartz sand.	SP	PID: 0 ppm Wet at 7-ft bgs.
10	8 - 12	4.0	CB3	----	8 - 12', As logged 5 - 8', (SP), pale brown (10YR 6/3), isolated clay stringer at 11-ft bgs.	SP	PID: 0 ppm
15	12 - 16	4.0	CB4	----	12 - 16, As logged 5 - 12', (SP), pale brown (10YR 6/3).	SP	PID: 0 ppm O2: 20.9% LEL: 0 %
20	16 - 20	3.1	CB5	----	16 - 20, As logged 5 - 16', (SP), pale brown (10YR 6/3).	SP	PID: 0 ppm
	20 - 24	4.0	CB6	----	20 - 23', As logged 5 - 20', (SP), pale brown (10YR 6/3). 23 - 24', **SILTY SAND**, (SM), dark grey)10YR 4/1), wet, medium dense, poorly graded fine quartz sand, subrounded	SP SM	PID: 0 ppm
25	24 - 28	4.0	CB7	----	24 - 25.5', As logged 23 - 24', (SM) 35.5 - 28', **CLAY**, (CL), very dark grey (10YR 3/1), dry stiff.	SM CL	6/22/2016 Sampled with 4' core barrel to 28-ft bgs Set shallow screen (**MW28S**): 15.5 - 25.5' bgs Filter pack: 13.5 - 25.5' bgs Bentonite seal: 11.5 - 13.5' bgs **MW28D**:Location about 8-ft north of MW28S. Surface casing set at 28-ft bgs.
30	28 - 32	4.0'	CB8	----	28 - 31', As logged 25.5 - 28', (CL)	CL	7/9/2016: Resume sampling at MW28D.

32	28 - 32	4.0'	CB8	----	31 - 32', **CLAYEY SAND**, (SC), grey (5YR 5/1), moist, medium dense, poorly graded fine quartz sand.	SC	
35	32 - 36	4.0'	CB9	----	32 - 35', As logged 31 - 32', (SC), trace silt. 33 - 36', **SAND**, (SP), grey (5YR 5/1), wet, dense, poorly graded very fine to fine quartz sand, subrounded.	SC SP	'33 - 36', mostly fine sand.
40	36 - 40'	2.1'	CB10	----	36 - 40', As logged 33 - 36', (SP), fine quartz sand.	SP	PID: 0 ppm
	40 - 44'	3.6'	CB11	----	40 - 44', As logged 33 - 36', (SP), very dark grey (5YR 3/1), very fine to fine quartz sand.	SP	PID: 0 ppm
45	44 - 48'	2.0'	CB12	----	44 - 48', As logged 33 - 44', (SP), fine quartz sand.	SP	PID: 0 ppm
50	48 - 52'	3.0'	CB13	----	48 - 52', **SAND**, (SW), very dark grey (5YR 3/1), wet, very dense, well graded fine to coarse quartz sand, subrounded, black organic layer from 50 - 50.1' bgs.	SW	PID: 0 ppm
55	52 - 56'	1.0'	CB14	----	52 - 53', **SAND**, (SW) very dark grey (5YR 3/1), wet, very dense, well graded medium to coarse quartz sand, subrounded, trace fine gravel.	SW	PID: 0 ppm Very hard at 52' bgs. Core barrel refusal at 53' bgs. Well screen will be set at 44 - 54' bgs.
60							

	PROJECT NUMBER	BORING NUMBER
ch2m SM	674204.FI.WI	MW29

SOIL BORING LOG

PROJECT : NALF Fentress Site 17 GW Investigation LOCATION : 100-ft west of the main taxiway

DRILLING CONTRACTOR : Parratt Wolff

DRILLING METHOD AND EQUIPMENT USED : CME Drill Rig, Hollow Stem Augers (8.25-in OD)

WATER LEVELS : Start: 06/25/2016 End: 6/26/2016 LOGGER : B. Rahe

DEPTH BELOW SURFACE (FT)	INTERVAL (FT)	RECOVERY (FT)	SAMPLE #/TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N')	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	USCS	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION. DRILLING ACTIONS/DRILLER COMMENTS
							PID Readings: Breathing Zone: Above Hole:
	0 - 4	4.0	CB1	----	0 - 01.5, **CLAYEY SILT**, (ML), reddish rown (5YR 4/4), dry, stiff. 1.5 - 3.0, **SAND**, (SP), yellowish red (5YR 6/6), dry, medium dense, poorly graded quartz sand. 3.0 - 4, **SILTY CLAY**, (CL), reddish grey (5YR 5/2), dry, hard, unctuous.	ML SP CL	
5	4 - 8	4.0	CB2	----	4 - 6', As logged 3 - 4', (CL) 6 - 8', **SAND**, (SP), gray (5YR 6/1), moist, medium dense, poorly graded subrounded fine quartz sand.	SP	PID: 0 ppm
10	8 - 12	3.8	CB3	----	8 - 10', As logged 6 - 8', (SP) 10 - 12, As logged 6 - 10', (SP), dark reddish gray (5YR 4/2), trace silt.	SP	PID: 0 ppm Wet at 8-ft bgs
15	12 - 16	4.0	CB4	----	12 - 16, As logged 6 - 12', (SP), gray (5YR 6/1), silt absent.	SP	PID: 0 ppm
20	16 - 20	3.5	CB5	----	16 - 20', As logged 6 - 16', (SP)	SP	PID: 0 ppm
	20 - 24	3.8	CB6	----	20 - 24', As logged 6 - 20', (SP)	SP	PID: 0 ppm
25	24 - 28	2.9	CB7	----	24 - 26', As logged 6 - 24', (SP). 26 - 28', **SILTY SAND**, (SM), dark gray (5YR 4/1), wet, medium dense, poorly graded fine quartz sand.	SP SM	PID: 0 ppm
30	28 - 32	4.0	CB8	----	28 - 30', As logged 26 - 28', (SM) 30 - 32', **SILTY CLAY**, (CL), dark reddish gray (5YR 4/2), dry, stiff to hard, trace black organics	SM CL	PID: 0 ppm Screen set 20 - 30' bgs Sampled to 32'; Drilled out to 30' bgs.

32	28 - 32			----			
35							
40							
45							
50							
55							
60							

	PROJECT NUMBER	BORING NUMBER
ch2m: SM	674204.FI.WI	MW30/30D

SOIL BORING LOG

PROJECT : NALF Fentress Site 17 GW Investigation LOCATION : 100 yards west of taxiway.

DRILLING CONTRACTOR : Parratt Wolff

DRILLING METHOD AND EQUIPMENT USED : CME Drill Rig, Hollow Stem Augers (8.25-in OD)

WATER LEVELS : Start: 06/26/2016 End: 07/06/2016 LOGGER : B. Rahe

DEPTH BELOW SURFACE (FT)	INTERVAL (FT)	RECOVERY (FT)	SAMPLE #/TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N')	SOIL DESCRIPTION SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	USCS	COMMENTS DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION. DRILLING ACTIONS/DRILLER COMMENTS PID Readings: Breathing Zone: Above Hole:
0	0 - 4	4.0'	CB1	----	0 - 0.5', **ROAD BASE**. 0.5 - 4.5', **SILTY CLAY**, (CL), gray (5YR 5/1), dry, stiff to hard, trace iron staining. 4.5 - 5.0', **CLAYEY SAND**, (SC), gray (5YR 5/1), dry, dense, fine quartz sand, poorly graded.	CL SC	
5	4 - 8	2.9'	CB2	----	4 - 6', As logged 4 - 5', (SC) 6 - 7', **SILTY SAND**, (SM), gray (5YR 6/1), dry, poorly graded fine quartz sand. 7 - 8', SAND, (SP), gray (5YR 6/1), wet, medium dense, poorly graded fine subrounded quartz sand.	SC SM SP	PID: 0 ppm
10	8 - 12	4.0'	CB3	----	8 - 12', As logged 7 - 8', (SP)	SP	PID: 0 ppm
15	12 - 16	4.0'	CB4	----	12 - 16', As logged 7 - 12', (SP), reddish brown (5YR 4/3), wet.	SP	PID: 0 ppm
20	16 - 20	4.0'	CB5	----	16 - 20', As logged 7 - 16', (SP)	SP	PID: 0 ppm
	20 - 24	4.0'	CB6	----	20 - 21', As logged 7 - 20', (SP) 21 - 24', **CLAYEY SAND**, (SC), dark gray (5YR 4/1), moist to wet, fine poorly graded quartz sand	SP SC	PID: 0 ppm
25	24 - 28	4.0'	CB7	----	24 - 26', As logged 21 - 24', (SC) 26 - 28', **SAND**, (SP), grey (5YR 6/1), wet, poorly graded fine quartz sand.	SC SP	PID: 0 ppm
30	28 - 32	4.0'	CB8	----	28 - 29.5', As logged 26 - 28', (SC) 29.5 - 32', **CLAY**, (CL), dark reddish brown (5YR 2.5/1), dry, stiff, trace black organics at 31.5' bgs.	SC CL	PID: 0 ppm Screen set 19.5 - 29.5 bgs Sampled to 32'; Drilled out to 30' bgs.

32	28 - 32	----	----	----	See Page 1 of 3.	CL	
	32 - 36	4.0'	CB9	----	32 - 36', **SILTY CLAY**, (CL), grey (5YR 5/1), dry, stiff.	CL	7/6/2016: Resume sampling at 32' bgs for MW30D. PID: 0 ppm
35	36 - 40'	2.9'	CB10	----	36 - 37', As logged 32 - 36' bgs, (CL). 37 - 40', **SANDY CLAY**, (CL), grey (5YR 5/1), stiff clay with poorly graded very fine to fine subrounded quartz sand.	CL	PID: 0 ppm
40	40 - 44'	4.0'	CB11	----	40 - 44', **SILTY CLAY**, (CL), grey (5YR 5/1), dry, stiff.	CL	PID: 0 ppm
45	44 - 48'	3.0'	CB12	----	44 - 45', As logged 40 - 44', (CL) 45 - 48', **SAND**, (SP), dark grey (5YR 4/1), wet, dense, poorly graded fine quartz sand, subrounded.	CL SP	PID: 0 ppm
50	48 - 52'	3.2'	CB13	----	48 - 50', As logged 45 - 48', (SP). 50 - 52',**SAND**, (SW), dark grey (5YR 4/1), wet, dense, well graded fine to medium subrounded quartz sand.	SP SW	PID: 0 ppm
55	52 - 56'	3.3'	CB14	----	52 - 56', As logged 50- - 52', (SW)	SW	PID: 0 ppm
60	56 - 60'	3.0'	CB15	----	56 - 59', As logged 50 - 56', (SW) '59 - 60', SAND, (SW), dark grey (5YR 5/1), wet, well graded medium to coarse sand, subrounded, 5% gravel to 1".	SW	PID: 0 ppm Clay in shoe of core barrel at 60' bgs.

	60 - 64'	4.0'	CB6	----	60 - 64', SILTY CLAY, (CL), dark reddish grey (5YR 4/2), dry, stiff.	CL	PID: 0 ppm Deep screen for MW30D set from 50 - 60' bgs.
5					Drilled out to 60-ft bgs Sampled to 64' bgs		
10							
15							
20							
25							
30							

	PROJECT NUMBER	BORING NUMBER
ch2m SM	674204.FI.WI	MW31/31D

SOIL BORING LOG

PROJECT : NALF Fentress Site 17 GW Investigation LOCATION : 150-ft west of Fentress Airfield Rd. by Gate 5.

DRILLING CONTRACTOR : Parratt Wolff

DRILLING METHOD AND EQUIPMENT USED : CME Drill Rig, Hollow Stem Augers (8.25-in OD)

WATER LEVELS : Start: 06/24/2016 End: 06/27/2016 LOGGER : B. Rahe

DEPTH BELOW SURFACE (FT)	INTERVAL (FT)	RECOVERY (FT)	SAMPLE #/TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N')	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	USCS	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION. DRILLING ACTIONS/DRILLER COMMENTS. PID Readings: Breathing Zone: Above Hole:
	0 - 4	3.8	CB1	----	0 - 4', **SILTY CLAY**, (CL), dark reddish grey (5YR 4/3), dry, stiff, trace iron staining, unctuous texture.	CL	
5	4 - 8	0.0	CB2	----	4 - 8, No recovery. Cuttings consistent with 0 - 4' bgs (CL), Estimate water table at 7' bgs. SAND, (SP), estimated at 7-ft bgs.	CL SP	PID: 0 ppm No recovery; one piece of gravel in show. Cuttings wet when augers at 7-ft bgs.
10	8 - 12	3.5	CB3	----	8 - 12, **SAND**, (SP), grey (5YR 5/1), wet, medium dense, poorly graded, subrounded fine quart sand.	SP	PID: 0 ppm
	12 - 16	4.0	CB4	----	12 - 16', As logged 8 - 12', (SP)	SP	PID: 0 ppm
15	16 - 20	4.0	CB5	----	16 - 20, As logged 8 - 16', (SP)	SP	PID: 0 ppm O2: 20.9% LEL: 0%
20	20 - 24	4.0	CB6	----	20 - 23.5', As logged 8 - 20', (SP) 23.5 - 24', **CLAYEY SAND**, (SC), dark grey (5YR 4/1), moist, medium dense, poorly graded quartz sand	SP SC	PID: 0 ppm
25	24 - 28	3.2	CB7	----	24 - 28', As logged 23.5 - 24', (SC)	SC	PID: 0 ppm
30	28 - 32	3.3	CB8	----	28 - 31', As logged 24 - 28', (SC)	SC	PID: 0 ppm Shallow screen for MW31S set at 20.5 - 30.5'

32	28 - 32			----	31 - 32', **SILTY CLAY**, (CL), dark reddish grey (5YR 4/2), dry, stiff.	CL	
35	32 - 36	2.1	CB9	----	32 - 36', As logged 31 - 32', (CL)	CL	06/27/2016: Start sampling for MW31D. PID: 0 ppm O2: 20.9% LEL: 0 %
40	36 - 40	4.0	CB10	----	36 - 39', As logged 31 - 36', (CL) 39 - 40', **CLAYEY SAND**, (SC), dark gray (5YR 4/1), moist, medium dense, poorly graded very fine subroundwater quartz sand.	CL SC	PID: 0 ppm
45	40 - 44	4.0	CB11	----	40 - 41', As logged 39 - 40', (SC) 41 - 43', **SILTY SAND**, (SM), dark gray (5YR 4/1), moist, medium dense, poorly graded fine quarts sand. 43 - 44', **SAND**, (SP), reddish gray (5YR 5/2), wet, medium dense, poorly graded fine subrounded quartz sand.	SC SM SP	PID: 0 ppm
	44 - 48	2.0	CB12	----	44 - 48', As logged 43 - 44', (SP).	SP	PID: 0 ppm
50	48 - 50	1.7	CB13	----	48 - 50', As logged 43 - 48', (SP)	SP	PID: 0 ppm
	50 - 54	4.0	CB14	----	50 - 54', **SAND**, (SW), reddish gray (5YR 5/2), wet, dense, well graded fine to medium quartz sand, subrounded, trace coarse sand.	SW	PID: 0 ppm
55	54 - 58	3.0	CB15	----	54 - 58', As logged 50 - 54', (SW)	SW	PID: 0 ppm Refusal at 57-ft bgs Set deep screen for MW31D at 48 - 58' bgs.
60	58 - 60	4.0	CB16	----	58 - 62', **SILTY CLAY**, (CL), dark reddish gray (5YR 4/2), dry stiff.	CL	Sampled to 62-ft bgs Drilled out to 60-ft bgs.

	PROJECT NUMBER	BORING NUMBER
ch2m: SM	674204.FI.WI	MW32

SOIL BORING LOG

PROJECT : NALF Fentress Site 17 GW Investigation LOCATION : Inside Gate 6 by Fentress Airfield Rd.

DRILLING CONTRACTOR : Parratt Wolff

DRILLING METHOD AND EQUIPMENT USED : CME Drill Rig, Hollow Stem Augers (8.25-in OD)

WATER LEVELS : Start: 07/10/2016 End: LOGGER : B. Rahe

DEPTH BELOW SURFACE (FT)	INTERVAL (FT)	RECOVERY (FT)	SAMPLE #/TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N')	SOIL DESCRIPTION SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	USCS	COMMENTS DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION. DRILLING ACTIONS/DRILLER COMMENTS PID Readings: Breathing Zone: Above Hole:
	0 - 4	3.6'	CB1	----	0 - 1', **SANDY CLAY**, (CL), yellowish red (5YR 5/6), dry, stiff. 1 - 4', **SILTY CLAY**, (CL), pinkish grey (5YR 6/2), dry, stiff, unctuous, mottled with yellowish red (5YR 5/8).	CL CL	
5	4 - 8	4.0'	CB2	----	4 - 6.5', As logged 1 - 4', (CL). 6.5 - 8.0', **SAND**, (SP), yellowish red (5YR 5/6), moist, medium dense, poorly graded fine quartz sand, subrounded.	CL SP	PID: 0 ppm Wet at 8' bgs
10	8 - 12	4.0'	CB3	----	8 - 12', **SAND**, (SP), dark grey (5YR 4/1), wet, medium dense, poorly graded fine quartz sand, subrounded.	SP	PID: 0 ppm
15	12 - 16	0.0'	CB4	----	12 - 16', NO RECOVERY. Visual observation of cuttings from 12 - 16' bgs are consistent with the interval from 6.5 - 12' bgs, **SAND,** (SP).	SP	
20	16 - 20	4.0'	CB5	----	16 - 17', As logged 8 - 16', (SP) 17 - 20', **SILTY SAND**, (SM), dary grey (5YR 4/1), wet, dense, poorly graded very fine to fine quartz sand.	SP SM	PID: 0 ppm O2: 20.9% LEL: 0%
	20 - 24	4.0'	CB6	----	20 - 21', **SAND**, (SP), reddish brown (5YR 5/3), wet, dense, poorly graded fine quartz sand, subrounded. 21 - 24', **SILTY SAND**, (SM), dark grey (5YR 4/1), wet, dense, poorly graded very fine quartz sand.	SP SM	PID: 0 ppm SAND (SP), fine to coarse, 23.8 - 29.0' bgs Clay (CL) in shoe of core barrel (23.9 - 24.0' bgs)
25	24 - 28	4.0'	CB7	----	24 - 25', As logged 21 - 24', (SM). 25 - 28', **SAND**, (SP), dark grey (5YR 4/1), wet, dense, poorly graded fine quartz sand.	SM SP	PID: 0 ppm
30	28 - 32			----			

PROJECT NUMBER	BORING NUMBER
674207	MW-32D

SOIL BORING LOG

PROJECT : NALF Fentress PFC Investigation **LOCATION :** Chesapeake, VA

ELEVATION : **DRILLING CONTRACTOR :** Parratt Wolff

DRILLING METHOD AND EQUIPMENT USED : Hollow Stem Auger Drilling 9.0-in OD/4.25-in ID Augers, 2-inch x 5-ft soil core barrell

WATER LEVELS: 5.18 ft BGS (3/29/17) **START :** 3/29/2017 **END:** 3/30/2017 **LOGGER :** L. Baerga

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE NUMBER AND TYPE	SAMPLE RECOVERY (FT)	USCS Code	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION. OVM (ppm): Breathing Zone Headspace
	20	C1	1.4			Drilled next to previously installed shallow well, MW-32S. Augered to 20 ft and started continuos soil coring.
21						
22				MH		
23						
24					23.7 CLAYEY SILT (MH), wet, soft 2.5Y 4/1 dark gray	
					24.3 Sand, fine grained, poorly graded (SP), wet 2.5Y 4/1 dark gray mixed with highly fragmented white shells	
25	25					
	25	C2	2.2		25.0 - 27.8 No Recovery	
26						
27				SP/SM		
					27.8 SILT (MH), little fine sand, soft, wet 2.5Y 4/1 dark gray	
28					28.4 Fine SAND, poorly graded (SP), trace silt, wet	
29					28.7 Fine SAND, little silt, poorly graded (SP), wet	
30	30					
	30	C3	2.0		29.9 Silty CLAY (CL), wet 30.0 - 33.0 No Recovery	
31				MH		
32						
33						
34					33.0 -35.0 Fine SAND, poorly graded (SP), trace silt, wet 2.5Y 4/1 dark gray faint bedding with zones of increased silt	
35	35					
	35	C4	5.0		35.0 - 38.0 No Recovery	
36				SP/SM		
37						
38						
				ML	38.0 - 38.5 SILT (ML), soft, wet, 2.5Y 4/1 dark gray	
39				CL	38.5 - 38.9 Silty CLAY (CL), damp, soft, 10 YR 5/4 brown	
				SP	38.9 Fine SAND (SP), dense, wet, 2.5Y 4/1 dark gray	
40	40			SW	39.6 Medium SAND, little coarse sand, little fine sand, trace silt (SW) wet, 2.5Y 4/1 dark gray	

	PROJECT NUMBER	BORING NUMBER
ch2m SM	674204.FI.WI	MW34

SOIL BORING LOG

PROJECT : NALF Fentress Site 17 GW Investigation LOCATION : Inside Gate 7 by Fentress Airfield Rd.

DRILLING CONTRACTOR : Parratt Wolff

DRILLING METHOD AND EQUIPMENT USED : CME Drill Rig, Hollow Stem Augers (8.25-in OD)

WATER LEVELS : Start: 07/10/2016 End: LOGGER : B. Rahe

DEPTH BELOW SURFACE (FT)	INTERVAL (FT)	RECOVERY (FT)	SAMPLE #/TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N')	SOIL DESCRIPTION SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	USCS	COMMENTS DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION. DRILLING ACTIONS/DRILLER COMMENTS PID Readings: Breathing Zone: Above Hole:
	0 - 4	4.0'	CB1	----	0 - 1', **ROAD BASE**. 1 - 2', **CLAY**, (CL), dark reddish grey (5YR 4/2), dry, stiff. 2 - 3', **CLAYEY SAND**, (SC), reddish grey (5YR 5/2), dry, medium dense, poorly graded. 3 - 4', **SAND,** (SP), light reddish brown (5YR 6/3), dry, poorly graded fine quartz sand.	BASE CL SC SP	
5	4 - 8	3.0'	CB2	----	4 - 8', **SAND**, (SP), reddish brown (5YR 5/4), moist to wet, medium dense, poorly graded fine quartz sand, subrounded.	SP	PID: 0 ppm O2: 20.9% LEL: 0% Wet at 7' bgs
10	8 - 12	2.0'	CB3	----	8 - 12', As logged 4 - 8', (SP), wet, reddish brown (5YR 4/3)	SP	PID: 0 ppm
15	12 - 16	0.0'	CB4	----	12 - 16', **NO RECOVERY**. Visual observation of cuttings from 12 - 16' bgs are consistent with the interval from 4 - 12' bgs, **SAND**, (SP).	SP	PID: 0 ppm O2: 20.9% LEL: 0%
20	16 - 20	4.0'	CB5	----	16 - 18', **SILTY SAND**, (SM), grey (5YR 5/1), wet, loose to medium dense, poorly graded very fine quart sand. 18 - 20', **SAND**, (SW), grey (5YR 5/1), wet, dense, well graded fine to coarse quartz sand, subrounded.	SM SW	PID: 0 ppm
	20 - 24	2.3'	CB6	----	20 - 24', **SAND**, (SP), grey (5YR 5/1), wet, dense, poorly graded fine quartz sand, subrounded.	SP	PID: 0 ppm
25	24 - 28	4.0'	CB7	----	24 - 28', As logged 20 - 24', (SP)	SP	PID: 0 ppm
30	28 - 32	4.0'	CB8	----	28 - 31', As logged 20 - 24', (SP)	SP	PID: 0 ppm

32	28 - 32	4.0'	CB8	----	31 - 32', **SAND**, (SW), grey (5YR 5/1), wet, dense, well graded fine to medium quartz sand, subrounded.	SW	
35	32 - 36	3.8'	CB9	----	32 - 36', As logged 31 - 32', (SW), wood fragments and black organic clay from 35.5 - 36'.	SW	PID: 0 ppm
40	36 - 40'	4.0'	CB10	----	36 - 40', As logged 31 - 36', (SW)	SW	PID: 0 ppm '07/10/2016: Set shallow screen 30 - 40' bgs.
45	40 - 44'	4.0'	CB11	----	40 - 44', As logged 31 - 40', (SW)	SW	PID: 0 ppm
50							
55							
60							

PROJECT NUMBER	BORING NUMBER
674207	MW-34D

SOIL BORING LOG

PROJECT : NALF Fentress PFC Investigation **LOCATION :** Chesapeake, VA

ELEVATION : **DRILLING CONTRACTOR :** Parratt Wolff

DRILLING METHOD AND EQUIPMENT USED : Hollow Stem Auger Drilling 9.0-in OD/4.25-in ID Augers, 2-inch x 5-ft soil core barrell

WATER LEVELS: 3.9 ft BGS (3/29/17) **START :** 3/28/2017 **END:** 3/29/2017 **LOGGER :** L. Baerga

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE NUMBER AND TYPE	SAMPLE RECOVERY (FT)	USCS Code	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION. OVM (ppm): Breathing Zone Headspace
	35	C1	1.6		35.0 - 36.6 SAND, fine grained, poorly graded (SP), little medium sand, trace silt, medium dense, wet 2.5Y 3/1 gray occassional seams of darker gray sand	Drilled next to previously installed shallow well, MW-34S. Augered to 35 ft and started continuos soil coring.
36						
37						
38						
39						
40	40					
	40	C2	1.5		40.0 - 41.5 SAND, medium grained, poorly graded (SP), little fine sand, trace coarse sand, trace silt, medium dense, wet 2.5Y 3/1 gray silt seam from 44.1 - 44.2 ft	
41						
42						
43						
44				SP		
45	45					
	45	C3	1.0		45.0 - 46.0 SAND, fine grained, poorly graded (SP), little silt, medium dense, wet 2.5Y 3/1 gray small inclusions of light gray to white clay which may be decomposed shell fragments	
46						
47						
48						
49						
50	50					
	50	C4	2.4		50.0 - 52.5 No Recovery	
51						
52						
53					52.5 Sand, fine grained, poorly graded (SP), little medium sand, wet 2.5Y 3/1 gray 52.8 SILT (ML), trace fine sand, soft, wet	

–						2.5Y 4/1 dark gray micaceous, white clay laminae and seams (decomposed shells?)	–
54				ML	53.4	1/2-inch thick seam of brown silt	–
–							–
55	55				55	Silt, little clay (MH) at tip of core sampler	–

Appendix C
Monitoring Well Completion Diagrams

PROJECT NUMBER	WELL NUMBER		
669783.FI.WI.01	OF-MW08	SHEET 1	OF 1

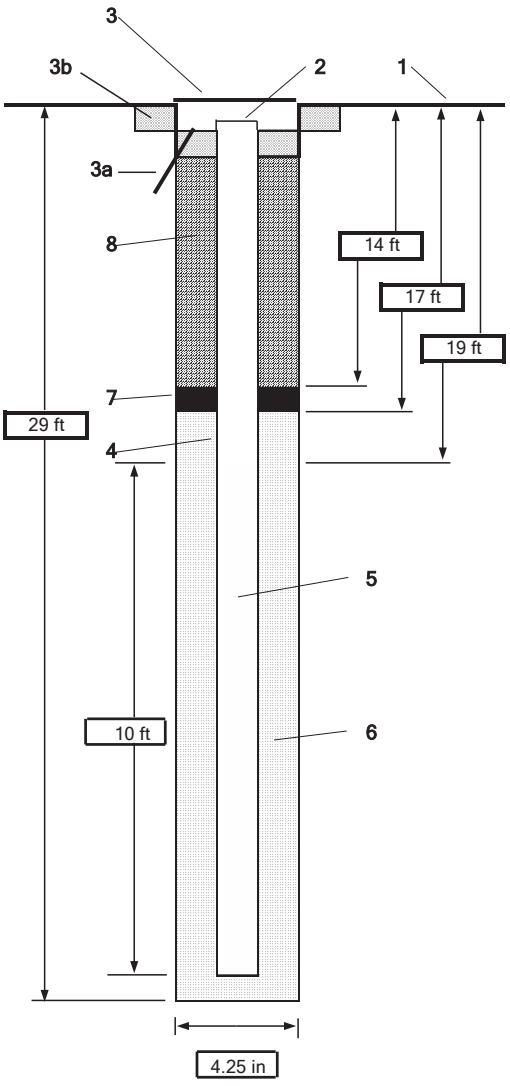
WELL COMPLETION DIAGRAM

PROJECT : Phase I Perflorinated Compound Investigation LOCATION : NALF Fentress, Chesapeake, Virginia (3423321.842 N, 12176530.4228 E)

DRILLING CONTRACTOR : Parratt Wolff

DRILLING METHOD AND EQUIPMENT USED : 4.25" HSA, geoprobe 7822DT

WATER LEVELS : 0.71 ft START : 12/10/15 13:30 END : 12/10/15 15:00 LOGGER : D. Brown



1- Ground elevation at well	12.01 ft
2- Top of casing elevation	11.71 ft
3- Wellhead protection cover type	Flush mount
a) drain tube?	No
b) concrete pad dimensions	12" Diameter circle
4- Dia./type of well casing	2" Diameter PVC
5- Type/slot size of screen	0.010" Machine slotted PVC
6- Type screen filter	#1 Sand Pack
a) Quantity used	5 - 50 lb bags
7- Type of seal	Bentonite chips
a) Quantity used	1 - 50 lb bag
8- Grout	
a) Grout mix used	Portland cement type I/II
b) Method of placement	Tremie pipe
c) Vol. of well casing grout	18 gallons
Development method	Surge with submersible pump
Development time	55 Minutes
Estimated purge volume	85 Gallons

Comments

PROJECT NUMBER	WELL NUMBER		
669783.FI.WI.01	OF-MW08D	SHEET 1	OF 1

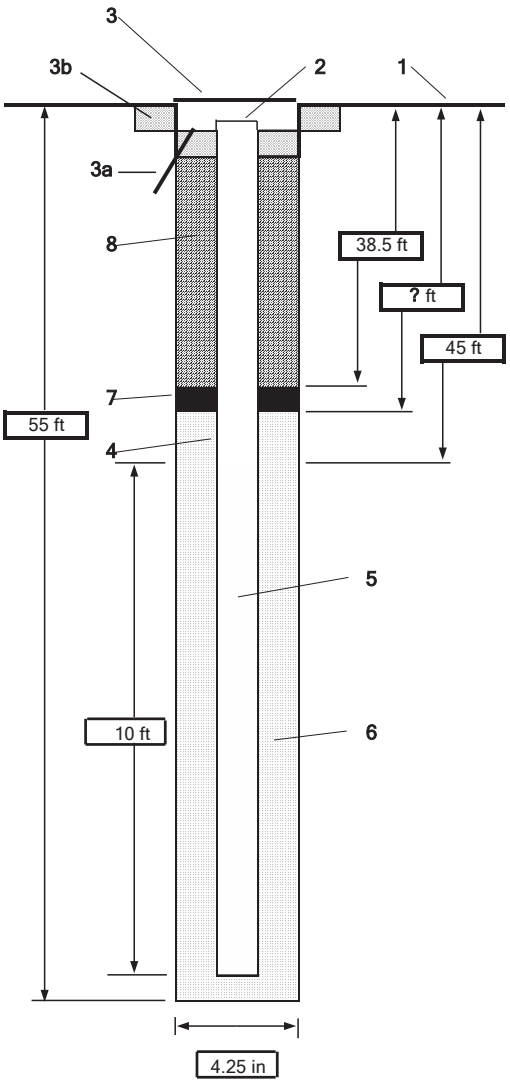
WELL COMPLETION DIAGRAM

PROJECT : Phase I Perflorinated Compound Investigation LOCATION : NALF Fentress, Chesapeake, Virginia (3423321.842 N, 12176530.4228 E)

DRILLING CONTRACTOR : Parratt Wolff

DRILLING METHOD AND EQUIPMENT USED : 4.25" HSA, geoprobe 7822DT

WATER LEVELS : 0.71 ft START : 12/10/15 13:30 END : 12/10/15 15:00 LOGGER : D. Brown



1- Ground elevation at well	12.01 ft
2- Top of casing elevation	11.71 ft
3- Wellhead protection cover type	Flush mount
a) drain tube?	No
b) concrete pad dimensions	12" Diameter circle
4- Dia./type of well casing	2" Diameter PVC
5- Type/slot size of screen	0.010" Machine slotted PVC
6- Type screen filter	#1 Sand Pack
a) Quantity used	5 - 50 lb bags
7- Type of seal	Bentonite chips
a) Quantity used	1 - 50 lb bag
8- Grout	
a) Grout mix used	Portland cement type I/II
b) Method of placement	Tremie pipe
c) Vol. of well casing grout	223.3 gallons
Development method	Surge with submersible pump
Development time	55 Minutes
Estimated purge volume	85 Gallons

Comments

PROJECT NUMBER	WELL NUMBER		
669783.FI.WI.01	OF-MW09	SHEET 1	OF 1

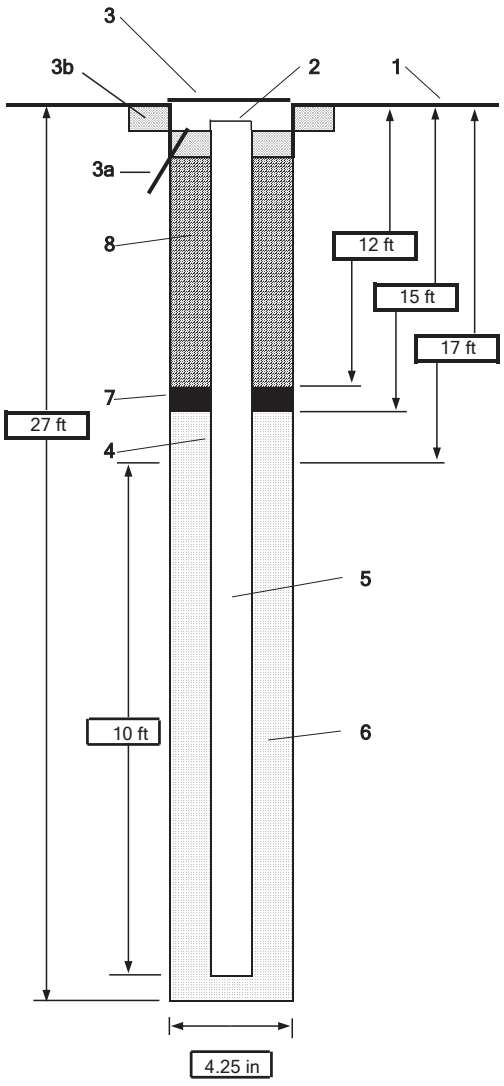
WELL COMPLETION DIAGRAM

PROJECT : Phase I Perflorinated Compound Investigation LOCATION : NALF Fentress, Chesapeake, Virginia (3423977.2976 N, 12175503.3567 E)

DRILLING CONTRACTOR : Parratt Wolff

DRILLING METHOD AND EQUIPMENT USED : 4.25" HSA, geoprobe 7822DT

WATER LEVELS : 2.16 ft START: 12/11/15 08:20 END: 12/11/15 11:20 LOGGER: D. Brown



1-	Ground elevation at well	13.31 ft
2-	Top of casing elevation	13.00 ft
3-	Wellhead protection cover type	Flush mount
	a) drain tube?	No
	b) concrete pad dimensions	12" Diameter circle
4-	Dia./type of well casing	2" Diameter PVC
5-	Type/slot size of screen	0.010" Machine slotted PVC
6-	Type screen filter	#1 Sand Pack
	a) Quantity used	6 - 50 lb bags
7-	Type of seal	Bentonite chips
	a) Quantity used	1 - 50 lb bag
8-	Grout	
	a) Grout mix used	Portland cement type I/II
	b) Method of placement	Tremie pipe
	c) Vol. of well casing grout	16 gallons
	Development method	Surge with submersible pump
	Development time	30 Minutes
	Estimated purge volume	58 Gallons

Comments

PROJECT NUMBER	WELL NUMBER		
669783.FI.WI.01	OF-MW09D	SHEET 1	OF 1

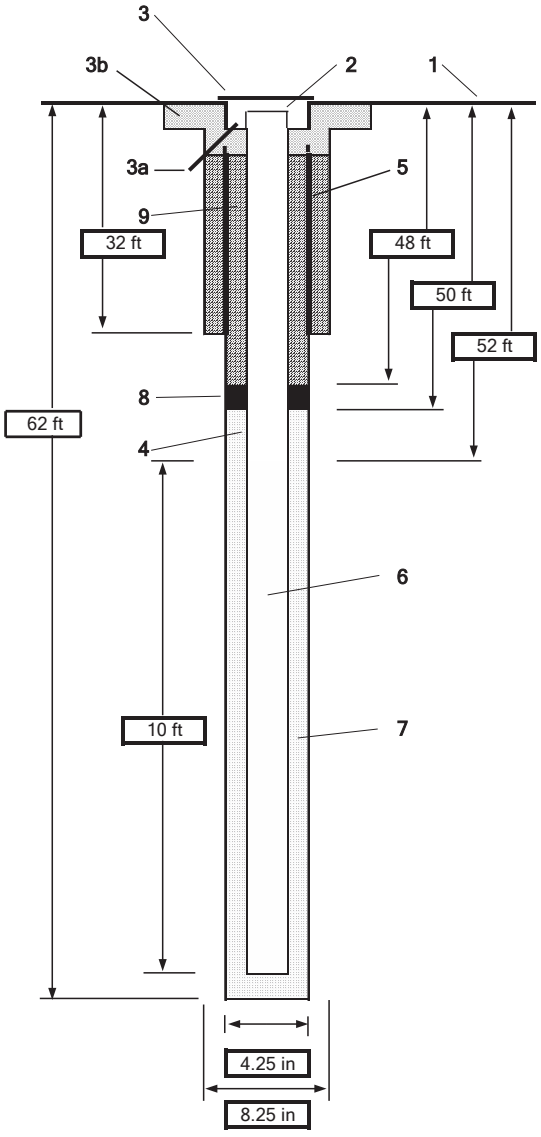
WELL COMPLETION DIAGRAM

PROJECT : Phase I Perflorinated Compound Investigation LOCATION :NALF Fentress, Chesapeake, Virginia (3423967.1122 N, 12175494.4536 E)

DRILLING CONTRACTOR : Parratt Wolff

DRILLING METHOD AND EQUIPMENT USED : 8.25" HSA with mud rotary, geoprobe 7822DT

WATER LEVELS : 5.62 ft START : 12/9/2015 15:15 END : 12/9/2015 15:35 LOGGER : D. Brown



1- Ground elevation at well	13.18 ft
2- Top of casing elevation	12.87 ft
3- Wellhead protection cover type	Flush mount
a) drain tube?	No
b) concrete pad dimensions	12" Diameter circle
4- Dia./type of well casing	2" Diameter PVC
5- Dia./type surface casing	8.25" Diameter steel casing
6- Type/slot/size of screen	0.010" Machine slotted PVC
	10 ft screen
7- Type screen filter	#1 Sand pack
a) Quantity used	5 - 50 lb bags
8- Type of seal	Bentonite chips
a) Quantity used	1 - 50 lb bag
9- Grout	
a) Grout mix used	Portland cement type I/II
b) Method of placement	Tremie pipe
c) Vol.of surface casing grout	63 gallons
d) Vol. of well casing grout	63 gallons
Development method	Surge with submersible pump
Development time	60 minutes
Estimated purge volume	110 gallons

Comments

PROJECT NUMBER	WELL NUMBER		
669783.FI.WI.01	OF-MW10	SHEET 1	OF 1

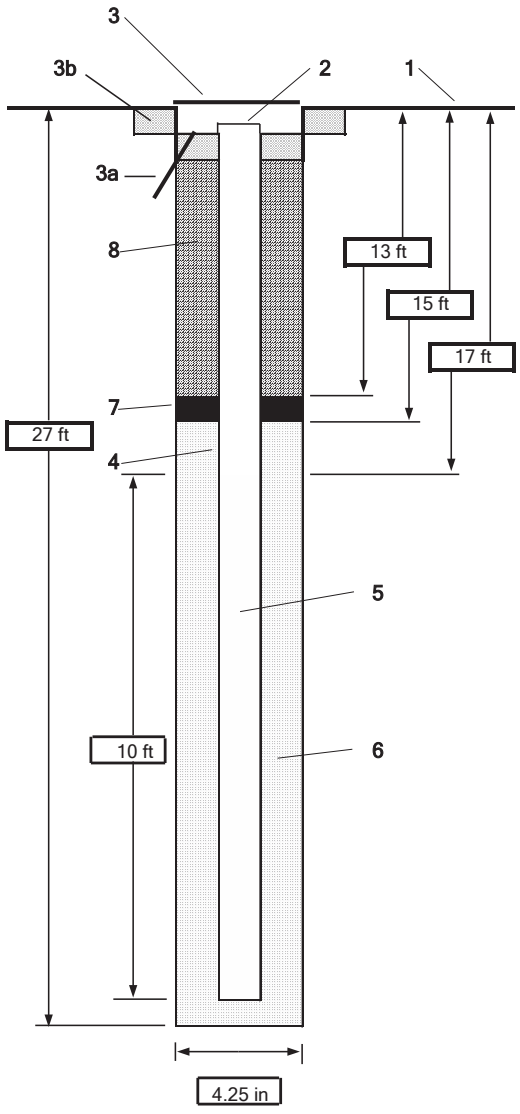
WELL COMPLETION DIAGRAM

PROJECT : Phase I Perflorinated Compound Investigation LOCATION : NALF Fentress, Chesapeake, Virginia (3424904.1962 N, 12176411.3726

DRILLING CONTRACTOR : Parratt Wolff

DRILLING METHOD AND EQUIPMENT USED : 4.25" HSA, geoprobe 7822DT

WATER LEVELS : 1.91 ft START : END : LOGGER :



1- Ground elevation at well: 13.36 ft

2- Top of casing elevation: 12.99 ft

3- Wellhead protection cover typ: Flush mount
- a) drain tube?: No
- b) concrete pad dimensions: 12" Diameter circle

4- Dia./type of well casing: 2" Diameter PVC

5- Type/slot size of screen: 0.010" Machine slotted PVC

6- Type screen filter: #1 Sand pack
- a) Quantity used: 5 - 50 lb bags

7- Type of seal: Bentonite chips
- a) Quantity used: 1/2 - 50 lb bag

8- Grout
- a) Grout mix used: Portland cement type I/II
- b) Method of placement: Tremie pipe
- c) Vol. of well casing grout: 17 gallons

Development method: Surge with submersible pump

Development time: 42 minutes

Estimated purge volume: 60 gallons

Comments

PROJECT NUMBER	WELL NUMBER		
669783.FI.WI.01	OF-MW10D	SHEET 1	OF 1

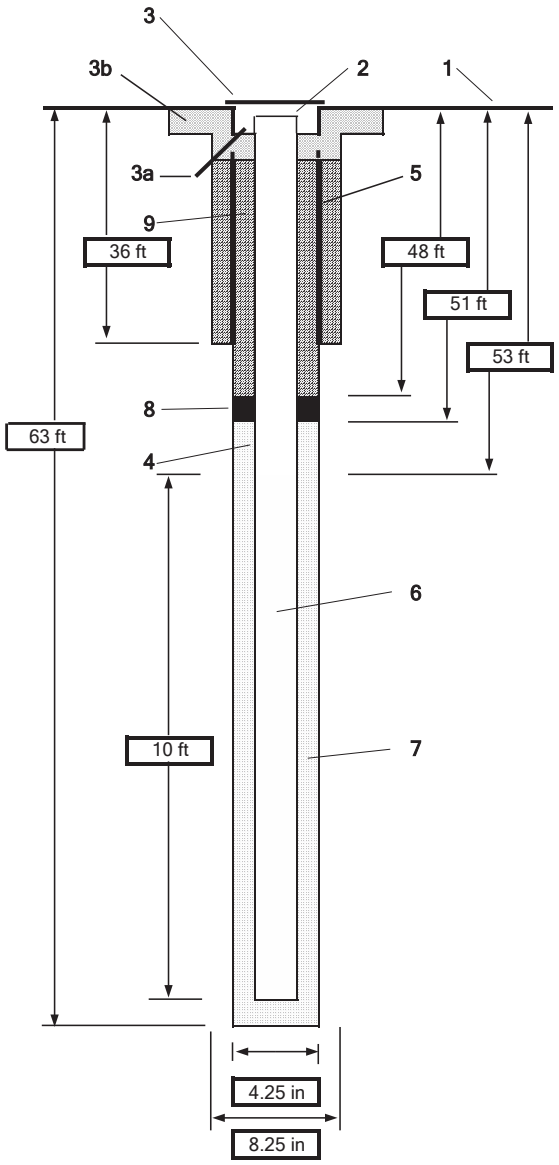
WELL COMPLETION DIAGRAM

PROJECT: Phase I Perflorinated Compound Investigation LOCATION : NALF Fentress, Chesapeake, Virginia (3424893.0693 N, 12176402.3564 E)

DRILLING CONTRACTOR: Parratt Wolff

DRILLING METHOD AND EQUIPMENT USED: 8.25" HSA with mud rotary, geoprobe 7822DT

WATER LEVELS : 6.21 ft START : 12/16/2015 14:30 END : 12/16/2015 16:30 LOGGER : M. Ost



1- Ground elevation at well	13.45 ft
2- Top of casing elevation	13.02 ft
3- Wellhead protection cover type	Flush mount
a) drain tube?	No
b) concrete pad dimensions	12" Diameter circle
4- Dia./type of well casing	2" Diameter PVC
5- Dia./type surface casing	8.25" Diameter steel casing
6- Type/slot/size of screen	0.010" Machine slotted PVC
	10 ft screen
7- Type screen filter	#1 Sand pack
a) Quantity used	5 - 50 lb bags
8- Type of seal	Bentonite chips
a) Quantity used	1/2 - 50 lb bag
9- Grout	
a) Grout mix used	Portland cement type I/II
b) Method of placement	Tremie pipe
c) Vol.of surface casing grout	63 gallons
d) Vol. of well casing grout	71 gallons
Development method	Surge with submersible pump
Development time	59 minutes
Estimated purge volume	98 gallons

Comments

PROJECT NUMBER	WELL NUMBER		
669783.FI.WI.01	OF-MW11	SHEET 1	OF 1

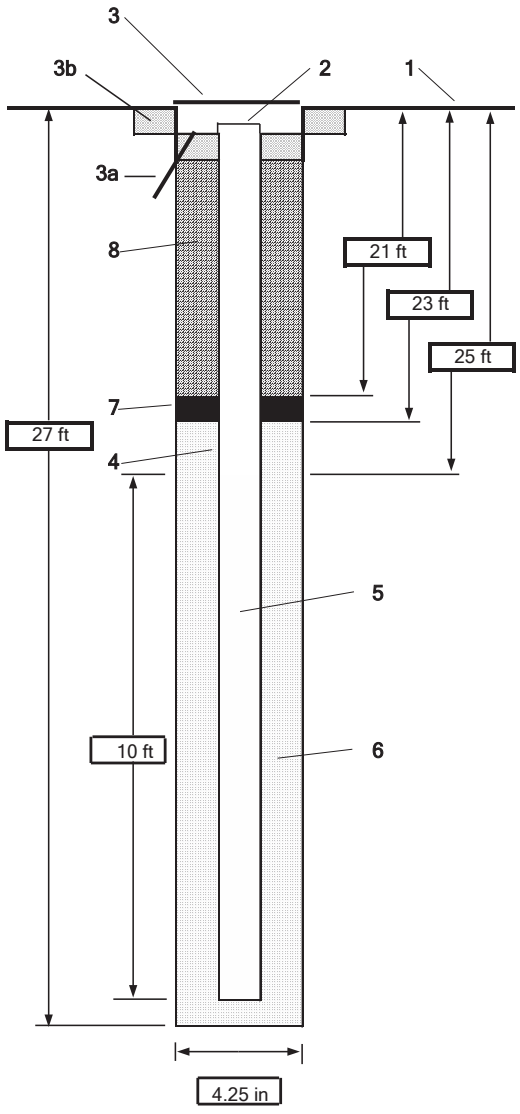
WELL COMPLETION DIAGRAM

PROJECT : Phase I Perflorinated Compound Investigation
LOCATION :NALF Fentress, Chesapeake, Virginia (3425306.3194 N, 12176761.7956

DRILLING CONTRACTOR : Parratt Wolff

DRILLING METHOD AND EQUIPMENT USED : 4.25" HSA, geoprobe 7822DT

WATER LEVELS : 2.14 ft | START : | END : | LOGGER : T. Stewart



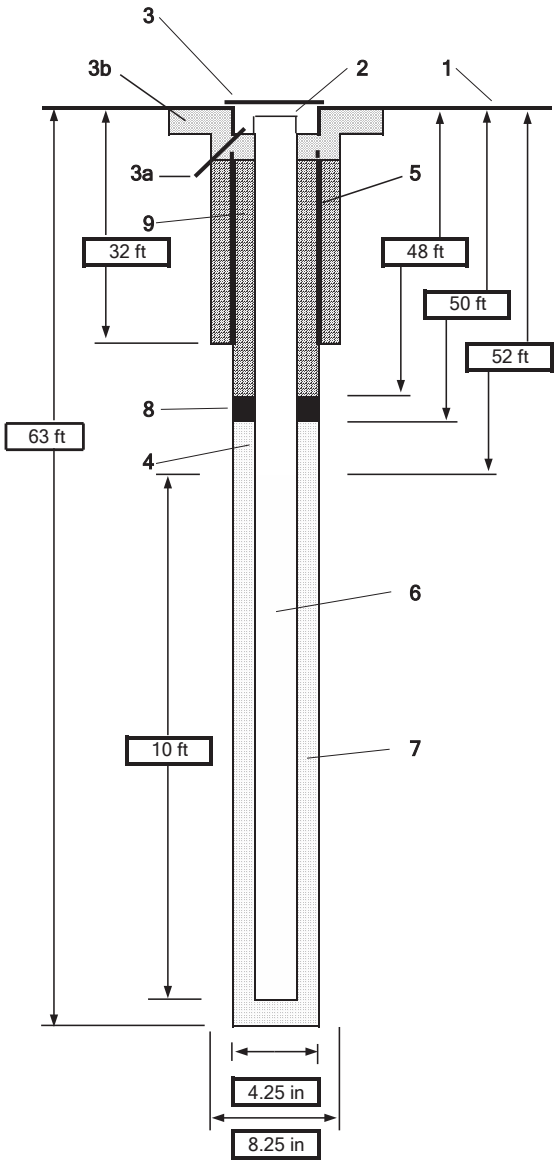
1- Ground elevation at well	13.27 ft
2- Top of casing elevation	12.89 ft
3- Wellhead protection cover typ	Flush mount
a) drain tube?	No
b) concrete pad dimensions	12" Diameter circle
4- Dia./type of well casing	2" Diameter PVC
5- Type/slot size of screen	0.010" Machine slotted PVC
6- Type screen filter	#1 Sand pack
a) Quantity used	5 - 50 lb bags
7- Type of seal	Bentonite chips
a) Quantity used	3/4 - 50 lb bag
8- Grout	
a) Grout mix used	Portland cement type I/II
b) Method of placement	Tremie pipe
c) Vol. of well casing grout	27 gallons
Development method	Surge with submersible pump
Development time	37 minutes
Estimated purge volume	55 gallons

Comments

PROJECT NUMBER	WELL NUMBER		
669783.FI.WI.01	OF-MW11D	SHEET 1	OF 1

WELL COMPLETION DIAGRAM

PROJECT : Phase I Perflorinated Compound Investigation
LOCATION :NALF Fentress, Chesapeake, Virginia (3425295.7021 N, 12176767.5765
DRILLING CONTRACTOR : Parratt Wolff
DRILLING METHOD AND EQUIPMENT USED : 8.25" HSA with mud rotary, geoprobe 7822DT
WATER LEVELS : 6.67 ft START : END : LOGGER : T. Stewart



1- Ground elevation at well	13.43 ft
2- Top of casing elevation	13.14 ft
3- Wellhead protection cover typ	Flush mount
a) drain tube?	No
b) concrete pad dimensions	12" Diameter circle
4- Dia./type of well casing	2" Diameter PVC
5- Dia./type surface casing	8.25" Diameter steel casing
6- Type/slot/size of screen	0.010" Machine slotted PVC
	10 ft screen
7- Type screen filter	#1 Sand pack
a) Quantity used	5 - 50 lb bags
8- Type of seal	Bentonite chips
a) Quantity used	3/4 - 50 lb bag
9- Grout	
a) Grout mix used	Portland cement type I/II
b) Method of placement	Tremie pipe
c) Vol.of surface casing grout	63 gallons
d) Vol. of well casing grout	63 gallons
Development method	Surge with submersible pump
Development time	69 minutes
Estimated purge volume	92 gallons

Comments

PROJECT NUMBER	WELL NUMBER	
669783.FI.WI.01	OF-MW12D	SHEET 1 OF 1

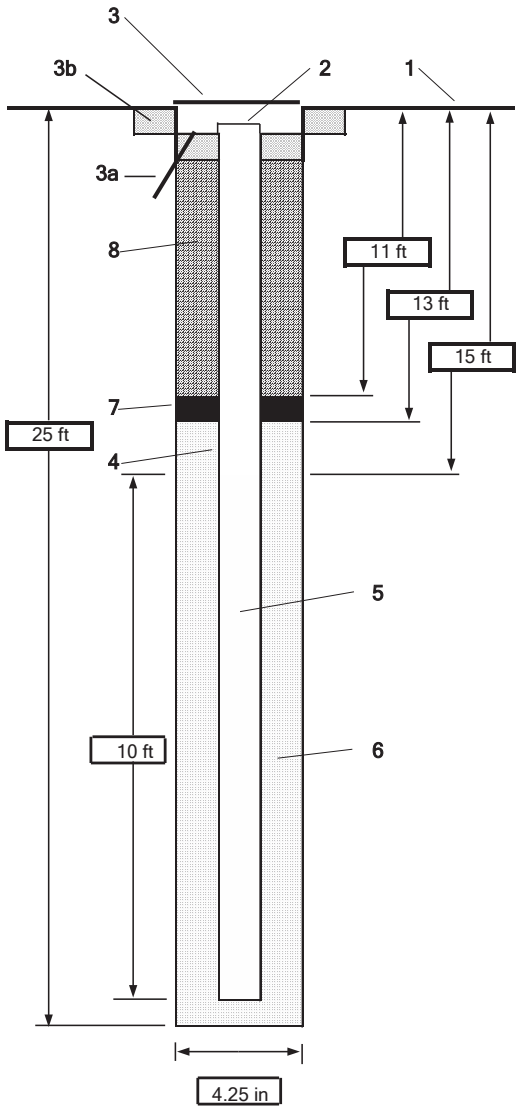
WELL COMPLETION DIAGRAM

PROJECT : Phase I Perflorinated Compound Investigation LOCATION :NALF Fentress, Chesapeake, Virginia (3425740.9723 N, 12176363.2031

DRILLING CONTRACTOR : Parratt Wolff

DRILLING METHOD AND EQUIPMENT USED : 4.25" HSA, geoprobe 7822DT

WATER LEVELS : 1.83 ft START : END : LOGGER : T. Stewart



1-	Ground elevation at well	12.26 ft
2-	Top of casing elevation	11.93 ft
3-	Wellhead protection cover typ	Flush mount
	a) drain tube?	No
	b) concrete pad dimensions	12" Diameter circle
4-	Dia./type of well casing	2" Diameter PVC
5-	Type/slot size of screen	0.010" Machine slotted PVC
6-	Type screen filter	#1 Sand pack
	a) Quantity used	5 - 50 lb bags
7-	Type of seal	Bentonite chips
	a) Quantity used	1/2 - 50 lb bag
8-	Grout	
	a) Grout mix used	Portland cement type I/II
	b) Method of placement	Tremie pipe
	c) Vol. of well casing grout	14 gallons
	Development method	Surge with submersible pump
	Development time	35 minutes
	Estimated purge volume	60 gallons

Comments

PROJECT NUMBER	WELL NUMBER		
669783.FI.WI.01	OF-MW12D	SHEET 1	OF 1

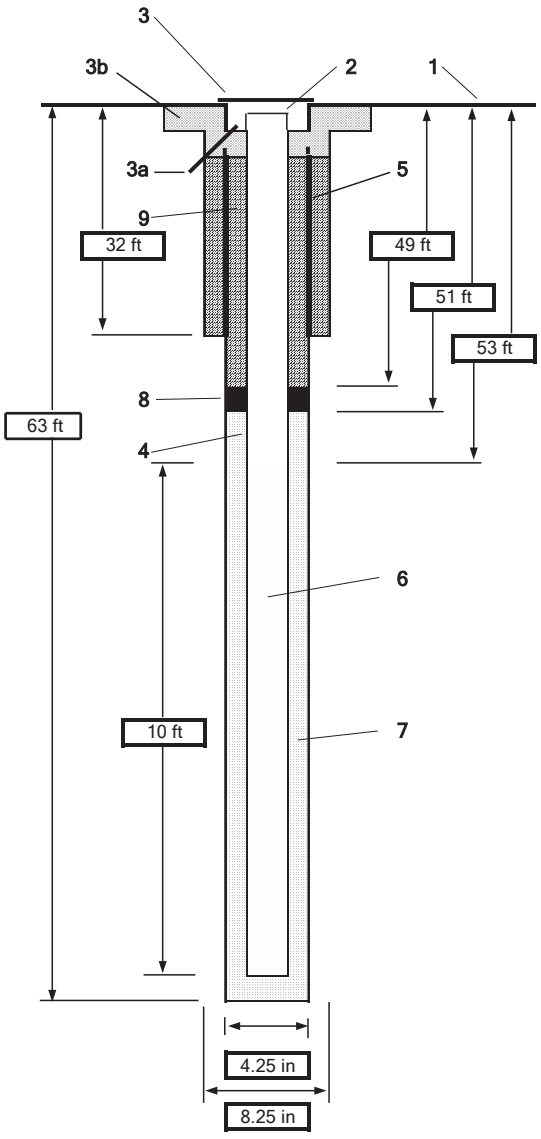
WELL COMPLETION DIAGRAM

PROJECT : Phase I Perflorinated Compound Investigation LOCATION :NALF Fentress, Chesapeake, Virginia (3425740.9723 N, 12176363.2031 E)

DRILLING CONTRACTOR : Paratt Wolff

DRILLING METHOD AND EQUIPMENT USED : 8.25" HSA with mud rotary, geoprobe 7822DT

WATER LEVELS : 5.40 ft START : 12/23/2015 09:00 END : 12/23/2015 11:15 LOGGER : M. Ost



1- Ground elevation at well	12.26 ft
2- Top of casing elevation	11.93 ft
3- Wellhead protection cover type	Flush mount
a) drain tube?	No
b) concrete pad dimensions	12" Diameter circle
4- Dia./type of well casing	2" Diameter PVC
5- Dia./type surface casing	8.25" Diameter steel casing
6- Type/slot/size of screen	0.010" Machine slotted 10 ft PVC screen
7- Type screen filter	#1 Sand pack
a) Quantity used	3 - 50 lb bags
8- Type of seal	Bentonite chips
a) Quantity used	1 - 50 lb bag
9- Grout	
a) Grout mix used	Portland cement type I/II
b) Method of placement	Tremie pipe
c) Vol.of surface casing grout	63 gallons
d) Vol. of well casing grout	63 gallons
Development method	Surge with submersible pump
Development time	112 minutes
Estimated purge volume	110 gallons

Comments

PROJECT NUMBER	WELL NUMBER		
669783.FI.WI.01	OF-MW13	SHEET 1	OF 1

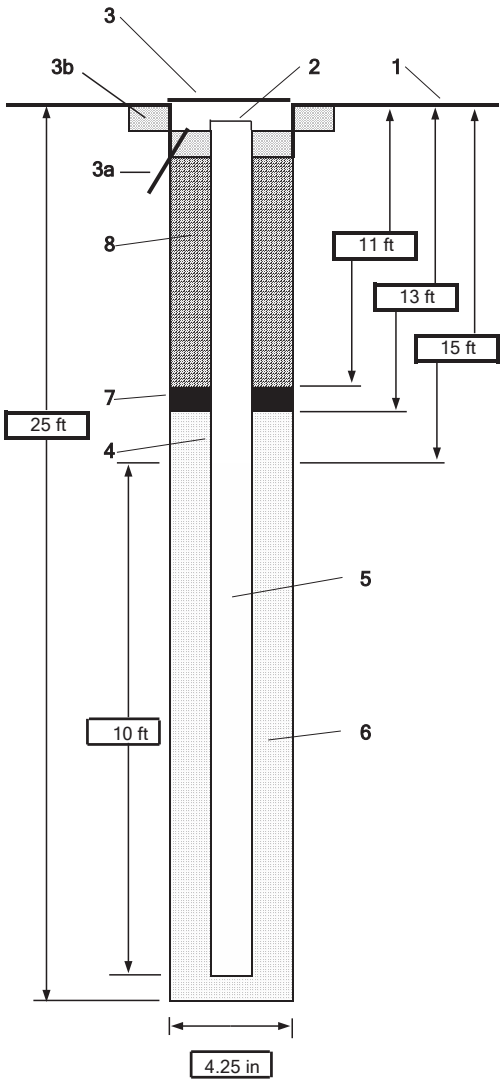
WELL COMPLETION DIAGRAM

PROJECT : Phase I Perflorinated Compound Investigation LOCATION : NALF Fentress, Chesapeake, Virginia (3425956.7087 N, 12178087.1195 E)

DRILLING CONTRACTOR : Parratt Wolff

DRILLING METHOD AND EQUIPMENT USED : 4.25" HSA , geoprobe 7822DT

WATER LEVELS : 2.66 ft START: 12/16/15 11:00 END: 12/16/15 12:20 LOGGER: M. Ost



1- Ground elevation at well: 12.21 ft

2- Top of casing elevation: 11.97 ft

3- Wellhead protection cover type: Flush mount
- a) drain tube?: No
- b) concrete pad dimensions: 12" Diameter circle

4- Dia./type of well casing: 2" Diameter PVC

5- Type/slot size of screen: 0.010" Machine slotted PVC

6- Type screen filter: #1 Sand pack
- a) Quantity used: 4 - 50 lb bags

7- Type of seal: Bentonite chips
- a) Quantity used: 1/2 - 50 lb bag

8- Grout
- a) Grout mix used: Portland cement type I/II
- b) Method of placement: Tremie pipe
- c) Vol. of well casing grout: 14 gallons

Development method: Surge with submersible pump

Development time: 37 minutes

Estimated purge volume: 58 gallons

Comments

PROJECT NUMBER	WELL NUMBER		
669783.FI.WI.01	OF-MW13D	SHEET 1	OF 1

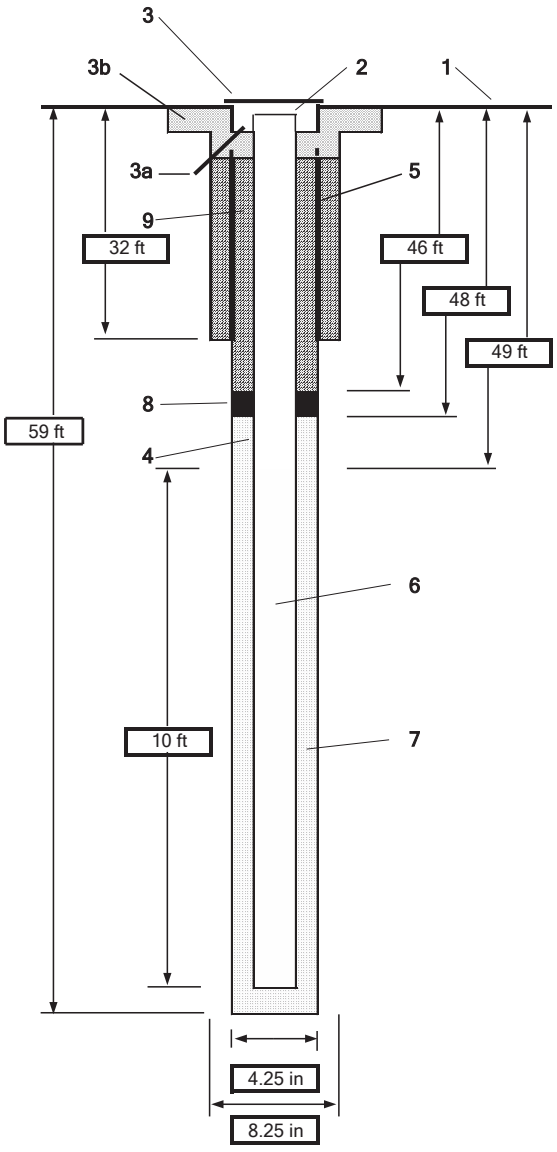
WELL COMPLETION DIAGRAM

PROJECT : Phase I Perflorinated Compound Investigation LOCATION :NALF Fentress, Chesapeake, Virginia (3425959.2586 N, 12178070.8609 E)

DRILLING CONTRACTOR : Parratt Wolff

DRILLING METHOD AND EQUIPMENT USED : 8.25" HSA with mud rotary, geoprobe 7822DT

WATER LEVELS : 6.59 ft START : 1/4/2016 13:55 END : 1/4/2016 16:15 LOGGER : M. Ost



1-	Ground elevation at well	12.47 ft
2-	Top of casing elevation	12.23 ft
3-	Wellhead protection cover type	Flush mount
	a) drain tube?	No
	b) concrete pad dimensions	12" Diameter circle
4-	Dia./type of well casing	2" Diameter PVC
5-	Dia./type surface casing	8.25" Diameter steel casing
6-	Type/slot/size of screen	0.010" Machine slotted PVC
		10 ft screen
7-	Type screen filter	#1 Sand pack
	a) Quantity used	5 - 50 lb bags
8-	Type of seal	Bentonite chips
	a) Quantity used	1 - 50 lb bag
9-	Grout	
	a) Grout mix used	Portland cement
	b) Method of placement	Tremie pipe
	c) Vol.of surface casing grout	63 gallons
	d) Vol. of well casing grout	60. gallons
	Development method	Surge with submersible pump
	Development time	62 minutes
	Estimated purge volume	108 gallons

Comments

PROJECT NUMBER	WELL NUMBER		
669783.FI.WI.01	OF-MW14	SHEET 1	OF 1

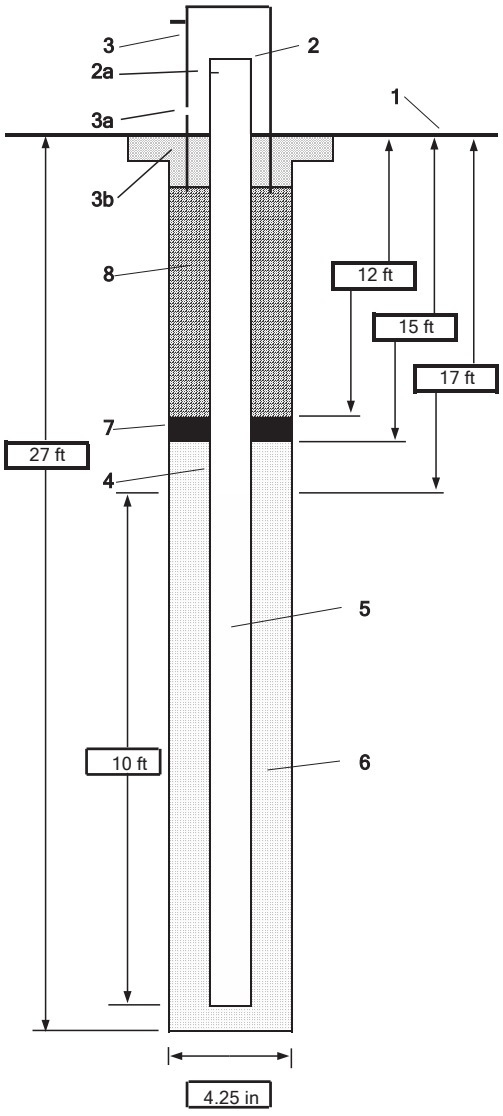
WELL COMPLETION DIAGRAM

PROJECT : Phase I Perflorinated Compound Investigation LOCATION : NALF Fentress, Chesapeake, Virginia (3424028.8154 N, 12179740.0864 E)

DRILLING CONTRACTOR : Parratt Wolff

DRILLING METHOD AND EQUIPMENT USED : 4.25" HSA, geoprobe 7822DT

WATER LEVELS : 5.30 ft START : 12/15/2015 10:00 END : 12/15/2015 11:10 LOGGER : T. Stewart



1-	Ground elevation at well	8.37 ft
2-	Top of casing elevation	11.52 ft
	a) vent hole?	No
3-	Wellhead protection cover type	4" x 4" Steel square
	a) weep hole?	No
	b) concrete pad dimensions	2' x 2' Concrete square
4-	Dia./type of well casing	2" Diameter PVC
5-	Type/slot size of screen	0.010" Machine slotted PVC 10 ft screen
6-	Type screen filter	#1 Sand pack
	a) Quantity used	6 - 50 lb bags
7-	Type of seal	Bentonite chips
	a) Quantity used	1 - 50 lb bage
8-	Grout	
	a) Grout mix used	Portland cement type I/II
	b) Method of placement	Tremie pipe
	c) Vol. of well casing grout	16 gallons
	Development method	Surge with submersible pump
	Development time	37 minutes
	Estimated purge volume	60 gallons

Comments

PROJECT NUMBER	WELL NUMBER		
669783.FI.WI.01	OF-MW15	SHEET 1	OF 1

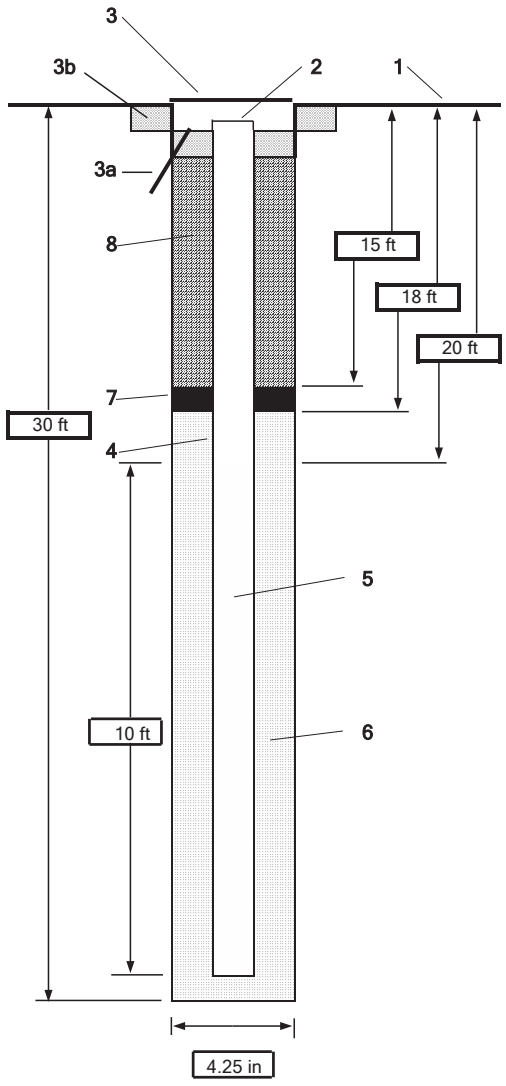
WELL COMPLETION DIAGRAM

PROJECT : Phase I Perflorinated Compound Investigation LOCATION : NALF Fentress, Chesapeake, Virginia (3422779.914 N, 12179699.4252 E)

DRILLING CONTRACTOR : Parratt Wolff

DRILLING METHOD AND EQUIPMENT USED : 4.25" HSA, geoprobe 7822DT

WATER LEVELS : 6.70 ft START : 12/9/2015 09:45 END : 12/9/2015 09:55 LOGGER : D. Brown



1-	Ground elevation at well	12.27 ft
2-	Top of casing elevation	11.56 ft
3-	Wellhead protection cover type	Flush mount
	a) drain tube?	No
	b) concrete pad dimensions	12" Diameter circle
4-	Dia./type of well casing	2" Diameter PVC
5-	Type/slot size of screen	0.010" Machine slotted PVC
6-	Type screen filter	#1 Sand pack
	a) Quantity used	6 - 50 lb bags
7-	Type of seal	Bentonite chips
	a) Quantity used	1 - 50 lb bag
8-	Grout	
	a) Grout mix used	Portland cement type I/II
	b) Method of placement	Tremie pipe
	c) Vol. of well casing grout	20 gallons
	Development method	Surge with submersible pump
	Development time	40 Minutes
	Estimated purge volume	75 Gallons

Comments

PROJECT NUMBER	WELL NUMBER		
669783.FI.WI.01	OF-MW15D	SHEET 1	OF 1

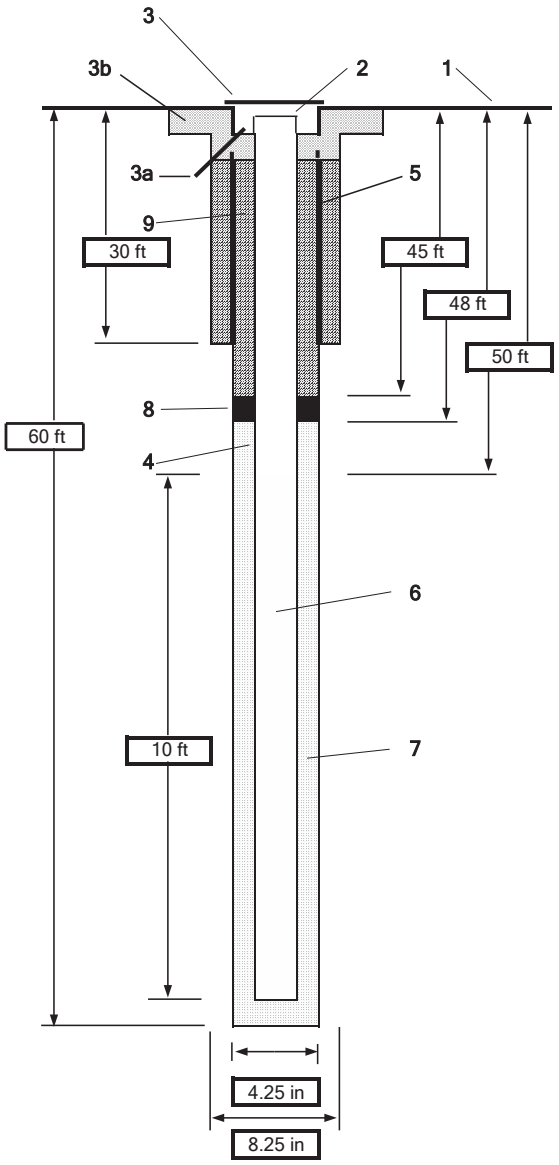
WELL COMPLETION DIAGRAM

PROJECT : Phase I Perflorinated Compound Investigation LOCATION :NALF Fentress, Chesapeake, Virginia (3422790.6327 N, 12179710.6625 E)

DRILLING CONTRACTOR : Paratt Wolff

DRILLING METHOD AND EQUIPMENT USED : 8.25" HSA with mud rotary, geoprobe 7822DT

WATER LEVELS : 4.69 ft START : 12/8/2015 13:30 END : 12/8/2015 14:30 LOGGER : D. Brown



1- Ground elevation at well	12.21 ft
2- Top of casing elevation	11.74 ft
3- Wellhead protection cover typ	Flush mount
a) drain tube?	No
b) concrete pad dimensions	12" Diameter circle
4- Dia./type of well casing	2" Diameter PVC
5- Dia./type surface casing	8.25" Diameter steel casing
6- Type/slot/size of screen	0.010" Machine slotted PVC
	10 ft screen
7- Type screen filter	#1 Sand pack
a) Quantity used	6 - 50 lb bags
8- Type of seal	Bentonite chips
a) Quantity used	1 - 50 lb bag
9- Grout	
a) Grout mix used	Portland cement type I/II
b) Method of placement	Tremie pipe
c) Vol.of surface casing grout	58 gallons
d) Vol. of well casing grout	59 gallons
Development method	Surge with submersible pump
Development time	90 gallons
Estimated purge volume	101 minutes

Comments

PROJECT NUMBER	WELL NUMBER	
669783.FI.WI.01	OF-MW24	SHEET 1 OF 1

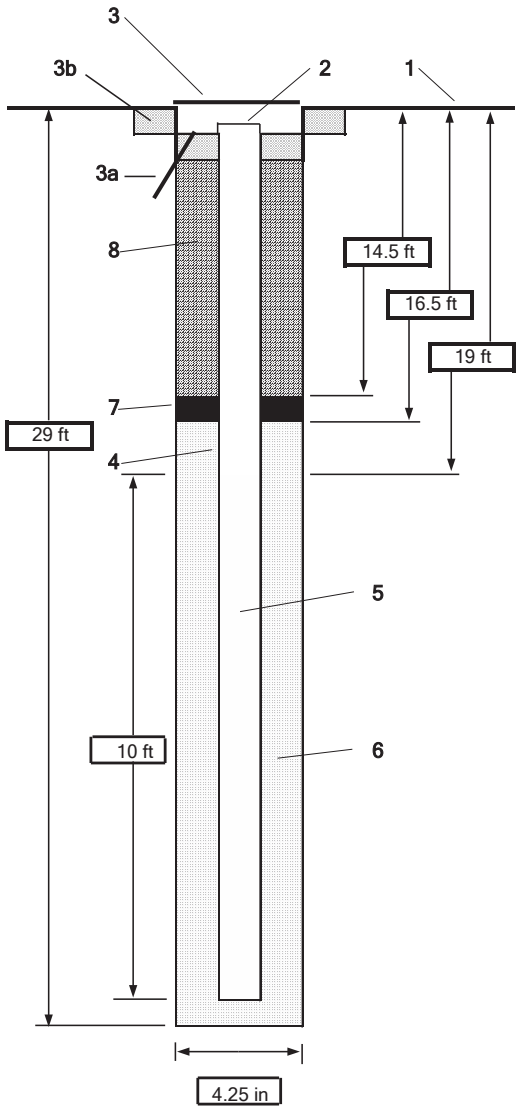
WELL COMPLETION DIAGRAM

PROJECT : Phase I Perflorinated Compound Investigation LOCATION :NALF Fentress, Chesapeake, Virginia (3425740.9723 N, 12176363.2031

DRILLING CONTRACTOR : Parratt Wolff

DRILLING METHOD AND EQUIPMENT USED : 4.25" HSA, geoprobe 7822DT

WATER LEVELS : 1.83 ft START : 6/21/16; 10:40 END : 6/21/16; 16:10 LOGGER : B. Rahe



1-	Ground elevation at well	10.93 ft
2-	Top of casing elevation	10.75 ft
3-	Wellhead protection cover typ	Flush mount
	a) drain tube?	No
	b) concrete pad dimensions	12" Diameter circle
4-	Dia./type of well casing	2" Diameter PVC
5-	Type/slot size of screen	0.010" Machine slotted PVC
6-	Type screen filter	#1 Sand pack
	a) Quantity used	5 - 50 lb bags
7-	Type of seal	Bentonite chips
	a) Quantity used	1/2 - 50 lb bag
8-	Grout	
	a) Grout mix used	Portland cement type I/II
	b) Method of placement	Tremie pipe
	c) Vol. of well casing grout	69.6 gallons
	Development method	Surge with submersible pump
	Development time	55 minutes
	Estimated purge volume	90 gallons

Comments

PROJECT NUMBER	WELL NUMBER	
669783.FI.WI.01	OF-MW25S	SHEET 1 OF 1

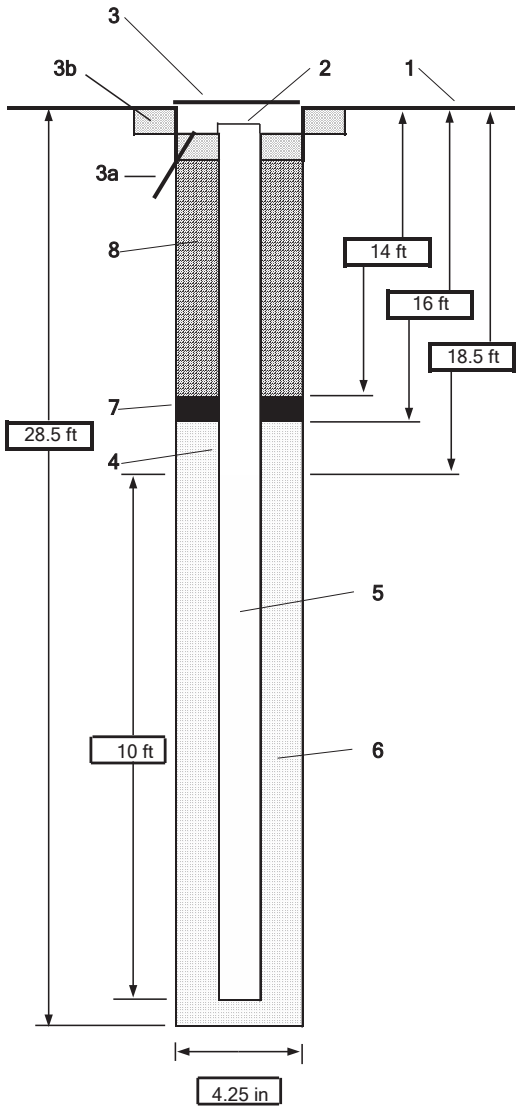
WELL COMPLETION DIAGRAM

PROJECT : Phase I Perflorinated Compound Investigation LOCATION :NALF Fentress, Chesapeake, Virginia (3425740.9723 N, 12176363.2031

DRILLING CONTRACTOR : Parratt Wolff

DRILLING METHOD AND EQUIPMENT USED : 4.25" HSA, geoprobe 7822DT

WATER LEVELS : 1.83 ft START : 6/25/16; 15:25 END : 6/26/16; 16:05 LOGGER : B. Rahe



1- Ground elevation at well: 12.23 ft

2- Top of casing elevation: 11.57 ft

3- Wellhead protection cover typ: Flush mount
- a) drain tube?: No
- b) concrete pad dimensions: 12" Diameter circle

4- Dia./type of well casing: 2" Diameter PVC

5- Type/slot size of screen: 0.010" Machine slotted PVC

6- Type screen filter: #1 Sand pack
- a) Quantity used: 5 - 50 lb bags

7- Type of seal: Bentonite chips
- a) Quantity used: 1/2 - 50 lb bag

8- Grout
- a) Grout mix used: Portland cement type I/II
- b) Method of placement: Tremie pipe
- c) Vol. of well casing grout: 69.6 gallons

Development method: Surge with submersible pump

Development time: 55 minutes

Estimated purge volume: 110 gallons

Comments

PROJECT NUMBER	WELL NUMBER	
669783.FI.WI.01	OF-MW27	SHEET 1 OF 1

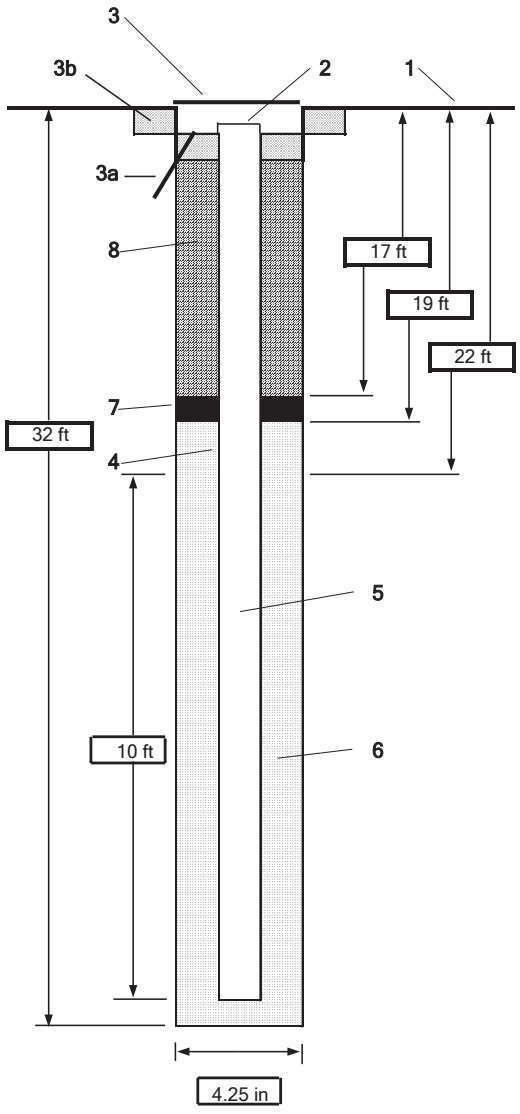
WELL COMPLETION DIAGRAM

PROJECT : Phase I Perflorinated Compound Investigation LOCATION :NALF Fentress, Chesapeake, Virginia (3425740.9723 N, 12176363.2031

DRILLING CONTRACTOR : Parratt Wolff

DRILLING METHOD AND EQUIPMENT USED : 4.25" HSA, geoprobe 7822DT

WATER LEVELS : 1.83 ft START : 7/7/16; 12:15 END : 7/7/16; 18:10 LOGGER : B. Rahe



1-	Ground elevation at well	12.20 ft
2-	Top of casing elevation	11.72 ft
3-	Wellhead protection cover typ	Flush mount
	a) drain tube?	No
	b) concrete pad dimensions	12" Diameter circle
4-	Dia./type of well casing	2" Diameter PVC
5-	Type/slot size of screen	0.010" Machine slotted PVC
6-	Type screen filter	#1 Sand pack
	a) Quantity used	5 - 50 lb bags
7-	Type of seal	Bentonite chips
	a) Quantity used	1/2 - 50 lb bag
8-	Grout	
	a) Grout mix used	Portland cement type I/II
	b) Method of placement	Tremie pipe
	c) Vol. of well casing grout	87 gallons
	Development method	Surge with submersible pump
	Development time	55 minutes
	Estimated purge volume	Not Recorded

Comments

PROJECT NUMBER	WELL NUMBER		
669783.FI.WI.01	OF-MW28	SHEET 1	OF 1

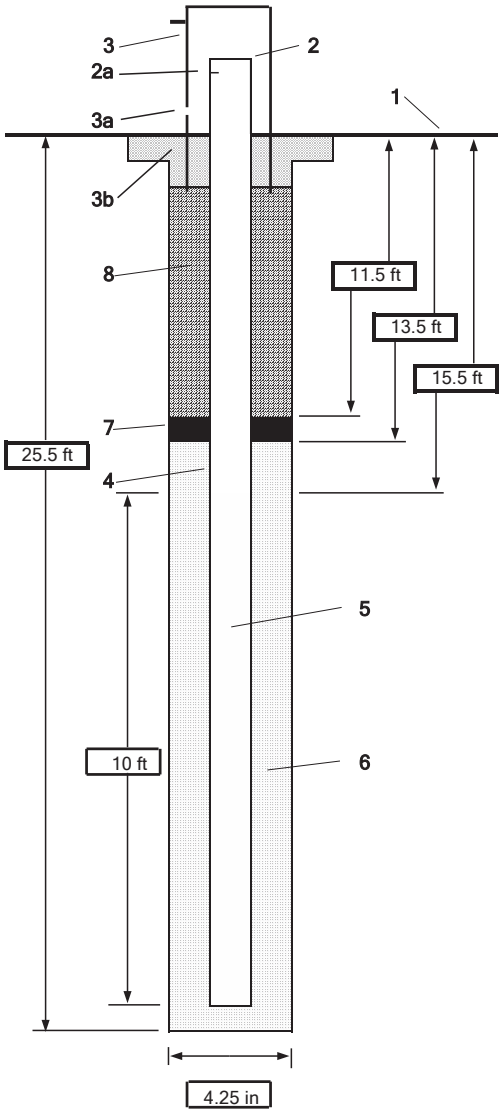
WELL COMPLETION DIAGRAM

PROJECT : Phase I Perflorinated Compound Investigation LOCATION : NALF Fentress, Chesapeake, Virginia (3424028.8154 N, 12179740.0864 E)

DRILLING CONTRACTOR : Parratt Wolff

DRILLING METHOD AND EQUIPMENT USED : 4.25" HSA, geoprobe 7822DT

WATER LEVELS : 5.30 ft START : 6/22/17; 08:35 END : 6/22/16; 12:20 LOGGER : B. Rahe



1-	Ground elevation at well	5.61 ft
2-	Top of casing elevation	7.56 ft
	a) vent hole?	No
3-	Wellhead protection cover type	4" x 4" Steel square
	a) weep hole?	No
	b) concrete pad dimensions	2' x 2' Concrete square
4-	Dia./type of well casing	2" Diameter PVC
5-	Type/slot size of screen	0.010" Machine slotted PVC 10 ft screen
6-	Type screen filter	#1 Sand pack
	a) Quantity used	6 - 50 lb bags
7-	Type of seal	Bentonite chips
	a) Quantity used	1 - 50 lb bage
8-	Grout	
	a) Grout mix used	Portland cement type I/II
	b) Method of placement	Tremie pipe
	c) Vol. of well casing grout	55.1 gallons
	Development method	Surge with submersible pump
	Development time	60 minutes
	Estimated purge volume	110 gallons

Comments

PROJECT NUMBER	WELL NUMBER		
669783.FI.WI.01	OF-MW28D	SHEET 1	OF 1

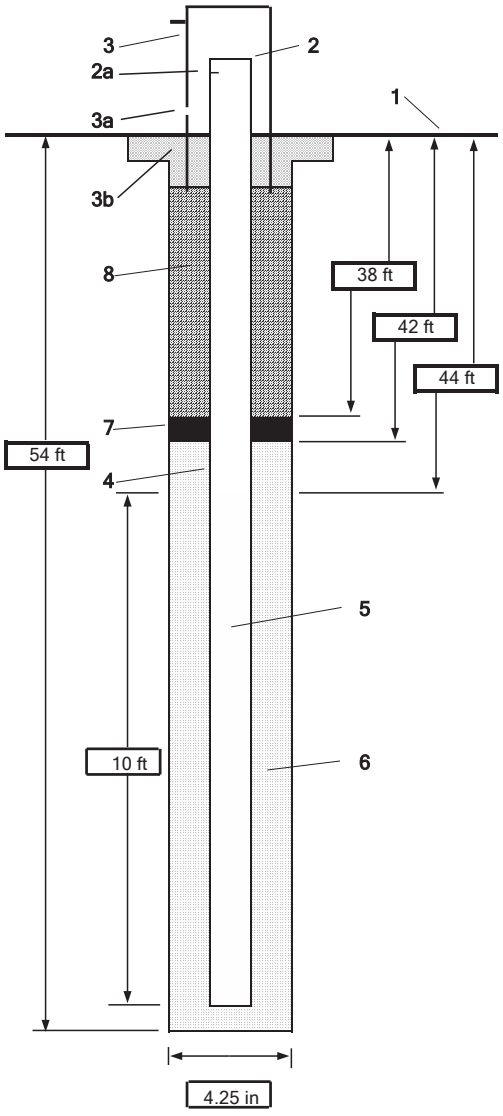
WELL COMPLETION DIAGRAM

PROJECT : Phase I Perflorinated Compound Investigation LOCATION : NALF Fentress, Chesapeake, Virginia (3424028.8154 N, 12179740.0864 E)

DRILLING CONTRACTOR : Parratt Wolff

DRILLING METHOD AND EQUIPMENT USED : 4.25" HSA, geoprobe 7822DT

WATER LEVELS : 5.30 ft START : 6/22/16 14:00 END : 6/22/16 18:50 LOGGER : B. Rahe



1-	Ground elevation at well	5.84 ft
2-	Top of casing elevation	7.39 ft
	a) vent hole?	No
3-	Wellhead protection cover type	4" x 4" Steel square
	a) weep hole?	No
	b) concrete pad dimensions	2' x 2' Concrete square
4-	Dia./type of well casing	2" Diameter PVC
5-	Type/slot size of screen	0.010" Machine slotted PVC 10 ft screen
6-	Type screen filter	#1 Sand pack
	a) Quantity used	6 - 50 lb bags
7-	Type of seal	Bentonite chips
	a) Quantity used	1 - 50 lb bage
8-	Grout	
	a) Grout mix used	Portland cement type I/II
	b) Method of placement	Tremie pipe
	c) Vol. of well casing grout	121.8 gallons
	Development method	Surge with submersible pump
	Development time	135 minutes
	Estimated purge volume	165 gallons

Comments

PROJECT NUMBER	WELL NUMBER		
669783.FI.WI.01	OF-MW29S	SHEET 1	OF 1

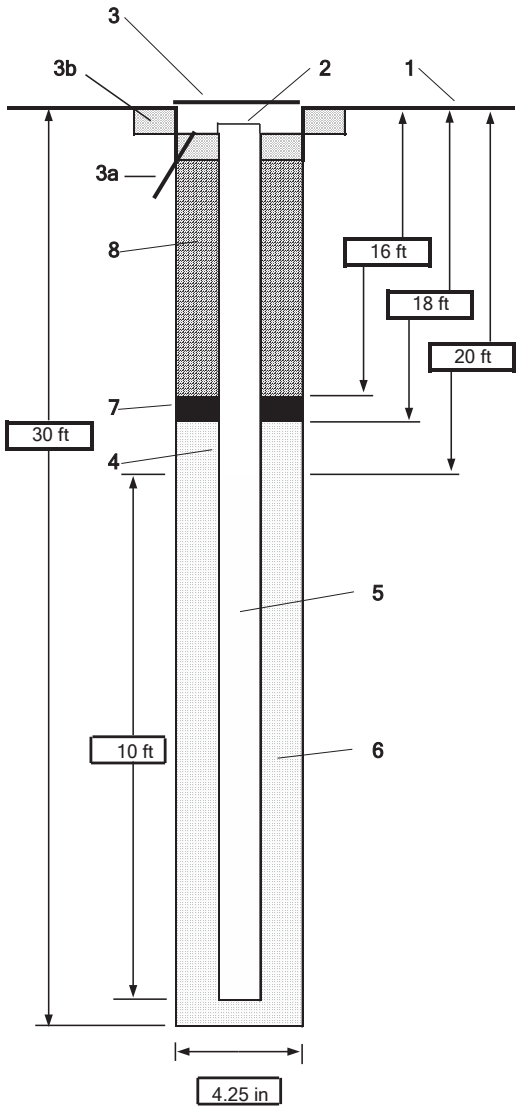
WELL COMPLETION DIAGRAM

PROJECT : Phase I Perflorinated Compound Investigation LOCATION :NALF Fentress, Chesapeake, Virginia (3425740.9723 N, 12176363.2031

DRILLING CONTRACTOR : Parratt Wolff

DRILLING METHOD AND EQUIPMENT USED : 4.25" HSA, geoprobe 7822DT

WATER LEVELS : 1.83 ft START : 6/25/16 09:30 END : 6/25/16 14:20 LOGGER : B. Rahe



1-	Ground elevation at well	13.76 ft
2-	Top of casing elevation	13.55 ft
3-	Wellhead protection cover typ	Flush mount
	a) drain tube?	No
	b) concrete pad dimensions	12" Diameter circle
4-	Dia./type of well casing	2" Diameter PVC
5-	Type/slot size of screen	0.010" Machine slotted PVC
6-	Type screen filter	#1 Sand pack
	a) Quantity used	5 - 50 lb bags
7-	Type of seal	Bentonite chips
	a) Quantity used	1/2 - 50 lb bag
8-	Grout	
	a) Grout mix used	Portland cement type I/II
	b) Method of placement	Tremie pipe
	c) Vol. of well casing grout	81.2 gallons
	Development method	Surge with submersible pump
	Development time	25 minutes
	Estimated purge volume	Not Recorded

Comments

PROJECT NUMBER	WELL NUMBER	
669783.FI.WI.01	OF-MW30D	SHEET 1 OF 1

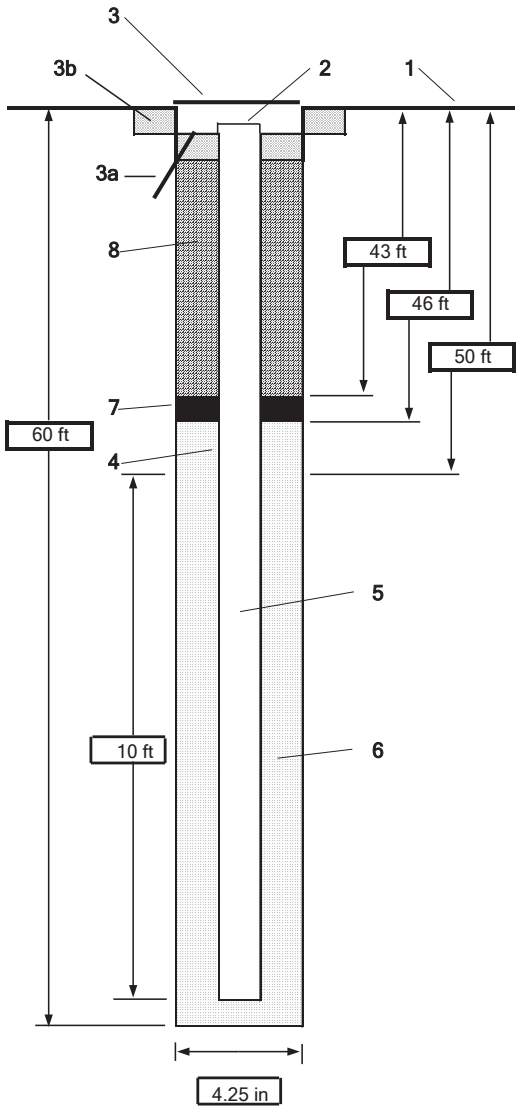
WELL COMPLETION DIAGRAM

PROJECT : Phase I Perflorinated Compound Investigation LOCATION :NALF Fentress, Chesapeake, Virginia (3425740.9723 N, 12176363.2031

DRILLING CONTRACTOR : Parratt Wolff

DRILLING METHOD AND EQUIPMENT USED : 4.25" HSA, geoprobe 7822DT

WATER LEVELS : 1.83 ft START : 6/28/17 08:20 END : 6/28/16 12:25 LOGGER : B. Rahe



1-	Ground elevation at well	12.20 ft
2-	Top of casing elevation	11.77 ft
3-	Wellhead protection cover typ	Flush mount
	a) drain tube?	No
	b) concrete pad dimensions	12" Diameter circle
4-	Dia./type of well casing	2" Diameter PVC
5-	Type/slot size of screen	0.010" Machine slotted PVC
6-	Type screen filter	#1 Sand pack
	a) Quantity used	5 - 50 lb bags
7-	Type of seal	Bentonite chips
	a) Quantity used	1/2 - 50 lb bag
8-	Grout	
	a) Grout mix used	Portland cement type I/II
	b) Method of placement	Tremie pipe
	c) Vol. of well casing grout	237.8 gallons
	Development method	Surge with submersible pump
	Development time	105 minutes
	Estimated purge volume	165 gallons

Comments

PROJECT NUMBER	WELL NUMBER		
669783.FI.WI.01	OF-MW30S	SHEET 1	OF 1

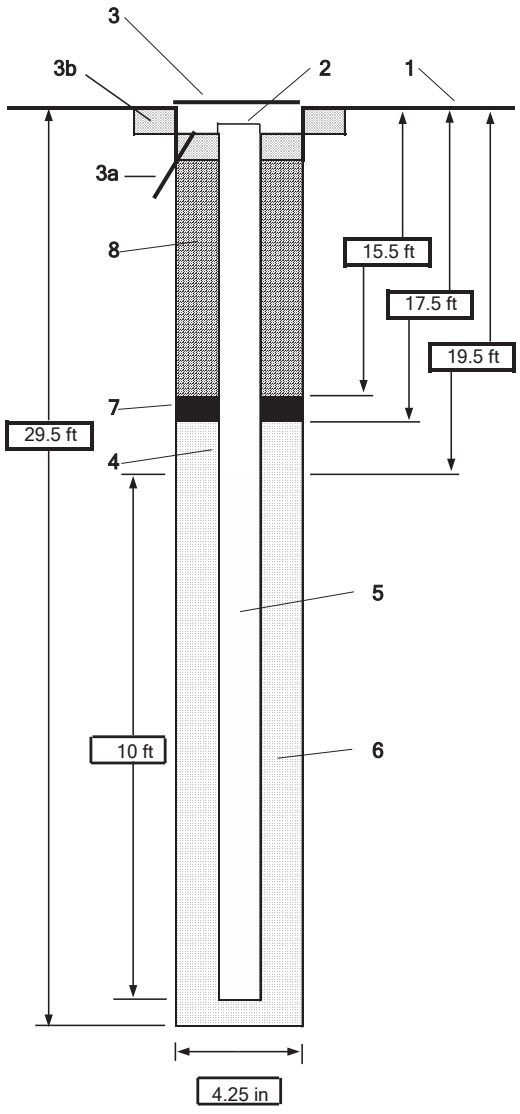
WELL COMPLETION DIAGRAM

PROJECT : Phase I Perflorinated Compound Investigation LOCATION :NALF Fentress, Chesapeake, Virginia (3425740.9723 N, 12176363.2031

DRILLING CONTRACTOR : Parratt Wolff

DRILLING METHOD AND EQUIPMENT USED : 4.25" HSA, geoprobe 7822DT

WATER LEVELS : 1.83 ft START : 6/26/16 11:20 END : 6/26/16 1605 LOGGER : B. Rahe



1-	Ground elevation at well	12.18 ft
2-	Top of casing elevation	11.91 ft
3-	Wellhead protection cover typ	Flush mount
	a) drain tube?	No
	b) concrete pad dimensions	12" Diameter circle
4-	Dia./type of well casing	2" Diameter PVC
5-	Type/slot size of screen	0.010" Machine slotted PVC
6-	Type screen filter	#1 Sand pack
	a) Quantity used	5 - 50 lb bags
7-	Type of seal	Bentonite chips
	a) Quantity used	1/2 - 50 lb bag
8-	Grout	
	a) Grout mix used	Portland cement type I/II
	b) Method of placement	Tremie pipe
	c) Vol. of well casing grout	78.3 gallons
	Development method	Surge with submersible pump
	Development time	80 minutes
	Estimated purge volume	110 gallons

Comments

PROJECT NUMBER	WELL NUMBER		
669783.FI.WI.01	OF-MW31	SHEET 1	OF 1

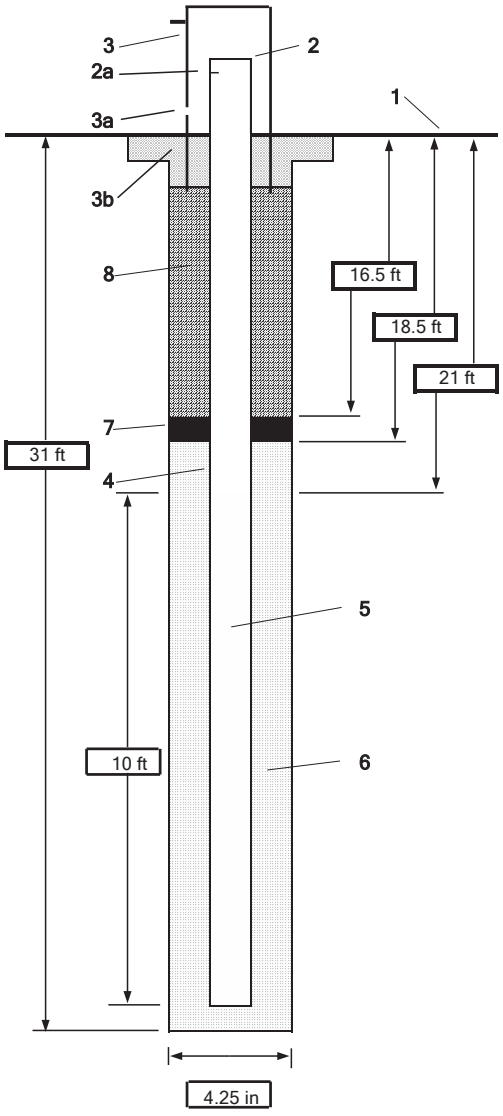
WELL COMPLETION DIAGRAM

PROJECT : Phase I Perflorinated Compound Investigation LOCATION : NALF Fentress, Chesapeake, Virginia (3424028.8154 N, 12179740.0864 E)

DRILLING CONTRACTOR : Parratt Wolff

DRILLING METHOD AND EQUIPMENT USED : 4.25" HSA, geoprobe 7822DT

WATER LEVELS : 5.30 ft START : 16/24/16 08:00 END : 6/24/16 12:50 LOGGER : B. Rahe



1-	Ground elevation at well	12.12 ft
2-	Top of casing elevation	14.10 ft
	a) vent hole?	No
3-	Wellhead protection cover type	4" x 4" Steel square
	a) weep hole?	No
	b) concrete pad dimensions	2' x 2' Concrete square
4-	Dia./type of well casing	2" Diameter PVC
5-	Type/slot size of screen	0.010" Machine slotted PVC
		10 ft screen
6-	Type screen filter	#1 Sand pack
	a) Quantity used	6 - 50 lb bags
7-	Type of seal	Bentonite chips
	a) Quantity used	1 - 50 lb bage
8-	Grout	
	a) Grout mix used	Portland cement type I/II
	b) Method of placement	Tremie pipe
	c) Vol. of well casing grout	84.1 gallons
	Development method	Surge with submersible pump
	Development time	160 minutes
	Estimated purge volume	45 gallons

Comments

PROJECT NUMBER	WELL NUMBER		
669783.FI.WI.01	OF-MW31D	SHEET 1	OF 1

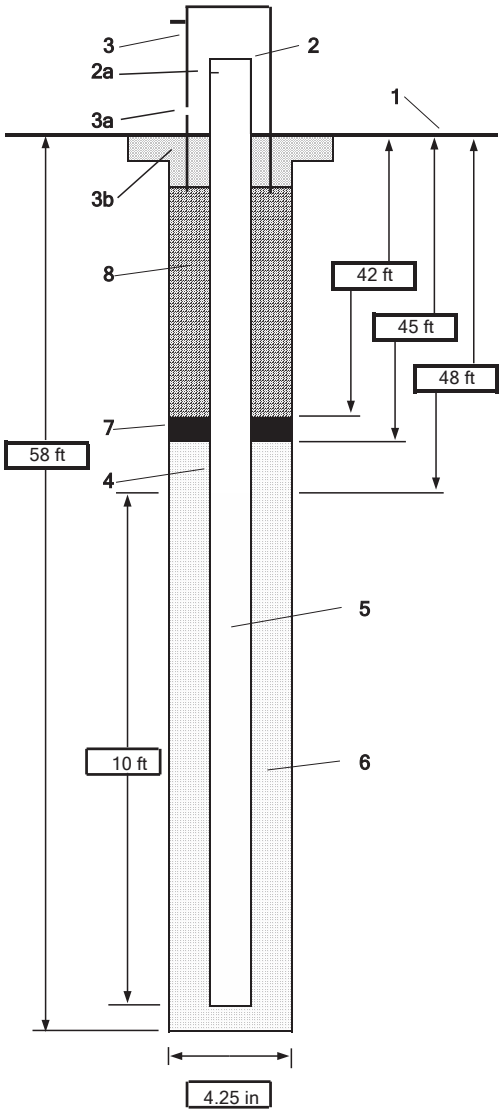
WELL COMPLETION DIAGRAM

PROJECT : Phase I Perflorinated Compound Investigation LOCATION : NALF Fentress, Chesapeake, Virginia (3424028.8154 N, 12179740.0864 E)

DRILLING CONTRACTOR : Parratt Wolff

DRILLING METHOD AND EQUIPMENT USED : 4.25" HSA, geoprobe 7822DT

WATER LEVELS : 5.30 ft START : 6/24/16 13:00 END : 6/24/16 18:30 LOGGER : B. Rahe



1-	Ground elevation at well	11.97 ft
2-	Top of casing elevation	13.74 ft
	a) vent hole?	No
3-	Wellhead protection cover type	4" x 4" Steel square
	a) weep hole?	No
	b) concrete pad dimensions	2' x 2' Concrete square
4-	Dia./type of well casing	2" Diameter PVC
5-	Type/slot size of screen	0.010" Machine slotted PVC
		10 ft screen
6-	Type screen filter	#1 Sand pack
	a) Quantity used	6 - 50 lb bags
7-	Type of seal	Bentonite chips
	a) Quantity used	1 - 50 lb bage
8-	Grout	
	a) Grout mix used	Portland cement type I/II
	b) Method of placement	Tremie pipe
	c) Vol. of well casing grout	232 gallons
	Development method	Surge with submersible pump
	Development time	60 minutes
	Estimated purge volume	100 gallons

Comments

PROJECT NUMBER	WELL NUMBER		
669783.FI.WI.01	OF-MW32	SHEET 1	OF 1

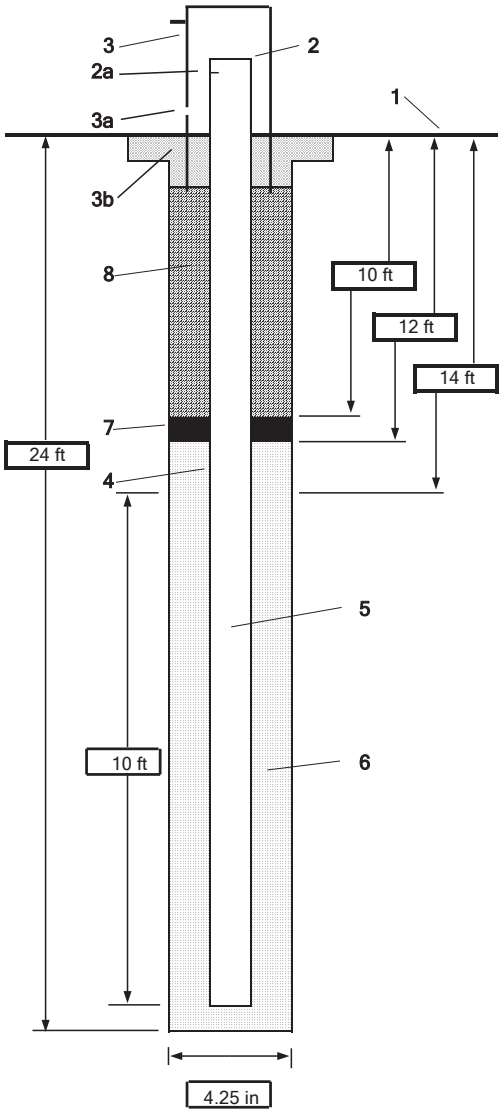
WELL COMPLETION DIAGRAM

PROJECT : Phase I Perflorinated Compound Investigation LOCATION : NALF Fentress, Chesapeake, Virginia (3424028.8154 N, 12179740.0864 E)

DRILLING CONTRACTOR : Parratt Wolff

DRILLING METHOD AND EQUIPMENT USED : 4.25" HSA, geoprobe 7822DT

WATER LEVELS : 5.30 ft START : 7/12/16 12:30 END : 7/12/16 17:15 LOGGER : B. Rahe



1-	Ground elevation at well	11.53 ft
2-	Top of casing elevation	13.96 ft
	a) vent hole?	No
3-	Wellhead protection cover type	4" x 4" Steel square
	a) weep hole?	No
	b) concrete pad dimensions	2' x 2' Concrete square
4-	Dia./type of well casing	2" Diameter PVC
5-	Type/slot size of screen	0.010" Machine slotted PVC 10 ft screen
6-	Type screen filter	#1 Sand pack
	a) Quantity used	6 - 50 lb bags
7-	Type of seal	Bentonite chips
	a) Quantity used	1 - 50 lb bage
8-	Grout	
	a) Grout mix used	Portland cement type I/II
	b) Method of placement	Tremie pipe
	c) Vol. of well casing grout	232 gallons
	Development method	Surge with submersible pump
	Development time	Not Recorded
	Estimated purge volume	Not Recorded

Comments

PROJECT NUMBER	WELL NUMBER		
674207.SI.SI	OF-MW32D	SHEET 1	OF 1

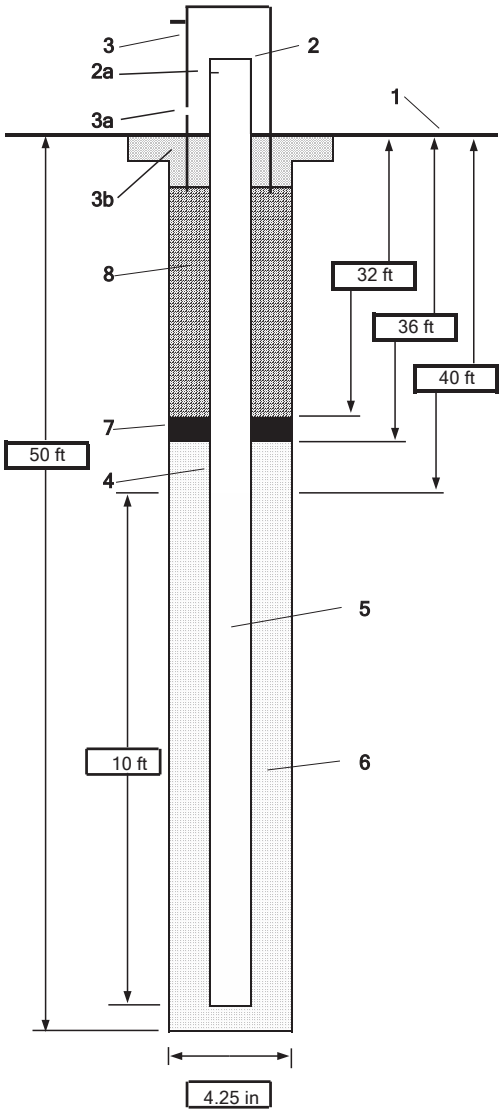
WELL COMPLETION DIAGRAM

PROJECT : Phase I Perflorinated Compound Investigation LOCATION : NALF Fentress, Chesapeake, Virginia (3424028.8154 N, 12179740.0864 E)

DRILLING CONTRACTOR : Parratt Wolff

DRILLING METHOD AND EQUIPMENT USED : 4.25" HSA, geoprobe 7822DT

WATER LEVELS : 6.84 ft START : 3/29/17 14:45 END : 3/30/17 13:00 LOGGER : L. Baerga



1-	Ground elevation at well	11.52 ft
2-	Top of casing elevation	14.46 ft
	a) vent hole?	No
3-	Wellhead protection cover type	Flush mount
	a) weep hole?	No
	b) concrete pad dimensions	12" Diameter circle
4-	Dia./type of well casing	2" Diameter PVC
5-	Type/slot size of screen	0.010" Machine slotted PVC
		10 ft screen
6-	Type screen filter	#1 Sand pack
	a) Quantity used	8 - 50 lb bags
7-	Type of seal	Bentonite chips
	a) Quantity used	3/4 - 50 lb bag
8-	Grout	
	a) Grout mix used	Portland cement type I/II
	b) Method of placement	Tremie pipe
	c) Vol. of well casing grout	40 gallons
	Development method	Surge with submersible pump
	Development time	85 minutes
	Estimated purge volume	45 gallons

Comments

PROJECT NUMBER	WELL NUMBER		
669783.FI.WI.01	OF-MW34	SHEET 1	OF 1

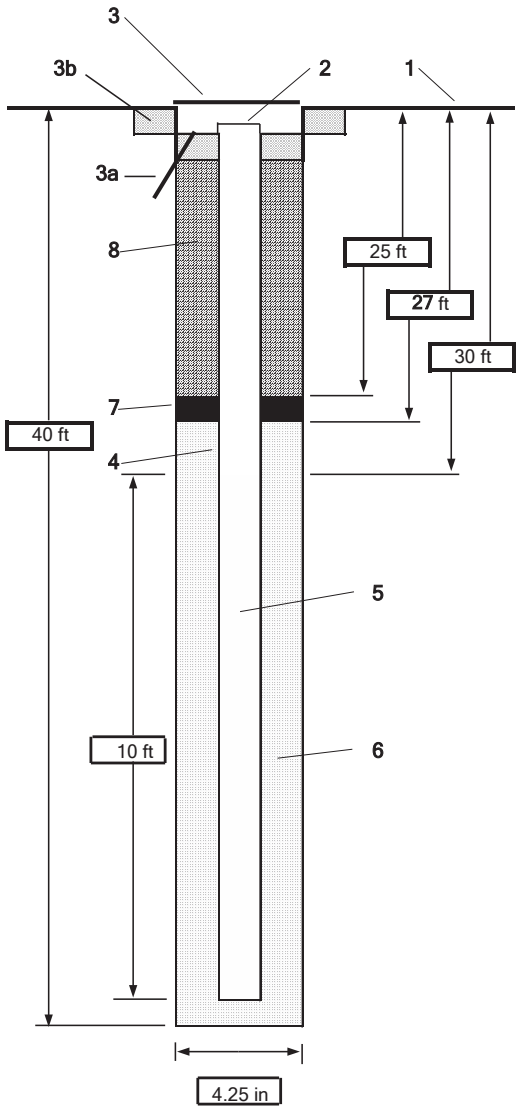
WELL COMPLETION DIAGRAM

PROJECT : Phase I Perflorinated Compound Investigation LOCATION :NALF Fentress, Chesapeake, Virginia (3425740.9723 N, 12176363.2031

DRILLING CONTRACTOR : Parratt Wolff

DRILLING METHOD AND EQUIPMENT USED : 4.25" HSA, geoprobe 7822DT

WATER LEVELS : 1.83 ft START : 7/10/16 11:30 END : 7/10/16 18:15 LOGGER : B. Rahe



1-	Ground elevation at well	10.66 ft
2-	Top of casing elevation	10.31 ft
3-	Wellhead protection cover typ	Flush mount
	a) drain tube?	No
	b) concrete pad dimensions	12" Diameter circle
4-	Dia./type of well casing	2" Diameter PVC
5-	Type/slot size of screen	0.010" Machine slotted PVC
6-	Type screen filter	#1 Sand pack
	a) Quantity used	5 - 50 lb bags
7-	Type of seal	Bentonite chips
	a) Quantity used	1/2 - 50 lb bag
8-	Grout	
	a) Grout mix used	Portland cement type I/II
	b) Method of placement	Tremie pipe
	c) Vol. of well casing grout	145 gallons
	Development method	Surge with submersible pump
	Development time	300 minutes
	Estimated purge volume	15 gallons

Comments

PROJECT NUMBER	WELL NUMBER	
674207.SI.SI	OF-MW34D	SHEET 1 OF 1

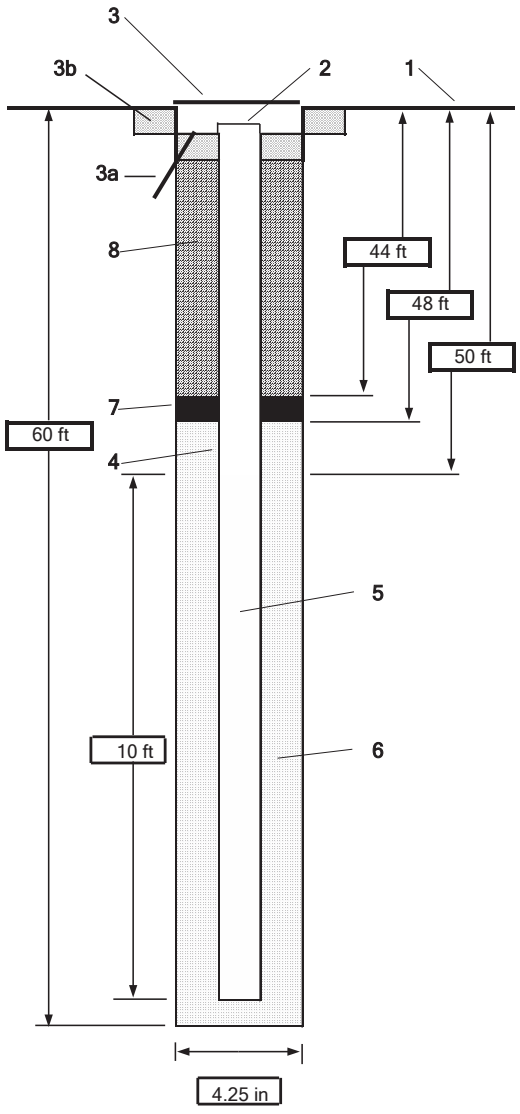
WELL COMPLETION DIAGRAM

PROJECT : Phase I Perflorinated Compound Investigation LOCATION :NALF Fentress, Chesapeake, Virginia (3425740.9723 N, 12176363.2031

DRILLING CONTRACTOR : Parratt Wolff

DRILLING METHOD AND EQUIPMENT USED : 4.25" HSA, geoprobe 7822DT

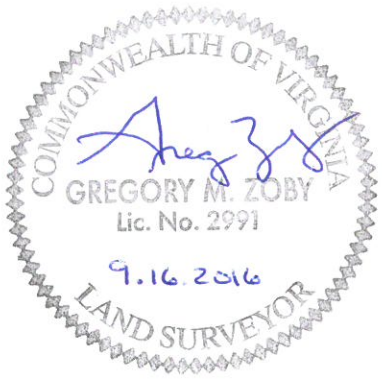
WATER LEVELS : 5.08 ft START : 3/28/17 10:45 END : 3/29/17 11:50 LOGGER : L. Baerga



1-	Ground elevation at well	10.66 ft
2-	Top of casing elevation	10.21 ft
3-	Wellhead protection cover typ	Flush mount
	a) drain tube?	No
	b) concrete pad dimensions	12" Diameter circle
4-	Dia./type of well casing	2" Diameter PVC
5-	Type/slot size of screen	0.010" Machine slotted PVC
6-	Type screen filter	#1 Sand pack
	a) Quantity used	8 - 50 lb bags
7-	Type of seal	Bentonite chips
	a) Quantity used	1/2 - 50 lb bag
8-	Grout	
	a) Grout mix used	Portland cement type I/II
	b) Method of placement	Tremie pipe
	c) Vol. of well casing grout	40 gallons
	Development method	Surge with submersible pump
	Development time	58 minutes
	Estimated purge volume	65 gallons

Comments

Appendix D
Professional Land Survey Reports



CLEAN 9000 CTO WE01

Site Naval Air Landing Field Fentress

Chesapeake, Virginia

MSA Project #16127A

Survey Report

MSA, P.C. provided surveying support for the monitoring of groundwater wells at Naval Air Landing Field (NALF) Fentress located in Chesapeake, Virginia.

This report summarizes the work completed at NALF Fentress to recover e3xisting horizontal and vertical control, establish horizontal and vertical control on site and locate and map the vertical and horizontal locations of thirteen (13) new groundwater monitoring wells.

All horizontal control work complied with Third Order Class I (1:10,000), as outlined in the FDGC Geospatial Positioning Accuracy Standards, Part 4: Standards for Architecture, Engineering, Construction (A/E/C) and Facility Management. See the attached spread sheet for the averages of the on-site control that were established using GPS.

Vertical control work complies with Third Order (0.050√ miles) Residual differences shown on the attached spread sheet using GPS observations show the maximum vertical error as 0.017'

FIELD OPERATION DATES

MSA conducted surveying work at NALF Fentress on August 31, 2016 and completed the work on September 2, 2016. The field crew consisted of Preston Lawrence and Stephen Moran. On August 31, 2016 the weather conditions were cloudy with a high temperature of 95° Fahrenheit. September 2nd was clear and windy with temperatures in the low 80's Fahrenheit.

NGS CONTROL

Horizontal control for the above referenced survey is based upon City of Chesapeake Station 057 and was verified utilizing RTK-Net GPS, a Leica 1200GPS was used in conjunction with the Leica SpiderNet CORS system to obtain the coordinates for the on-site control points numbered 54 and 57. Once the GPS established control points were in place, a traverse and differential level loop were run around the site and additional control points numbered 58, 59, 82 and were set using traditional survey methods. Control points 54, 57, and 82 are #5 rebar set at ground level. The relative precision of the traverse for NALF was (5,622.65/0.001 = 1/1,778,500). Coordinates are based on the Virginia State Plane Coordinate System, South Zone NAD 83/94 HARN.

Appendix E
Investigation-derived Waste Profiles and Disposal Manifests

Clearfield MMG
resourceful waste management

Material Characterization Form

Applicant Information

Company Name:	CH2M Hill, Inc.
Address:	5701 Cleveland Street, Ste. 200
City / State / Zip:	Virginia Beach, VA 23462
Contact:	Stephanie Sawyer
Phone:	757-671-6273
Fax:	
e-mail:	Stephanie.Sawyer@CH2M.com

Generator Information

Company Name:	NAVFAC MIDLANT
Address:	9742 Maryland Ave., LP-24
City / State / Zip:	Norfolk, VA 23511
Contact:	Bobby Hughes
Phone:	757-341-0471
Fax:	
e-mail:	bobby.hughes@navy.mil

Project Description

Site Name:	Naval Auxiliary Landing Field Fentress
Site Address:	Naval Auxiliary Landing Field Fentress, 2500 Lockheed Avenue, Chesapeake, VA 23322
Source of Contamination:	Aqueous Film Forming Foam (AFFF)
Waste Generating Activity:	Monitoring well installation and purging activities

Waste Description

Applicant must complete the following information and attach all laboratory analyses and / or MSDS utilized to characterize the material as non-hazardous and acceptable for receipt by Clearfield MMG.

General Description: Decon and purge water

Matrix: [ ] Soil [ ] Sludge [X] Water [ ] Debris / Absorbents

Petroleum Type: *(Check all that apply)*
[ ] Virgin (un-used) [ ] Non-Virgin (used) [X] None
[ ] Gas [ ] Diesel / # 2 [ ] Motor / Hydraulic Oil [ ] # 4, 5, or 6 Oil

Other Contaminants: see analysis

Volume: (4) 55 gallon Drums **Lab Analysis Completed:** [X] YES [ ] NO

Generator Certification

I hereby certify, based upon my diligent inquiry into the activities and processes generating the waste described on this form, that these materials are not classified as listed or characteristic hazardous waste as regulated by the Commonwealth of Virginia or the state of origin of this waste; that the materials do not contain 50.0 parts per million or more of polychlorinated biphenyls (PCB's); that the analytical results, completed M*aterial Characterization Form* and attached documentation are a representative, true, and accurate description of these materials; that no deliberate or willful omissions have been made in the preparation of this form; and that all known or suspect hazards have been disclosed herein. I further acknowledge that I am aware it is the duty of all persons to dispose of their solid waste in a legal manner (Va.Code ' 10.1-1418.1.A).

Generator or Agent Signature / Date | *Generator or Agent Printed Name*

If I am an agent signing on behalf of the generator, I have confirmed with the generator that the information contained in this profile is accurate and complete.

For Facility Use Only

Approved By: Approval Code:

Approval Date: Comments:

All Deliveries Must be Accompanied by an Approved MCF or Reference Approval Code on Manifest

Clearfield MMG
resourceful waste management

Material Characterization Form

Applicant Information

Company Name:	CH2M Hill, Inc.
Address:	5701 Cleveland Street, Ste. 200
City / State / Zip:	Virginia Beach, VA 23462
Contact:	Katie Tippin
Phone:	757-671-6258
Fax:	
e-mail:	Katie.Tippin@CH2M.com

Generator Information

Company Name:	NAVFAC MIDLANT
Address:	9742 Maryland Ave., LP-24
City / State / Zip:	Norfolk, VA 23511
Contact:	Sean McClatchey
Phone:	757-341-0410
Fax:	757-341-0415
e-mail:	patrick.mcclatchey@navy.mil

Project Description

Site Name:	Naval Auxiliary Landing Field Fentress
Site Address:	Naval Auxiliary Landing Field Fentress, 2500 Lockheed Avenue, Chesapeake, VA 23322
Source of Contamination:	Aqueous Film Forming Foam (AFFF)
Waste Generating Activity:	Monitoring well installation and purging activities

Waste Description

Applicant must complete the following information and attach all laboratory analyses and / or MSDS utilized to characterize the material as non-hazardous and acceptable for receipt by Clearfield MMG.

General Description: Soils & Drilling Sludge

Matrix: [X] Soil [ ] Sludge [ ] Water [ ] Debris / Absorbents

Petroleum Type: *(Check all that apply)*
[ ] Virgin (un-used) [ ] Non-Virgin (used) [X] None
[ ] Gas [ ] Diesel / # 2 [ ] Motor / Hydraulic Oil [ ] # 4, 5, or 6 Oil

Other Contaminants: see analysis

Volume: (75) 55 gallon Drums **Lab Analysis Completed:** [X] YES [ ] NO

Generator Certification

I hereby certify, based upon my diligent inquiry into the activities and processes generating the waste described on this form, that these materials are not classified as listed or characteristic hazardous waste as regulated by the Commonwealth of Virginia or the state of origin of this waste; that the materials do not contain 50.0 parts per million or more of polychlorinated biphenyls (PCB's); that the analytical results, completed M*aterial Characterization Form* and attached documentation are a representative, true, and accurate description of these materials; that no deliberate or willful omissions have been made in the preparation of this form; and that all known or suspect hazards have been disclosed herein. I further acknowledge that I am aware it is the duty of all persons to dispose of their solid waste in a legal manner (Va.Code ' 10.1-1418.1.A).

MCCLATCHEY.PATRICK.SEAN.1048717272
Digitally signed by MCCLATCHEY.PATRICK.SEAN.1048717272
DN: c=US, o=U.S. Government, ou=DoD, ou=PKI, ou=USN, cn=MCCLATCHEY.PATRICK.SEAN.1048717272
Date: 2016.03.04 06:40:30 -05'00'

Patrick Sean McClatchey

Generator or Agent Signature / Date ***Generator or Agent Printed Name***

If I am an agent signing on behalf of the generator, I have confirmed with the generator that the information contained in this profile is accurate and complete.

For Facility Use Only

Approved By: Approval Code:

Approval Date: Comments:

All Deliveries Must be Accompanied by an Approved MCF or Reference Approval Code on Manifest

Clearfield MMG
resourceful waste management

Material Characterization Form

Applicant Information

Company Name:	CH2M Hill, Inc.
Address:	5701 Cleveland Street, Ste. 200
City / State / Zip:	Virginia Beach, VA 23462
Contact:	Stephanie Sawyer
Phone:	757-671-6273
Fax:	
e-mail:	Stephanie.Sawyer@CH2M.com

Generator Information

Company Name:	NAVFAC MIDLANT
Address:	9742 Maryland Ave., LP-24
City / State / Zip:	Norfolk, VA 23511
Contact:	Bobby Hughes
Phone:	757-341-0471
Fax:	
e-mail:	bobby.hughes@navy.mil

Project Description

Site Name: Naval Auxiliary Landing Field Fentress

Site Address: Naval Auxiliary Landing Field Fentress, 2500 Lockheed Avenue, Chesapeake, VA 23322

Source of Contamination: Aqueous Film Forming Foam (AFFF)

Waste Generating Activity: Monitoring well installation and purging activities

Waste Description

Applicant must complete the following information and attach all laboratory analyses and / or MSDS utilized to characterize the material as non-hazardous and acceptable for receipt by Clearfield MMG.

General Description: Soils & Drilling Sludge

Matrix: [X] Soil [ ] Sludge [ ] Water [ ] Debris / Absorbents

Petroleum Type: *(Check all that apply)*
[ ] Virgin (un-used) [ ] Non-Virgin (used) [X] None
[ ] Gas [ ] Diesel / # 2 [ ] Motor / Hydraulic Oil [ ] # 4, 5, or 6 Oil

Other Contaminants: see analysis

Volume: (8) 55 gallon Drums **Lab Analysis Completed:** [X] YES [ ] NO

Generator Certification

I hereby certify, based upon my diligent inquiry into the activities and processes generating the waste described on this form, that these materials are not classified as listed or characteristic hazardous waste as regulated by the Commonwealth of Virginia or the state of origin of this waste; that the materials do not contain 50.0 parts per million or more of polychlorinated biphenyls (PCB's); that the analytical results, completed M*aterial Characterization Form* and attached documentation are a representative, true, and accurate description of these materials; that no deliberate or willful omissions have been made in the preparation of this form; and that all known or suspect hazards have been disclosed herein. I further acknowledge that I am aware it is the duty of all persons to dispose of their solid waste in a legal manner (Va.Code ' 10.1-1418.1.A).

Generator or Agent Signature / Date | *Generator or Agent Printed Name*

If I am an agent signing on behalf of the generator, I have confirmed with the generator that the information contained in this profile is accurate and complete.

For Facility Use Only

Approved By: Approval Code:

Approval Date: Comments:

All Deliveries Must be Accompanied by an Approved MCF or Reference Approval Code on Manifest

Clearfield MMG
resourceful waste management

Material Characterization Form

Applicant Information

Company Name:	CH2M Hill, Inc.
Address:	5701 Cleveland Street, Ste. 200
City / State / Zip:	Virginia Beach, VA 23462
Contact:	Katie Tippin
Phone:	757-671-6258
Fax:	
e-mail:	Katie.Tippin@CH2M.com

Generator Information

Company Name:	NAVFAC MIDLANT
Address:	9742 Maryland Ave., LP-24
City / State / Zip:	Norfolk, VA 23511
Contact:	Sean McClatchey
Phone:	757-341-0410
Fax:	757-341-0415
e-mail:	patrick.mcclatchey@navy.mil

Project Description

Site Name:	Naval Auxiliary Landing Field Fentress
Site Address:	Naval Auxiliary Landing Field Fentress, 2500 Lockheed Avenue, Chesapeake, VA, 23322
Source of Contamination:	Aqueous Film Forming Foam (AFFF)
Waste Generating Activity:	Monitoring well installation and purging activities

Waste Description

Applicant must complete the following information and attach all laboratory analyses and / or MSDS utilized to characterize the material as non-hazardous and acceptable for receipt by Clearfield MMG.

General Description: Development, Purge, and Decontamination Water

Matrix: [ ] Soil [ ] Sludge [X] Water [ ] Debris / Absorbents

Petroleum Type: *(Check all that apply)*
[ ] Virgin (un-used) [ ] Non-Virgin (used) [X] None
[ ] Gas [ ] Diesel / # 2 [ ] Motor / Hydraulic Oil [ ] # 4, 5, or 6 Oil

Other Contaminants: see analysis

Volume: (54) 55 gallon Drums **Lab Analysis Completed:** [X] YES [ ] NO

Generator Certification

I hereby certify, based upon my diligent inquiry into the activities and processes generating the waste described on this form, that these materials are not classified as listed or characteristic hazardous waste as regulated by the Commonwealth of Virginia or the state of origin of this waste; that the materials do not contain 50.0 parts per million or more of polychlorinated biphenyls (PCB's); that the analytical results, completed M*aterial Characterization Form* and attached documentation are a representative, true, and accurate description of these materials; that no deliberate or willful omissions have been made in the preparation of this form; and that all known or suspect hazards have been disclosed herein. I further acknowledge that I am aware it is the duty of all persons to dispose of their solid waste in a legal manner (Va.Code ' 10.1-1418.1.A).

MCCLATCHEY.PATRICK.SEAN.1048717272

Digitally signed by MCCLATCHEY.PATRICK.SEAN.1048717272
DN: c=US, o=U.S. Government, ou=DoD, ou=PKI, ou=USN, cn=MCCLATCHEY.PATRICK.SEAN.1048717272
Date: 2016.03.04 06:33:35 -05'00'

Patrick Sean McClatchey

Generator or Agent Signature / Date ***Generator or Agent Printed Name***

If I am an agent signing on behalf of the generator, I have confirmed with the generator that the information contained in this profile is accurate and complete.

For Facility Use Only

Approved By:		Approval Code:	
Approval Date:		Comments:	

All Deliveries Must be Accompanied by an Approved MCF or Reference Approval Code on Manifest

Clearfield MMG
Post Office Box 1444
Chesapeake, VA 23327
(757) 549-8448
FAX: (757) 549-6668

NON-HAZARDOUS SHIPPING MANIFEST

MANIFEST NO._____

GENERATOR VARIOUS - NALF Fentress

NAME	**NAVFAC Mid-Atlantic**	TELEPHONE	**757-341-0471**		
ADDRESS	**9742 Maryland Ave. Bldg LP-24**	CITY	**Norfolk**	STATE	**VA**
SHIPMENT ORIGIN	**NALF Fentress, 2500 Lockheed Ave.**	CITY	**Chesapeake**	STATE	**VA**
AUTHORIZED AGENT	**c/o CH2M Hill, Inc.**	FIRM			
ADDRESS		OTHER	**CTO-WE7G** **Project # 669783.FI.FS.01**		

MATERIAL CHARACTERIZATION

ACTIVITY GENERATING THIS MATERIAL: UST/AST REMOVAL _____ OTHER **Well Installation Activities**

PETROLEUM TYPE (S): **N/A** VIRGIN PRODUCT_____ NON-VIRGIN PRODUCT_____

PHYSICAL STATE: STOCKPILED _____ EXCAVATING_____ DRUMS **32** *(soil)* OTHER _____

HANDLING INSTRUCTIONS: **Transport To Facility Designated Below**

FIRE OR SPILL INSTRCUTIONS: **Non-Flammable / Non-Hazardous**

DESTINATION: **Chesapeake Facility, 416 Dominion Blvd. North**

I hereby certify, to the best of my knowledge, the material characterized above is non-hazardous as defined by the Virginia Hazardous Waste Management Regulations, Federal Regulations under Subtitle C – RCRA, U.S. Department of Transportation, or local / state of origin regulations.

MCCLATCHEY.PATRICK.SEAN.1048717272

Digitally signed by MCCLATCHEY.PATRICK.SEAN.1048717272
DN: c=US, o=U.S. Government, ou=DoD, ou=PKI, ou=USN, cn=MCCLATCHEY.PATRICK.SEAN.1048717272
Date: 2016.03.04 06:48:25 -05'00'

Signature of Generator / Agent

Patrick Sean McClatchey / 3/04/2016

Printed Name / Date

TRANSPORTER

TRANSPORTER NAME **Clearfield MMG, Inc.** TELEPHONE **757-549-8448** TRUCK NO. **14**

I certify that the materials described above were received by me for shipment and delivered to the designated facility.

Transporter Signature / Date

FACILTIY

I certify that the materials described above were delivered to the facility and received by me.

ACCEPTED BY_____ DATE _____

REASONS FOR REJECTION _____

Gross Weight	
Tare Weight	
Net Weight	
Tons	

FACILITY

Clearfield MMG
Post Office Box 1444
Chesapeake, VA 23327
(757) 549-8448
FAX: (757) 549-6668

NON-HAZARDOUS SHIPPING MANIFEST

MANIFEST NO._____

GENERATOR VARIOUS - NALF Fentress

NAME	**NAVFAC Mid-Atlantic**	TELEPHONE	**757-341-0471**
ADDRESS	**9742 Maryland Ave. Bldg LP-24**	CITY **Norfolk**	STATE **VA**
SHIPMENT ORIGIN	**NALF Fentress, 2500 Lockheed Ave.**	CITY **Chesapeake**	STATE **VA**
AUTHORIZED AGENT	**c/o CH2M Hill, Inc.**	FIRM	
ADDRESS		OTHER	**CTO-WE7G** **Project # 669783.FI.FS.01**

MATERIAL CHARACTERIZATION

ACTIVITY GENERATING THIS MATERIAL: UST/AST REMOVAL _____ OTHER **Well Installation Activities**

PETROLEUM TYPE (S): **N/A** VIRGIN PRODUCT_____ NON-VIRGIN PRODUCT_____

PHYSICAL STATE: STOCKPILED _____ EXCAVATING_____ DRUMS **32** *(soil)* OTHER _____

HANDLING INSTRUCTIONS: **Transport To Facility Designated Below**

FIRE OR SPILL INSTRCUTIONS: **Non-Flammable / Non-Hazardous**

DESTINATION: **Chesapeake Facility, 416 Dominion Blvd. North**

I hereby certify, to the best of my knowledge, the material characterized above is non-hazardous as defined by the Virginia Hazardous Waste Management Regulations, Federal Regulations under Subtitle C – RCRA, U.S. Department of Transportation, or local / state of origin regulations.

MCCLATCHEY.PATRICK.SEAN.1048717272

Digitally signed by MCCLATCHEY.PATRICK.SEAN.1048717272
DN: c=US, o=U.S. Government, ou=DoD, ou=PKI, ou=USN, cn=MCCLATCHEY.PATRICK.SEAN.1048717272
Date: 2016.03.04 06:49:48 -05'00'

Signature of Generator / Agent

Patrick Sean McClatchey / 3/04/2016
Printed Name / Date

TRANSPORTER

TRANSPORTER NAME **Clearfield MMG, Inc.** TELEPHONE **757-549-8448** TRUCK NO. **14**

I certify that the materials described above were received by me for shipment and delivered to the designated facility.

Transporter Signature / Date

FACILTIY

I certify that the materials described above were delivered to the facility and received by me.

ACCEPTED BY_____ DATE _____

REASONS FOR REJECTION _____

Gross Weight	
Tare Weight	
Net Weight	
Tons	

FACILITY

Clearfield MMG
Post Office Box 1444
Chesapeake, VA 23327
(757) 549-8448
FAX: (757) 549-6668

NON-HAZARDOUS SHIPPING MANIFEST

MANIFEST NO._____

GENERATOR VARIOUS - NALF Fentress

NAME	**NAVFAC Mid-Atlantic**	TELEPHONE	**757-341-0471**
ADDRESS	**9742 Maryland Ave. Bldg LP-24**	CITY **Norfolk**	STATE **VA**
SHIPMENT ORIGIN	**NALF Fentress, 2500 Lockheed Ave.**	CITY **Chesapeake**	STATE **VA**
AUTHORIZED AGENT	**c/o CH2M Hill, Inc.**	FIRM	
ADDRESS		OTHER	**CTO-WE7G** **Project # 669783.FI.FS.01**

MATERIAL CHARACTERIZATION

ACTIVITY GENERATING THIS MATERIAL: UST/AST REMOVAL _____ OTHER **Well Installation Activities**

PETROLEUM TYPE (S): **N/A** VIRGIN PRODUCT_____ NON-VIRGIN PRODUCT_____

PHYSICAL STATE: STOCKPILED _____ EXCAVATING_____ DRUMS **33** *(groundwater)* OTHER _____

HANDLING INSTRUCTIONS: **Transport To Facility Designated Below**

FIRE OR SPILL INSTRCUTIONS: **Non-Flammable / Non-Hazardous**

DESTINATION: **Chesapeake Facility, 416 Dominion Blvd. North**

I hereby certify, to the best of my knowledge, the material characterized above is non-hazardous as defined by the Virginia Hazardous Waste Management Regulations, Federal Regulations under Subtitle C – RCRA, U.S. Department of Transportation, or local / state of origin regulations.

MCCLATCHEY.PATRICK.SEAN.1048717272

Digitally signed by MCCLATCHEY.PATRICK.SEAN.1048717272
DN: c=US, o=U.S. Government, ou=DoD, ou=PKI, ou=USN, cn=MCCLATCHEY.PATRICK.SEAN.1048717272
Date: 2016.03.04 06:50:21 -05'00'

Signature of Generator / Agent

Patrick Sean McClatchey / 3/04/2016
Printed Name / Date

TRANSPORTER

TRANSPORTER NAME **Clearfield MMG, Inc.** TELEPHONE **757-549-8448** TRUCK NO. **14**

I certify that the materials described above were received by me for shipment and delivered to the designated facility.

Transporter Signature / Date

FACILTIY

I certify that the materials described above were delivered to the facility and received by me.

ACCEPTED BY_____ DATE _____

REASONS FOR REJECTION _____

Gross Weight	
Tare Weight	
Net Weight	
Tons	

FACILITY

Clearfield MMG
Post Office Box 1444
Chesapeake, VA 23327
(757) 549-8448
FAX: (757) 549-6668

NON-HAZARDOUS SHIPPING MANIFEST

MANIFEST NO._____

GENERATOR VARIOUS - NALF Fentress

NAME	**NAVFAC Mid-Atlantic**	TELEPHONE	**757-341-0471**		
ADDRESS	**9742 Maryland Ave. Bldg LP-24**	CITY	**Norfolk**	STATE	**VA**
SHIPMENT ORIGIN	**NALF Fentress, 2500 Lockheed Ave.**	CITY	**Chesapeake**	STATE	**VA**
AUTHORIZED AGENT	**c/o CH2M Hill, Inc.**	FIRM			
ADDRESS		OTHER	**CTO-WE7G** **Project # 669783.FI.FS.01**		

MATERIAL CHARACTERIZATION

ACTIVITY GENERATING THIS MATERIAL: UST/AST REMOVAL _____ OTHER **Well Installation Activities**

PETROLEUM TYPE (S): **N/A** VIRGIN PRODUCT_____ NON-VIRGIN PRODUCT_____

PHYSICAL STATE: STOCKPILED _____ EXCAVATING_____ DRUMS **21** OTHER _____

(groundwater)

HANDLING INSTRUCTIONS: **Transport To Facility Designated Below**

FIRE OR SPILL INSTRCUTIONS: **Non-Flammable / Non-Hazardous**

DESTINATION: **Chesapeake Facility, 416 Dominion Blvd. North**

I hereby certify, to the best of my knowledge, the material characterized above is non-hazardous as defined by the Virginia Hazardous Waste Management Regulations, Federal Regulations under Subtitle C – RCRA, U.S. Department of Transportation, or local / state of origin regulations.

MCCLATCHEY.PATRICK.SEAN.1048717272

Digitally signed by MCCLATCHEY.PATRICK.SEAN.1048717272
DN: c=US, o=U.S. Government, ou=DoD, ou=PKI, ou=USN, cn=MCCLATCHEY.PATRICK.SEAN.1048717272
Date: 2016.03.04 06:50:51 -05'00'

Signature of Generator / Agent

Patrick Sean McClatchey / 3/04/2016
Printed Name / Date

TRANSPORTER

TRANSPORTER NAME **Clearfield MMG, Inc.** TELEPHONE **757-549-8448** TRUCK NO. **14**

I certify that the materials described above were received by me for shipment and delivered to the designated facility.

Transporter Signature / Date

FACILTIY

I certify that the materials described above were delivered to the facility and received by me.

ACCEPTED BY_____ DATE _____

REASONS FOR REJECTION _____

Gross Weight	
Tare Weight	
Net Weight	
Tons	

FACILITY

Clearfield MMG
Post Office Box 1444
Chesapeake, VA 23327
(757) 549-8448
FAX: (757) 549-6668

NON-HAZARDOUS SHIPPING MANIFEST

MANIFEST NO._____

GENERATOR VARIOUS - NALF Fentress

NAME **NAVFAC Mid-Atlantic** TELEPHONE **757-341-0471**

ADDRESS **9742 Maryland Ave. Bldg LP-24** CITY **Norfolk** STATE **VA**

SHIPMENT ORIGIN **NALF Fentress, 2500 Lockheed Ave.** CITY **Chesapeake** STATE **VA**

AUTHORIZED AGENT **c/o CH2M Hill, Inc.** FIRM

ADDRESS OTHER **CTO-WE7G**
Project # 669783.FI.FS.01

MATERIAL CHARACTERIZATION

ACTIVITY GENERATING THIS MATERIAL: UST/AST REMOVAL _____ OTHER **Well Installation Activities**

PETROLEUM TYPE (S): **N/A** VIRGIN PRODUCT_____ NON-VIRGIN PRODUCT_____

PHYSICAL STATE: STOCKPILED _____ EXCAVATING_____ DRUMS **11** *(soil)* OTHER _____

HANDLING INSTRUCTIONS: **Transport To Facility Designated Below**

FIRE OR SPILL INSTRCUTIONS: **Non-Flammable / Non-Hazardous**

DESTINATION: **Chesapeake Facility, 416 Dominion Blvd. North**

I hereby certify, to the best of my knowledge, the material characterized above is non-hazardous as defined by the Virginia Hazardous Waste Management Regulations, Federal Regulations under Subtitle C – RCRA, U.S. Department of Transportation, or local / state of origin regulations.

MCCLATCHEY.PATRICK.SEAN.1048717272

Digitally signed by MCCLATCHEY.PATRICK.SEAN.1048717272
DN: c=US, o=U.S. Government, ou=DoD, ou=PKI, ou=USN, cn=MCCLATCHEY.PATRICK.SEAN.1048717272
Date: 2016.03.04 06:51:22 -05'00'

Signature of Generator / Agent

Patrick Sean McClatchey / 3/04/2016
Printed Name / Date

TRANSPORTER

TRANSPORTER NAME **Clearfield MMG, Inc.** TELEPHONE **757-549-8448** TRUCK NO. **14**

I certify that the materials described above were received by me for shipment and delivered to the designated facility.

Transporter Signature / Date

FACILTIY

I certify that the materials described above were delivered to the facility and received by me.

ACCEPTED BY_____ DATE _____

REASONS FOR REJECTION _____

Gross Weight	
Tare Weight	
Net Weight	
Tons	

FACILITY

Appendix F
Data Quality Evaluation

Data Validation Summary

Oceana CTO-WE44, NALF Fentress

TO: Juliana Dean/VBO

Anita Dodson/VBO

FROM: Tiffany McGlynn/GNV

CC: Herb Kelly/GNV

DATE: January 18, 2015

Introduction

The following data validation report discusses the data validation process and findings for TestAmerica Laboratories for SDG 320-16572-1.

Samples were analyzed using the following analytical method:

- WS-LC-0025 Perfluorinated Hydrocarbons

The samples included in this SDG are listed in the table below.

Sample Name	Matrix
OF14-MW07S-1215	Water
OF14-MW06S-1215	Water
OF-MW16-1215	Water
OF-MW16P-1215	Water
OF-MW17-1215	Water
OF14-MW07D-1215	Water
OF14-MW06D-1215	Water
OF-MW15-1215	Water
OF-MW09-1215	Water
OF-MW10-1215	Water
OF-EB122315	Water
OF-MW08-1215	Water

Sample Name	Matrix
OF-MW08P-1215	Water
OF-MW12-1215	Water
OF-MW11-1215	Water
OF-MW14-1215	Water
OF-MW13-1215	Water
OF-EB122815	Water
OF-FB01-123015	Water
OF-INF01-1215	Water
OF-INF01P-1215	Water
OF-EFF01-1215	Water
OF-EFF01P-1215	Water
OF-MW12D-1215	Water
OF-FB02-123015	Water
OF14-MW07S-1215	Water

Data Evaluation

Data was evaluated in accordance with the analytical methods and with the criteria found in the following guidance documents: Sampling and Analysis Plan Perfluorinated Compound Investigation, Naval Auxiliary Landing Field Fentress, Chesapeake, Virginia Contract Task Order WE44 (December 2015) and National Functional Guidelines for Organic Data Review (2014) as applicable. The samples were evaluated based on the following criteria:

- Data Completeness
- Technical Holding Times
- Tuning Instrument
- Initial/Continuing Calibrations
- Blanks
- Internal Standards
- Laboratory Control Samples
- Isotope Dilution Analyte
- Field Duplicates
- Identification/Quantitation
- Reporting Limits

Overall Evaluation of Data/Potential Usability Issues

Specific details regarding qualification of the data are addressed in the sections below. If an issue is not addressed there were no actions required based on unmet quality criteria. When more than one qualifier is associated with a compound/analyte, the validator has chosen the qualifier that best indicates possible bias in the results and qualified these data accordingly.

Data Completeness

The SDG was received complete and intact.

Technical Holding Times

According to the chain of custody records, sampling was performed on the days of 12/21-23, 28, and 30/2015. Samples were received at the laboratory on the days of 12/22, 23, 24, 29 and 31/2015. All sample preparation and analyses were performed within holding time requirements.

Blanks

Several compounds were detected in the equipment blanks as listed below. Affected data are summarized in **Attachment 1**.

Blank ID	Compound	Conc.	Units
OF-EB122315	Perfluorohexanesulfonic acid (PFHxS)	0.0012	UG_L
OF-EB122815	Perfluorohexanesulfonic acid (PFHxS)	0.00080	UG_L
OF-EB122815	Perfluorooctanesulfonic acid (PFOS)	0.0012	UG_L
OF-FB01-123015	Perfluorohexanesulfonic acid (PFHxS)	0.00089	UG_L
OF-FB01-123015	Perfluorooctanesulfonic acid (PFOS)	0.0029	UG_L

Field Duplicate Precision

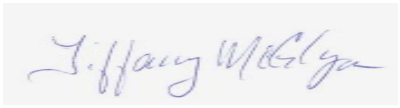
Perfluorooctanoic Acid (PFOA) did not meet required precision criteria in native sample OF-MW16-1215 and field duplicate OF-MW16P-1215. Affected data are summarized in **Attachment 1**.

Conclusion

These data can be used in the project decision-making process as qualified by the data quality evaluation process.

Please do not hesitate to contact us about this validation report.

Sincerely,



Tiffany McGlynn

Qualification Flags

Exclude	More appropriate data exist for this analyte.
R	Data were rejected for use.
UL	Analyte not detected, quantitation limit is potentially biased low.
UJ	Analyte not detected, estimated quantitation limit.
U	Analyte not detected.
B	Not detected substantially above the level reported in laboratory or field blanks.
L	Analyte present, estimated value potentially biased low.
K	Analyte present, estimated value potentially biased high.
N	Analyte identification presumptive; no second column analysis performed or GC/MS tentative identification.
J	Analyte present, estimated value.
NJ	Analysis indicates the presence of an analyte that was "tentatively identified" and the associated value represents its approximate concentration.
None	Placeholder for calculating quality control issues that do not require flagging.
=	Analyte was detected at a concentration greater than the quantitation limit.

Qualifier Code Reference

Value	Description
%SOL	High Moisture content
2C	Second Column – Poor Dual Column Reproducibility
2S	Second Source – Bad reproducibility between tandem detectors
BD	Blank Spike/Blank Spike Duplicate(LCS/LCSD) Precision
BRL	Below Reporting Limit
BSH	Blank Spike/LCS – High Recovery
BSL	Blank Spike/LCS – Low Recovery
CC	Continuing Calibration
CCBL	Continuing Calibration Blank Contamination
CCH	Continuing Calibration Verification – High Recovery
CCL	Continuing Calibration Verification – Low Recovery
DL	Redundant Result – due to Dilution
EBL	Equipment Blank Contamination
EMPC	Estimated Possible Maximum Concentration
ESH	Extraction Standard - High Recovery
ESL	Extraction Standard - Low Recovery
FBL	Field Blank Contamination
FD	Field Duplicate
HT	Holding Time
ICB	Initial Calibration – Bad Linearity or Curve Function
ICH	Initial Calibration – High Relative Response Factors
ICL	Initial Calibration – Low Relative Response Factors
IR15	Ion ratio exceeds +/- 15% difference
ISH	Internal Standard – High Recovery
ISL	Internal Standard – Low Recovery
LD	Lab Duplicate Reproducibility
LR	Concentration Exceeds Linear Range
MBL	Method Blank Contamination
MDP	Matrix Spike/Matrix Spike Duplicate Precision
MI	Matrix interference obscuring the raw data

Value	Description
MSH	Matrix Spike and/or Matrix Spike Duplicate – High Recovery
MSL	Matrix Spike and/or Matrix Spike Duplicate – Low Recovery
OT	Other
PD	Pesticide Degradation
RE	Redundant Result - due to Reanalysis or Re-extraction
SD	Serial Dilution Reproducibility
SSH	Spiked Surrogate – High Recovery
SSL	Spiked Surrogate – Low Recovery
TBL	Trip Blank Contamination
TN	Tune

Oceana CTO-WE44 Fentress PFC
Attachment 1 Change Qual. Table
SDG 320-16572-1

Sample ID	Compound	Q Flag	Qual Code
OF-MW16-1215	Perfluorooctanoic acid (PFOA)	J	FD
OF-MW16P-1215	Perfluorooctanoic acid (PFOA)	J	FD
OF14-MW07D-1215	Perfluorohexanesulfonic acid (PFHxS)	B	EBL
OF-MW15-1215	Perfluorohexanesulfonic acid (PFHxS)	B	EBL
OF-MW14-1215	Perfluorohexanesulfonic acid (PFHxS)	B	EBL

Data Validation Summary

Oceana CTO-WE44, NALF Fentress

TO: Juliana Dean/VBO

Anita Dodson/VBO

FROM: Tiffany McGlynn/GNV

CC: Herb Kelly/GNV

DATE: January 29, 2016

Introduction

The following data validation report discusses the data validation process and findings for TestAmerica Laboratories for SDG 320-16783-1.

Samples were analyzed using the following analytical method:

- WS-LC-0025 Perfluorinated Hydrocarbons

The samples included in this SDG are listed in the table below.

Sample Name	Matrix
OF-MW15D-0116	Water
OF-MW13DP-0116	Water
OF-MW10D-0116	Water
OF-MW11D-0116	Water
OF-MW09D-0116	Water
OF-MW13D-0116	Water
OF-EB011116	Water

Data Evaluation

Data was evaluated in accordance with the analytical methods and with the criteria found in the following guidance documents: Sampling and Analysis Plan Perfluorinated Compound

Investigation, Naval Auxiliary Landing Field Fentress, Chesapeake, Virginia Contract Task Order WE44 (December 2015) and National Functional Guidelines for Organic Data Review (2014) as applicable. The samples were evaluated based on the following criteria:

- Data Completeness
- Technical Holding Times
- Tuning Instrument
- Initial/Continuing Calibrations
- Blanks
- Internal Standards
- Laboratory Control Samples
- Isotope Dilution Analyte
- Field Duplicates
- Identification/Quantitation
- Reporting Limits

Overall Evaluation of Data/Potential Usability Issues

Specific details regarding qualification of the data are addressed in the sections below. If an issue is not addressed there were no actions required based on unmet quality criteria. When more than one qualifier is associated with a compound/analyte, the validator has chosen the qualifier that best indicates possible bias in the results and qualified these data accordingly.

Data Completeness

The SDG was received complete and intact.

Technical Holding Times

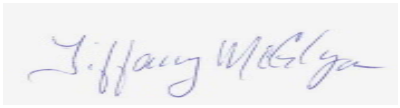
According to the chain of custody records, sampling was performed on 1/11/16 and 1/12/16. Samples were received at the laboratory on 1/12/16 and 1/13/16. All sample preparation and analyses were performed within holding time requirements.

Conclusion

These data can be used in the project decision-making process as qualified by the data quality evaluation process.

Please do not hesitate to contact us about this validation report.

Sincerely,



Tiffany McGlynn

Qualification Flags

Exclude	More appropriate data exist for this analyte.
R	Data were rejected for use.
UL	Analyte not detected, quantitation limit is potentially biased low.
UJ	Analyte not detected, estimated quantitation limit.
U	Analyte not detected.
B	Not detected substantially above the level reported in laboratory or field blanks.
L	Analyte present, estimated value potentially biased low.
K	Analyte present, estimated value potentially biased high.
N	Analyte identification presumptive; no second column analysis performed or GC/MS tentative identification.
J	Analyte present, estimated value.
NJ	Analysis indicates the presence of an analyte that was "tentatively identified" and the associated value represents its approximate concentration.
None	Placeholder for calculating quality control issues that do not require flagging.
=	Analyte was detected at a concentration greater than the quantitation limit.

Qualifier Code Reference

Value	Description
%SOL	High Moisture content
2C	Second Column – Poor Dual Column Reproducibility
2S	Second Source – Bad reproducibility between tandem detectors
BD	Blank Spike/Blank Spike Duplicate(LCS/LCSD) Precision
BRL	Below Reporting Limit
BSH	Blank Spike/LCS – High Recovery
BSL	Blank Spike/LCS – Low Recovery
CC	Continuing Calibration
CCBL	Continuing Calibration Blank Contamination
CCH	Continuing Calibration Verification – High Recovery
CCL	Continuing Calibration Verification – Low Recovery
DL	Redundant Result – due to Dilution
EBL	Equipment Blank Contamination
EMPC	Estimated Possible Maximum Concentration
ESH	Extraction Standard - High Recovery
ESL	Extraction Standard - Low Recovery
FBL	Field Blank Contamination
FD	Field Duplicate
HT	Holding Time
ICB	Initial Calibration – Bad Linearity or Curve Function
ICH	Initial Calibration – High Relative Response Factors
ICL	Initial Calibration – Low Relative Response Factors
IR15	Ion ratio exceeds +/- 15% difference
ISH	Internal Standard – High Recovery
ISL	Internal Standard – Low Recovery
LD	Lab Duplicate Reproducibility
LR	Concentration Exceeds Linear Range
MBL	Method Blank Contamination
MDP	Matrix Spike/Matrix Spike Duplicate Precision
MI	Matrix interference obscuring the raw data

Value	Description
MSH	Matrix Spike and/or Matrix Spike Duplicate – High Recovery
MSL	Matrix Spike and/or Matrix Spike Duplicate – Low Recovery
OT	Other
PD	Pesticide Degradation
RE	Redundant Result - due to Reanalysis or Re-extraction
SD	Serial Dilution Reproducibility
SSH	Spiked Surrogate – High Recovery
SSL	Spiked Surrogate – Low Recovery
TBL	Trip Blank Contamination
TN	Tune

MEMORANDUM CH2MHILL

Data Validation Summary

Oceana CTO-WE44, NALF Fentress

TO: Juliana Dean/VBO

Anita Dodson/VBO

FROM: Tiffany McGlynn/GNV

CC: Herb Kelly/GNV

DATE: March 18, 2016

Introduction

The following data validation report discusses the data validation process and findings for TestAmerica Laboratories and Maxxam Laboratories in the Sample Delivery Groups (SDGs) listed in the table below.

Samples were analyzed using the following analytical methods:

- WS-LC-0025 & 537 MOD Perfluorinated Hydrocarbons

The samples included in these SDGs are listed in the table below.

SDG	Sample Name	Matrix
320-17150	OF-RW42B-0216	Water
320-17150	OF-RW39-0216	Water
320-17150	OF-FB40-0216	Water
320-17150	OF-RW40-0216	Water
320-17150	OF-FB43-0216	Water
320-17150	OF-RW43-0216	Water
320-17150	OF-FB42B-0216	Water
320-17150	OF-RW42A-0216	Water
320-17150	OF-FB42A-0216	Water
320-17150	OF-RW35-0216	Water
320-17150	OF-FB35-0216	Water

SDG	Sample Name	Matrix
320-17150	OF-RW58-0216	Water
320-17150	OF-FB58-0216	Water
320-17150	OF-FB39-0216	Water
320-17154	OF-FB09-0216	Water
320-17154	OF-FB67-0216	Water
320-17154	OF-RW09-0216	Water
320-17154	OF-FB37-0216	Water
320-17154	OF-RW37-0216	Water
320-17154	OF-RW11-0216	Water
320-17154	OF-FB11-0216	Water
320-17154	OF-RW28-0216	Water
320-17154	OF-FB28-0216	Water
320-17154	OF-RW67-0216	Water
320-17183	OF-RW66-0216	Water
320-17183	OF-FB27-0216	Water
320-17183	OF-FB66-0216	Water
320-17183	OF-RW49-0216	Water
320-17183	OF-FB49-0216	Water
320-17183	OF-RW36A-0216	Water
320-17183	OF-FB36A-0216	Water
320-17183	OF-RW51A-0216	Water
320-17183	OF-FB51A-0216	Water
320-17183	OF-RW27-0216	Water
320-17184	OF-RW20-0216	Water
320-17184	OF-FB30-0216	Water
320-17184	OF-FB69-0216	Water
320-17184	OF-RW69-0216	Water
320-17184	OF-FB26-0216	Water
320-17184	OF-RW26-0216	Water
320-17184	OF-FB20-0216	Water
320-17184	OF-RW55-0216	Water
320-17184	OF-FB55-0216	Water
320-17184	OF-RW54-0216	Water
320-17184	OF-FB54-0216	Water
320-17184	OF-RW68-0216	Water
320-17184	OF-FB68-0216	Water
320-17184	OF-RW30-0216	Water
320-17185	OF-FB08-0216	Water
320-17185	OF-RW51-0216	Water
320-17185	OF-RW51P-0216	Water

SDG	Sample Name	Matrix
320-17185	OF-RW08-0216	Water
320-17185	OF-RW08P-0216	Water
320-17185	OF-FB41-0216	Water
320-17185	OF-RW41-0216	Water
320-17185	OF-RW41P-0216	Water
320-17185	OF-FB56-0216	Water
320-17185	OF-RW56-0216	Water
320-17185	OF-FB51-0216	Water
320-17190	OF-FB12-0216	Water
320-17190	OF-RW12-0216	Water
320-17190	OF-FB57-0216	Water
320-17190	OF-RW57-0216	Water
320-17190	OF-RW57P-0216	Water
320-17190	OF-FB25-0216	Water
320-17190	OF-RW25-0216	Water
320-17190	OF-FB16-0216	Water
320-17190	OF-RW16-0216	Water
320-17219	OF-FB47-0216	Water
320-17219	OF-RW47-0216	Water
320-17219	OF-FB47A-0216	Water
320-17219	OF-RW47A-0216	Water
320-17219	OF-FB48-0216	Water
320-17219	OF-RW48-0216	Water
320-17236	OF-FB70-0216	Water
320-17236	OF-RW70-0216	Water
320-17236	OF-FB44-0216	Water
320-17236	OF-RW44-0216	Water
320-17236	OF-RW44P-0216	Water
320-17236	OF-FB65-0216	Water
320-17236	OF-RW65-0216	Water
320-17236	OF-FB21-0216	Water
320-17236	OF-RW21-0216	Water
320-17241	OF-FB62-0216	Water
320-17241	OF-RW34-0216	Water
320-17241	OF-FB38-0216	Water
320-17241	OF-RW38-0216	Water
320-17241	OF-RW62-0216	Water
320-17241	OF-FB63-0216	Water
320-17241	OF-RW63-0216	Water
320-17241	OF-FB59-0216	Water

SDG	Sample Name	Matrix
320-17241	OF-RW59-0216	Water
320-17241	OF-FB50-0216	Water
320-17241	OF-RW50-0216	Water
320-17241	OF-FB34-0216	Water
320-17278	OF-FB24-0216	Water
320-17278	OF-RW24-0216	Water
320-17278	OF-FB31-0216	Water
320-17278	OF-RW31-0216	Water
320-17278	OF-FB60-0216	Water
320-17278	OF-RW60-0216	Water
320-17278	OF-RW60P-0216	Water
320-17278	OF-FB46-0216	Water
320-17278	OF-RW46-0216	Water
320-17321	OF-FB02-0216	Water
320-17321	OF-RW02-0216	Water
320-17321	OF-FB15-0216	Water
320-17321	OF-RW15-0216	Water
320-17321	OF-FB18-0216	Water
320-17321	OF-RW18-0216	Water
320-17859	OF-FB07-0316	Water
320-17859	OF-RW07-0316	Water
320-17859	OF-HPFB01-0316	Water
320-17859	OF-HP01-0316	Water

Data Evaluation

Data was evaluated in accordance with the analytical methods and with the criteria found in the following guidance documents: Sampling and Analysis Plan Perfluorinated Compound Investigation, Naval Auxiliary Landing Field Fentress, Chesapeake, Virginia Contract Task Order WE44 (December 2015) and National Functional Guidelines for Organic Data Review (August 2014) with Region 3 Modification (Use of 'B' qualifier) as applicable. The samples were evaluated based on the following criteria:

- Data Completeness
- Technical Holding Times
- Tuning Instrument
- Initial/Continuing Calibrations
- Blanks

- Internal Standards
- Laboratory Control Samples
- Isotope Dilution Analyte
- Field Duplicates
- Identification/Quantitation
- Reporting Limits

Overall Evaluation of Data/Potential Usability Issues

Specific details regarding qualification of the data are addressed in the sections below. If an issue is not addressed there were no actions required based on unmet quality criteria. When more than one qualifier is associated with a compound/analyte, the validator has chosen the qualifier that best indicates possible bias in the results and qualified these data accordingly.

Data Completeness

The SDG was received complete and intact.

Technical Holding Times

According to the chain of custody records, sampling was performed on 2/3/16 through 2/16/16. Samples were received at the laboratory 2/4/16 through 2/17/16. All sample preparation and analyses were performed within holding time requirements with the exception of the samples listed below. Affected data are summarized in **Attachment 1**.

Sample Name	SDG
OF-RW42B-0216	320-17150
OF-RW08-0216	320-17185
OF-RW08P-0216	320-17185
OF-FB62-0216	320-17241
OF-RW34-0216	320-17241
OF-FB38-0216	320-17241
OF-RW38-0216	320-17241
OF-RW62-0216	320-17241
OF-FB63-0216	320-17241
OF-RW63-0216	320-17241
OF-FB59-0216	320-17241

Sample Name	SDG
OF-RW59-0216	320-17241
OF-FB50-0216	320-17241
OF-RW50-0216	320-17241
OF-FB34-0216	320-17241

Blanks

Several compounds were detected in the field blanks and method blanks as listed below. Affected data are summarized in **Attachment 1**.

SDG	Blank ID	Compound	Conc.	Units
320-17183	OF-FB49-0216	Perfluorohexanesulfonic acid (PFHxS)	0.00068	UG_L
320-17183	OF-FB36A-0216	Perfluorooctane Sulfonate (PFOS)	0.00042	UG_L
320-17185	OF-FB51-0216	Perfluorobutanesulfonic acid (PFBS)	0.00063	UG_L
320-17190	OF-FB12-0216	Perfluorohexanesulfonic acid (PFHxS)	0.00079	UG_L
320-17190	OF-FB57-0216	Perfluorohexanesulfonic acid (PFHxS)	0.00083	UG_L
320-17190	OF-FB25-0216	Perfluorobutanesulfonic acid (PFBS)	0.00092	UG_L
320-17190	OF-FB16-0216	Perfluorobutanesulfonic acid (PFBS)	0.0011	UG_L
320-17190	MB 320-100277/1-A	Perfluorobutanesulfonic acid (PFBS)	0.00103	UG_L
320-17190	MB 320-100277/1-A	Perfluorohexanesulfonic acid (PFHxS)	0.00102	UG_L
320-17190	MB 320-100277/1-A	Perfluorooctane Sulfonate (PFOS)	0.00144	UG_L
320-17859	MB 320-104553/1-A	Perfluorooctanoic acid (PFOA)	0.00217	UG_L

Field Duplicate Precision

Perfluoroheptanoic acid (PFHpA) did not meet required precision criteria in native sample OF-RW51-0216 and field duplicate OF-RW51P-0216. Affected data are summarized in **Attachment 1**.

Matrix Spike/Spike Duplicate

For spiked sample OF-RW56-0216 in SDG 320-17185, perfluorobutanesulfonic acid (PFBS) exhibited high recoveries in the MS/MSD. Affected data are summarized in **Attachment 1**.

Surrogates

Surrogates for the samples listed below exhibited low recoveries. Affected data are summarized in **Attachment 1**.

Sample Name	SDG
OF-RW67-0216	320-17154
OF-RW47-0216	320-17219
OF-RW70-0216	320-17236

Sample Name	SDG
OF-RW24-0216	320-17278

Internal Standards

Internal standards exhibited low recoveries for the samples listed below. Affected data are summarized in **Attachment 1**.

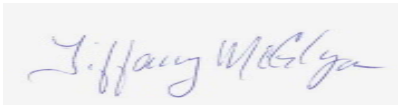
Sample Name	SDG
OF-RW37-0216	320-17154
OF-FB56-0216	320-17185

Conclusion

These data can be used in the project decision-making process as qualified by the data quality evaluation process.

Please do not hesitate to contact us about this validation report.

Sincerely,



Tiffany McGlynn

Qualification Flags

Exclude	More appropriate data exist for this analyte.
R	Data were rejected for use.
UL	Analyte not detected, quantitation limit is potentially biased low.
UJ	Analyte not detected, estimated quantitation limit.
U	Analyte not detected.
B	Not detected substantially above the level reported in laboratory or field blanks.
L	Analyte present, estimated value potentially biased low.
K	Analyte present, estimated value potentially biased high.
N	Analyte identification presumptive; no second column analysis performed or GC/MS tentative identification.
J	Analyte present, estimated value.
NJ	Analysis indicates the presence of an analyte that was "tentatively identified" and the associated value represents its approximate concentration.
None	Placeholder for calculating quality control issues that do not require flagging.
=	Analyte was detected at a concentration greater than the quantitation limit.

Qualifier Code Reference

Value	Description
%SOL	High Moisture content
2C	Second Column – Poor Dual Column Reproducibility
2S	Second Source – Bad reproducibility between tandem detectors
BD	Blank Spike/Blank Spike Duplicate(LCS/LCSD) Precision
BRL	Below Reporting Limit
BSH	Blank Spike/LCS – High Recovery
BSL	Blank Spike/LCS – Low Recovery
CC	Continuing Calibration
CCBL	Continuing Calibration Blank Contamination
CCH	Continuing Calibration Verification – High Recovery
CCL	Continuing Calibration Verification – Low Recovery
DL	Redundant Result – due to Dilution
EBL	Equipment Blank Contamination
EMPC	Estimated Possible Maximum Concentration
ESH	Extraction Standard - High Recovery
ESL	Extraction Standard - Low Recovery
FBL	Field Blank Contamination
FD	Field Duplicate
HT	Holding Time
ICB	Initial Calibration – Bad Linearity or Curve Function
ICH	Initial Calibration – High Relative Response Factors
ICL	Initial Calibration – Low Relative Response Factors
IR15	Ion ratio exceeds +/- 15% difference
ISH	Internal Standard – High Recovery
ISL	Internal Standard – Low Recovery
LD	Lab Duplicate Reproducibility
LR	Concentration Exceeds Linear Range
MBL	Method Blank Contamination
MDP	Matrix Spike/Matrix Spike Duplicate Precision
MI	Matrix interference obscuring the raw data

Value	Description
MSH	Matrix Spike and/or Matrix Spike Duplicate – High Recovery
MSL	Matrix Spike and/or Matrix Spike Duplicate – Low Recovery
OT	Other
PD	Pesticide Degradation
RE	Redundant Result - due to Reanalysis or Re-extraction
SD	Serial Dilution Reproducibility
SSH	Spiked Surrogate – High Recovery
SSL	Spiked Surrogate – Low Recovery
TBL	Trip Blank Contamination
TN	Tune

Oceana CTO-WE44 Fentress PFC
Attachment 1 Change Qual. Table

SDG	Sample ID	Compound	Q Flag	Qual Code
320-17150	OF-RW42B-0216	Perfluorohexanesulfonic acid (PFHxS)	J	HT
320-17150	OF-RW42B-0216	Perfluorooctanoic acid (PFOA)	J	HT
320-17154	OF-RW37-0216	Perfluoroheptanoic acid (PFHpA)	J	ISL
320-17154	OF-RW67-0216	Perfluoroheptanoic acid (PFHpA)	UJ	SSL
320-17183	OF-RW49-0216	Perfluorohexanesulfonic acid (PFHxS)	B	FBL
320-17185	OF-RW51-0216	Perfluoroheptanoic acid (PFHpA)	J	FD
320-17185	OF-RW51P-0216	Perfluoroheptanoic acid (PFHpA)	J	FD
320-17185	OF-RW08-0216	Perfluorooctane Sulfonate (PFOS)	J	HT
320-17185	OF-RW08P-0216	Perfluorooctane Sulfonate (PFOS)	J	HT
320-17185	OF-FB56-0216	Perfluoroheptanoic acid (PFHpA)	UJ	ISL
320-17185	OF-RW56-0216	Perfluorobutanesulfonic acid (PFBS)	J	MSH
320-17190	OF-FB12-0216	Perfluorohexanesulfonic acid (PFHxS)	B	MBL
320-17190	OF-FB57-0216	Perfluorohexanesulfonic acid (PFHxS)	B	MBL
320-17190	OF-FB25-0216	Perfluorobutanesulfonic acid (PFBS)	B	MBL
320-17190	OF-RW25-0216	Perfluorobutanesulfonic acid (PFBS)	B	MBL
320-17190	OF-FB16-0216	Perfluorobutanesulfonic acid (PFBS)	B	MBL
320-17219	OF-RW47-0216	Perfluorobutanesulfonic acid (PFBS)	J-	SSL
320-17219	OF-RW47-0216	Perfluoroheptanoic acid (PFHpA)	UJ	SSL
320-17219	OF-RW47-0216	Perfluorohexanesulfonic acid (PFHxS)	UJ	SSL
320-17219	OF-RW47-0216	Perfluorononanoic acid (PFNA)	UJ	SSL
320-17219	OF-RW47-0216	Perfluorooctanoic acid (PFOA)	UJ	SSL
320-17219	OF-RW47-0216	Perfluorooctane Sulfonate (PFOS)	UJ	SSL
320-17236	OF-RW70-0216	Perfluorobutanesulfonic acid (PFBS)	UJ	SSL
320-17236	OF-RW70-0216	Perfluoroheptanoic acid (PFHpA)	UJ	SSL
320-17236	OF-RW70-0216	Perfluorohexanesulfonic acid (PFHxS)	UJ	SSL
320-17236	OF-RW70-0216	Perfluorononanoic acid (PFNA)	UJ	SSL
320-17236	OF-RW70-0216	Perfluorooctane Sulfonate (PFOS)	UJ	SSL
320-17236	OF-RW70-0216	Perfluorooctanoic acid (PFOA)	UJ	SSL
320-17241	OF-FB62-0216	Perfluorobutanesulfonic acid (PFBS)	UJ	HT
320-17241	OF-FB62-0216	Perfluoroheptanoic acid (PFHpA)	UJ	HT
320-17241	OF-FB62-0216	Perfluorohexanesulfonic acid (PFHxS)	UJ	HT
320-17241	OF-FB62-0216	Perfluorononanoic acid (PFNA)	UJ	HT
320-17241	OF-FB62-0216	Perfluorooctane Sulfonate (PFOS)	UJ	HT
320-17241	OF-FB62-0216	Perfluorooctanoic acid (PFOA)	UJ	HT
320-17241	OF-RW34-0216	Perfluorobutanesulfonic acid (PFBS)	UJ	HT
320-17241	OF-RW34-0216	Perfluoroheptanoic acid (PFHpA)	UJ	HT
320-17241	OF-RW34-0216	Perfluorohexanesulfonic acid (PFHxS)	UJ	HT
320-17241	OF-RW34-0216	Perfluorononanoic acid (PFNA)	UJ	HT
320-17241	OF-RW34-0216	Perfluorooctane Sulfonate (PFOS)	UJ	HT
320-17241	OF-RW34-0216	Perfluorooctanoic acid (PFOA)	UJ	HT
320-17241	OF-FB38-0216	Perfluorobutanesulfonic acid (PFBS)	UJ	HT
320-17241	OF-FB38-0216	Perfluoroheptanoic acid (PFHpA)	UJ	HT
320-17241	OF-FB38-0216	Perfluorohexanesulfonic acid (PFHxS)	UJ	HT
320-17241	OF-FB38-0216	Perfluorononanoic acid (PFNA)	UJ	HT

Oceana CTO-WE44 Fentress PFC
Attachment 1 Change Qual. Table

SDG	Sample ID	Compound	Q Flag	Qual Code
320-17241	OF-FB38-0216	Perfluorooctane Sulfonate (PFOS)	UJ	HT
320-17241	OF-FB38-0216	Perfluorooctanoic acid (PFOA)	UJ	HT
320-17241	OF-RW38-0216	Perfluorobutanesulfonic acid (PFBS)	UJ	HT
320-17241	OF-RW38-0216	Perfluoroheptanoic acid (PFHpA)	UJ	HT
320-17241	OF-RW38-0216	Perfluorohexanesulfonic acid (PFHxS)	UJ	HT
320-17241	OF-RW38-0216	Perfluorononanoic acid (PFNA)	UJ	HT
320-17241	OF-RW38-0216	Perfluorooctane Sulfonate (PFOS)	UJ	HT
320-17241	OF-RW38-0216	Perfluorooctanoic acid (PFOA)	UJ	HT
320-17241	OF-RW62-0216	Perfluorobutanesulfonic acid (PFBS)	UJ	HT
320-17241	OF-RW62-0216	Perfluoroheptanoic acid (PFHpA)	UJ	HT
320-17241	OF-RW62-0216	Perfluorohexanesulfonic acid (PFHxS)	J	HT
320-17241	OF-RW62-0216	Perfluorononanoic acid (PFNA)	UJ	HT
320-17241	OF-RW62-0216	Perfluorooctane Sulfonate (PFOS)	J	HT
320-17241	OF-RW62-0216	Perfluorooctanoic acid (PFOA)	UJ	HT
320-17241	OF-FB63-0216	Perfluorobutanesulfonic acid (PFBS)	UJ	HT
320-17241	OF-FB63-0216	Perfluoroheptanoic acid (PFHpA)	UJ	HT
320-17241	OF-FB63-0216	Perfluorohexanesulfonic acid (PFHxS)	UJ	HT
320-17241	OF-FB63-0216	Perfluorononanoic acid (PFNA)	UJ	HT
320-17241	OF-FB63-0216	Perfluorooctane Sulfonate (PFOS)	UJ	HT
320-17241	OF-FB63-0216	Perfluorooctanoic acid (PFOA)	UJ	HT
320-17241	OF-RW63-0216	Perfluorobutanesulfonic acid (PFBS)	J	HT
320-17241	OF-RW63-0216	Perfluoroheptanoic acid (PFHpA)	J	HT
320-17241	OF-RW63-0216	Perfluorohexanesulfonic acid (PFHxS)	J	HT
320-17241	OF-RW63-0216	Perfluorononanoic acid (PFNA)	J	HT
320-17241	OF-RW63-0216	Perfluorooctane Sulfonate (PFOS)	J	HT
320-17241	OF-RW63-0216	Perfluorooctanoic acid (PFOA)	J	HT
320-17241	OF-FB59-0216	Perfluorobutanesulfonic acid (PFBS)	UJ	HT
320-17241	OF-FB59-0216	Perfluoroheptanoic acid (PFHpA)	UJ	HT
320-17241	OF-FB59-0216	Perfluorohexanesulfonic acid (PFHxS)	UJ	HT
320-17241	OF-FB59-0216	Perfluorononanoic acid (PFNA)	UJ	HT
320-17241	OF-FB59-0216	Perfluorooctane Sulfonate (PFOS)	UJ	HT
320-17241	OF-FB59-0216	Perfluorooctanoic acid (PFOA)	UJ	HT
320-17241	OF-RW59-0216	Perfluorobutanesulfonic acid (PFBS)	J	HT
320-17241	OF-RW59-0216	Perfluoroheptanoic acid (PFHpA)	J	HT
320-17241	OF-RW59-0216	Perfluorohexanesulfonic acid (PFHxS)	J	HT
320-17241	OF-RW59-0216	Perfluorononanoic acid (PFNA)	J	HT
320-17241	OF-RW59-0216	Perfluorooctane Sulfonate (PFOS)	J	HT
320-17241	OF-RW59-0216	Perfluorooctanoic acid (PFOA)	J	HT
320-17241	OF-FB50-0216	Perfluorobutanesulfonic acid (PFBS)	UJ	HT
320-17241	OF-FB50-0216	Perfluoroheptanoic acid (PFHpA)	UJ	HT
320-17241	OF-FB50-0216	Perfluorohexanesulfonic acid (PFHxS)	UJ	HT
320-17241	OF-FB50-0216	Perfluorononanoic acid (PFNA)	UJ	HT
320-17241	OF-FB50-0216	Perfluorooctane Sulfonate (PFOS)	UJ	HT
320-17241	OF-FB50-0216	Perfluorooctanoic acid (PFOA)	UJ	HT

Oceana CTO-WE44 Fentress PFC
Attachment 1 Change Qual. Table

SDG	Sample ID	Compound	Q Flag	Qual Code
320-17241	OF-RW50-0216	Perfluorobutanesulfonic acid (PFBS)	UJ	HT
320-17241	OF-RW50-0216	Perfluoroheptanoic acid (PFHpA)	UJ	HT
320-17241	OF-RW50-0216	Perfluorohexanesulfonic acid (PFHxS)	UJ	HT
320-17241	OF-RW50-0216	Perfluorononanoic acid (PFNA)	UJ	HT
320-17241	OF-RW50-0216	Perfluorooctane Sulfonate (PFOS)	UJ	HT
320-17241	OF-RW50-0216	Perfluorooctanoic acid (PFOA)	UJ	HT
320-17241	OF-FB34-0216	Perfluorobutanesulfonic acid (PFBS)	UJ	HT
320-17241	OF-FB34-0216	Perfluoroheptanoic acid (PFHpA)	UJ	HT
320-17241	OF-FB34-0216	Perfluorohexanesulfonic acid (PFHxS)	UJ	HT
320-17241	OF-FB34-0216	Perfluorononanoic acid (PFNA)	UJ	HT
320-17241	OF-FB34-0216	Perfluorooctane Sulfonate (PFOS)	UJ	HT
320-17241	OF-FB34-0216	Perfluorooctanoic acid (PFOA)	UJ	HT
320-17278	OF-RW24-0216	Perfluoroheptanoic acid (PFHpA)	UJ	SSL
320-17278	OF-RW24-0216	Perfluorononanoic acid (PFNA)	UJ	SSL
320-17859	OF-RW07-0316	Perfluorooctanoic acid (PFOA)	B	MBL

Data Validation Summary

Oceana CTO-WE44, NALF Fentress

TO: Tiffany Hill/CVO

Anita Dodson/VBO

FROM: Tiffany McGlynn/GNV

CC: Herb Kelly/GNV

DATE: June 14, 2016

Introduction

The following data validation report discusses the data validation process and findings for TestAmerica Laboratories in the Sample Delivery Groups (SDGs) listed in the table below.

Samples were analyzed using the following analytical methods:

- WS-LC-0025 Perfluorinated Hydrocarbons
- SW6010C Iron, total & dissolved

The samples included in these SDGs are listed in the table below.

SDG	Sample_Name	Matrix
320-18704-1	OF-RW44-0516	Water
320-18704-1	OF-FB44-0516	Water
320-18704-1	OF-RW42B2-0516	Water
320-18704-1	OF-FB42B2-0516	Water
320-18704-1	OF-RW42A-0516	Water
320-18704-1	OF-FB42A-0516	Water
320-18704-1	OF-RW42B-0516	Water
320-18704-1	OF-FB42B-0516	Water
320-18704-1	OF-RW42C-516	Water
320-18704-1	OF-RW42CD-0516	Water

SDG	Sample_Name	Matrix
320-18704-1	OF-FB42C-0516	Water
320-18719-1	OF-FB08-0516	Water
320-18719-1	OF-RW08-0516	Water
320-18719-1	OF-FB71-0516	Water
320-18719-1	OF-RW71-0516	Water
320-18719-1	OF-FB84-0516	Water
320-18719-1	OF-RW84-0516	Water
320-18794-1	OF-INF01-0516	Water
320-18794-1	OF-EFF01-0516	Water
320-18794-1	OF-FB78-0516	Water
320-18794-1	OF-RW78-0516	Water
320-18794-1	OF-RW78D-0516	Water
320-18794-1	OF-FB77-0516	Water
320-18794-1	OF-RW77-0516	Water
320-18796-1	OF-STORLAG-0516	Water
320-18796-1	OF-TRMTLAG-0516	Water
320-18796-1	OF-POLLLAG-0516	Water
320-18796-1	OF-CLTANK-0516	Water
320-18796-1	OF-BACKWASH-0516	Water
320-18796-1	OF-FILTER-0516	Water
320-18918-1	OF-RW83-0516	Water
320-18918-1	OF-FB83-0516	Water
320-18849-1	OF-FB74-0516	Water
320-18849-1	OF-RW74-0516	Water
320-18849-1	OF-FB59-0516	Water
320-18849-1	OF-RW59-0516	Water
320-19022-1	OF-STORLAG-PT-0516	Water
320-19022-1	OF-TRMLAG-PT-0516	Water
320-19022-1	OF-POLLAG-PT-0516	Water
320-19022-1	OF-CLTANK-PT-0516	Water
320-19022-1	OF-BACKWASH-PT-0516	Water
320-19022-1	OF-FILTER-PT-0516	Water
320-19022-1	OF-INF01-PT-0615	Water
320-19022-1	OF-PROCESS BLANK-PT-0516	Water

Data Evaluation

Data was evaluated in accordance with the analytical methods and with the criteria found in the following guidance documents: Sampling and Analysis Plan Perfluorinated Compound Investigation, Naval Auxiliary Landing Field Fentress, Chesapeake, Virginia Contract Task Order WE44 (December 2015), National Functional Guidelines for Organic Data Review

(August 2014), and National Functional Guidelines for Inorganic Data Review (August 2014), with Region 3 Modification (Use of 'B' qualifier) as applicable. The samples were evaluated based on the following criteria:

- Data Completeness
- Technical Holding Times
- Tuning Instrument
- Initial/Continuing Calibrations
- Blanks
- Internal Standards
- Laboratory Control Samples
- Matrix Spike/Spike Duplicate
- Serial Dilution
- Isotope Dilution Analyte
- Field Duplicates
- Identification/Quantitation
- Reporting Limits
- Total vs. Dissolved

Overall Evaluation of Data/Potential Usability Issues

Specific details regarding qualification of the data are addressed in the sections below. If an issue is not addressed there were no actions required based on unmet quality criteria. When more than one qualifier is associated with a compound/analyte, the validator has chosen the qualifier that best indicates possible bias in the results and qualified these data accordingly.

Data Completeness

The SDGs were received complete and intact.

Technical Holding Times

According to the chain of custody records, sampling was performed on 5/4/16 through 5/19/16. Samples were received at the laboratory 5/6/16 through 5/20/16. All sample preparation and analyses were performed within holding time requirements.

Blanks

Several compounds were detected in the field blanks and method blanks as listed below. Affected data are summarized in **Attachment 1**.

Blank ID	Compound	Conc.	Units
OF-FB42C-0516	Perfluorohexanesulfonic acid (PFHxS)	0.0011	UG_L
OF-FB44-0516	Perfluorooctane Sulfonate (PFOS)	0.0037	UG_L
OF-FB42B2-0516	Perfluorohexanesulfonic acid (PFHxS)	0.00097	UG_L
OF-FB42A-0516	Perfluorooctane Sulfonate (PFOS)	0.0029	UG_L
OF-FB78-0516	Perfluorooctane Sulfonate (PFOS)	0.011	UG_L
OF-FB78-0516	Perfluorooctanoic acid (PFOA)	0.0040	UG_L
OF-FB78-0516	Perfluorohexanesulfonic acid (PFHxS)	0.0016	UG_L
MB 280-325382/1-A	Iron	23.7	UG_L
MB 320-109334/1-A	Perfluorooctane Sulfonate (PFOS)	0.00149	UG_L
MB 320-109334/1-A	Perfluorooctane Sulfonate (PFOS)	0.00149	UG_L
MB 320-109640/1-A	Perfluorooctane Sulfonate (PFOS)	0.00136	UG_L
MB 320-109640/1-A	Perfluorooctane Sulfonate (PFOS)	0.00136	UG_L

Lab Control Sample/Sample Duplicate

Perfluorohexanesulfonic acid (PFHxS) did not meet RPD criteria between the LCS and LCSD in SDGs 320-18719-1 and 320-18704-1. Affected data are summarized in **Attachment 1**.

Isotope Dilution Analyte

Internal standards exhibited low or high recoveries for the samples listed below. Affected data are summarized in **Attachment 1**.

SDG	Sample_Name
320-18794-1	OF-INF01-0516
320-18794-1	OF-EFF01-0516
320-18794-1	OF-RW78-0516
320-18796-1	OF-STORLAG-0516
320-18796-1	OF-POLLLAG-0516
320-18796-1	OF-CLTANK-0516
320-18796-1	OF-BACKWASH-0516

SDG	Sample_Name
320-18918-1	OF-RW83-0516
320-18918-1	OF-FB83-0516
320-19022-1	OF-INF01-PT-0615

Total vs. Dissolved

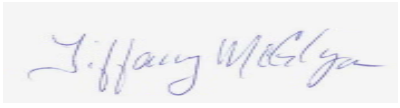
Iron did not meet criteria for total and dissolved for sample OF-STORLAG-0516. Affected data are summarized in **Attachment 1**.

Conclusion

These data can be used in the project decision-making process as qualified by the data quality evaluation process.

Please do not hesitate to contact us about this validation report.

Sincerely,



Tiffany McGlynn

Qualification Flags

Exclude	More appropriate data exist for this analyte.
R	Data were rejected for use.
UL	Analyte not detected, quantitation limit is potentially biased low.
UJ	Analyte not detected, estimated quantitation limit.
U	Analyte not detected.
B	Not detected substantially above the level reported in laboratory or field blanks.
L	Analyte present, estimated value potentially biased low.
K	Analyte present, estimated value potentially biased high.
N	Analyte identification presumptive; no second column analysis performed or GC/MS tentative identification.
J	Analyte present, estimated value.
NJ	Analysis indicates the presence of an analyte that was "tentatively identified" and the associated value represents its approximate concentration.
None	Placeholder for calculating quality control issues that do not require flagging.
=	Analyte was detected at a concentration greater than the quantitation limit.

Qualifier Code Reference

Value	Description
%SOL	High Moisture content
2C	Second Column – Poor Dual Column Reproducibility
2S	Second Source – Bad reproducibility between tandem detectors
BD	Blank Spike/Blank Spike Duplicate(LCS/LCSD) Precision
BRL	Below Reporting Limit
BSH	Blank Spike/LCS – High Recovery
BSL	Blank Spike/LCS – Low Recovery
CC	Continuing Calibration
CCBL	Continuing Calibration Blank Contamination
CCH	Continuing Calibration Verification – High Recovery
CCL	Continuing Calibration Verification – Low Recovery
DL	Redundant Result – due to Dilution
EBL	Equipment Blank Contamination
EMPC	Estimated Possible Maximum Concentration
ESH	Extraction Standard - High Recovery
ESL	Extraction Standard - Low Recovery
FBL	Field Blank Contamination
FD	Field Duplicate
HT	Holding Time
ICB	Initial Calibration – Bad Linearity or Curve Function
ICH	Initial Calibration – High Relative Response Factors
ICL	Initial Calibration – Low Relative Response Factors
IR15	Ion ratio exceeds +/- 15% difference
ISH	Internal Standard – High Recovery
ISL	Internal Standard – Low Recovery
LD	Lab Duplicate Reproducibility
LR	Concentration Exceeds Linear Range
MBL	Method Blank Contamination
MDP	Matrix Spike/Matrix Spike Duplicate Precision
MI	Matrix interference obscuring the raw data

Value	Description
MSH	Matrix Spike and/or Matrix Spike Duplicate – High Recovery
MSL	Matrix Spike and/or Matrix Spike Duplicate – Low Recovery
OT	Other
PD	Pesticide Degradation
RE	Redundant Result - due to Reanalysis or Re-extraction
SD	Serial Dilution Reproducibility
SSH	Spiked Surrogate – High Recovery
SSL	Spiked Surrogate – Low Recovery
TBL	Trip Blank Contamination
TN	Tune

Oceana CTO-WE44 Fentress PFC
Attachment 1 Change Qual. Table

SDG	Sample ID	Compound	Q Flag	Qual Code
320-18704-1	OF-RW44-0516	Perfluorohexanesulfonic acid (PFHxS)	J	BD
320-18704-1	OF-RW42CD-0516	Perfluorohexanesulfonic acid (PFHxS)	J	BD
320-18704-1	OF-FB42C-0516	Perfluorohexanesulfonic acid (PFHxS)	J	BD
320-18704-1	OF-RW42B2-0516	Perfluorohexanesulfonic acid (PFHxS)	J	BD
320-18704-1	OF-FB42B2-0516	Perfluorohexanesulfonic acid (PFHxS)	J	BD
320-18704-1	OF-RW42A-0516	Perfluorohexanesulfonic acid (PFHxS)	J	BD
320-18704-1	OF-FB42A-0516	Perfluorooctane Sulfonate (PFOS)	B	MBL
320-18704-1	OF-RW42B-0516	Perfluorohexanesulfonic acid (PFHxS)	J	BD
320-18704-1	OF-RW42C-516	Perfluorohexanesulfonic acid (PFHxS)	J	BD
320-18719-1	OF-RW08-0516	Perfluorohexanesulfonic acid (PFHxS)	J	BD
320-18794-1	OF-INF01-0516	Perfluorobutanesulfonic acid (PFBS)	J-	ISH
320-18794-1	OF-INF01-0516	Perfluorohexanesulfonic acid (PFHxS)	J-	ISH
320-18794-1	OF-EFF01-0516	Perfluorobutanesulfonic acid (PFBS)	J-	ISH
320-18794-1	OF-EFF01-0516	Perfluorohexanesulfonic acid (PFHxS)	J-	ISH
320-18794-1	OF-EFF01-0516	Perfluorooctane Sulfonate (PFOS)	J-	ISH
320-18794-1	OF-RW78-0516	Perfluorooctane Sulfonate (PFOS)	B	FBL
320-18794-1	OF-RW78-0516	Perfluoroheptanoic acid (PFHpA)	UJ	ISL
320-18794-1	OF-RW78-0516	Perfluorooctanoic acid (PFOA)	B	FBL
320-18794-1	OF-RW78-0516	Perfluorononanoic acid (PFNA)	UJ	ISL
320-18794-1	OF-RW78-0516	Perfluorobutanesulfonic acid (PFBS)	UJ	ISL
320-18794-1	OF-RW78-0516	Perfluorohexanesulfonic acid (PFHxS)	B	FBL
320-18794-1	OF-RW78D-0516	Perfluorooctanoic acid (PFOA)	B	FBL
320-18796-1	OF-STORLAG-0516	Perfluoroheptanoic acid (PFHpA)	J-	ISH
320-18796-1	OF-STORLAG-0516	Perfluorooctanoic acid (PFOA)	J-	ISH
320-18796-1	OF-STORLAG-0516	Perfluorohexanesulfonic acid (PFHxS)	J-	ISH
320-18796-1	OF-STORLAG-0516	Iron	J	OT
320-18796-1	OF-STORLAG-0516	Iron, diss	J	OT
320-18796-1	OF-POLLLAG-0516	Perfluoroheptanoic acid (PFHpA)	J-	ISH
320-18796-1	OF-POLLLAG-0516	Perfluorooctanoic acid (PFOA)	J-	ISH
320-18796-1	OF-POLLLAG-0516	Perfluorohexanesulfonic acid (PFHxS)	J-	ISH
320-18796-1	OF-CLTANK-0516	Perfluoroheptanoic acid (PFHpA)	J-	ISH
320-18796-1	OF-CLTANK-0516	Perfluorooctanoic acid (PFOA)	J-	ISH
320-18796-1	OF-CLTANK-0516	Perfluorohexanesulfonic acid (PFHxS)	J-	ISH
320-18796-1	OF-BACKWASH-0516	Perfluorobutanesulfonic acid (PFBS)	J-	ISH
320-18796-1	OF-BACKWASH-0516	Perfluorohexanesulfonic acid (PFHxS)	J-	ISH
320-18918-1	OF-RW83-0516	Perfluorooctane Sulfonate (PFOS)	J+	ISL
320-18918-1	OF-FB83-0516	Perfluorooctane Sulfonate (PFOS)	UJ	ISL
320-19022-1	OF-INF01-PT-0615	Perfluorononanoic acid (PFNA)	J+	ISL

Data Validation Summary

Oceana CTO-WE44, NALF Fentress

TO: Tiffany Hill/CVO

Anita Dodson/VBO

FROM: Tiffany McGlynn/GNV

CC: Herb Kelly/GNV

DATE: September 9, 2016

Introduction

The following data validation report discusses the data validation process and findings for Vista Analytical in the Sample Delivery Groups (SDGs) listed in the table below.

Samples were analyzed using the following analytical methods:

- 537 MOD Perfluorinated Hydrocarbons

The samples included in these SDGs are listed in the table below.

SDG	Sample_Name	Matrix
1600783	OFPOL-MW-7-0616	Water
1600783	OFPOL-MW-4-0616	Water
1600783	OFPOL-MW-8-0616	Water
1600783	OFPOL-MW-6-0616	Water
1600783	OFPOL-MW-3-0616	Water
1600783	OFPOL-MW-3P-0616	Water
1600783	OFPOL-MW-2-0616	Water
1600783	OF-MW13-0616	Water
1600783	OF-MW11-0616	Water
1600818	OF14-MW07S-0616	Water
1600818	OF14-MW07D-0616	Water
1600818	OF-MW14-0616	Water

SDG	Sample_Name	Matrix
1600818	OF-MW16-0616	Water
1600818	OF-FB062016	Water
1600818	OF-EB062016	Water
1600818	OF-MW15-0616	Water
1600818	OF-MW15D-0616	Water
1600818	OF14-MW06-0616	Water
1600818	OF14-MW06D-0616	Water
1600818	OF-MW17-0616	Water
1600818	OF-MW12D-0616	Water
1600818	OF-MW12-0616	Water
1600818	OF-MW13D-0616	Water
1600818	OF-MW13DP-0616	Water
1600818	OF-MW11D-0616	Water
1600820	OF-MW10-0616	Water
1600820	OF-MW08-0616	Water
1600820	OF-MW08P-0616	Water
1600820	OF-MW10D-0616	Water
1600820	OF-MW09-0616	Water
1600820	OF-MW09D-0616	Water
1600872	OF-MW28-0716	Water
1600872	OF-MW25-0716	Water
1600872	OF-MW31-0716	Water
1600872	OF-FB070616	Water
1600896	OF-MW24-0716	Water
1600896	OF-FB071116	Water
1600896	OF-MW27-0716	Water
1600903	OF-MW30-0716	Water
1600903	OF-MW30P-0716	Water
1600903	OF-MW30D-0716	Water
1600903	OF-MW28D-0716	Water
1600903	OF-MW32-0716	Water
1600903	OF-MW29-0716	Water
1600903	OF-MW08D-0716	Water
1600903	OF-MW34-0716	Water
1600903	OF-MW31D-0716	Water

Data Evaluation

Data was evaluated in accordance with the analytical methods and with the criteria found in the following guidance documents: Sampling and Analysis Plan Basewide Perfluorinated Compound Site Investigation, Naval Auxiliary Landing Field Fentress, Chesapeake, Virginia

Contract Task Order WE44 (August 2016) and National Functional Guidelines for Organic Data Review (August 2014) with Region 3 Modification (Use of 'B' qualifier) as applicable. The samples were evaluated based on the following criteria:

- Data Completeness
- Technical Holding Times
- Tuning Instrument
- Initial/Continuing Calibrations
- Blanks
- Internal Standards
- Laboratory Control Samples
- Isotope Dilution Analyte
- Field Duplicates
- Identification/Quantitation
- Reporting Limits

Overall Evaluation of Data/Potential Usability Issues

Specific details regarding qualification of the data are addressed in the sections below. If an issue is not addressed there were no actions required based on unmet quality criteria. When more than one qualifier is associated with a compound/analyte, the validator has chosen the qualifier that best indicates possible bias in the results and qualified these data accordingly.

Data Completeness

The SDG was received complete and intact.

Technical Holding Times

According to the chain of custody records, sampling was performed on 6/17/16 through 7/14/16. Samples were received at the laboratory 6/18/16 through 7/15/16. All sample preparation and analyses were performed within holding time requirements.

Conclusion

These data can be used in the project decision-making process as qualified by the data quality evaluation process.

Please do not hesitate to contact us about this validation report.

Sincerely,



Tiffany McGlynn

Qualification Flags

Exclude	More appropriate data exist for this analyte.
R	Data were rejected for use.
UL	Analyte not detected, quantitation limit is potentially biased low.
UJ	Analyte not detected, estimated quantitation limit.
U	Analyte not detected.
B	Not detected substantially above the level reported in laboratory or field blanks.
L	Analyte present, estimated value potentially biased low.
K	Analyte present, estimated value potentially biased high.
N	Analyte identification presumptive; no second column analysis performed or GC/MS tentative identification.
J	Analyte present, estimated value.
NJ	Analysis indicates the presence of an analyte that was "tentatively identified" and the associated value represents its approximate concentration.
None	Placeholder for calculating quality control issues that do not require flagging.
=	Analyte was detected at a concentration greater than the quantitation limit.

Qualifier Code Reference

Value	Description
%SOL	High Moisture content
2C	Second Column – Poor Dual Column Reproducibility
2S	Second Source – Bad reproducibility between tandem detectors
BD	Blank Spike/Blank Spike Duplicate(LCS/LCSD) Precision
BRL	Below Reporting Limit
BSH	Blank Spike/LCS – High Recovery
BSL	Blank Spike/LCS – Low Recovery
CC	Continuing Calibration
CCBL	Continuing Calibration Blank Contamination
CCH	Continuing Calibration Verification – High Recovery
CCL	Continuing Calibration Verification – Low Recovery
DL	Redundant Result – due to Dilution
EBL	Equipment Blank Contamination
EMPC	Estimated Possible Maximum Concentration
ESH	Extraction Standard - High Recovery
ESL	Extraction Standard - Low Recovery
FBL	Field Blank Contamination
FD	Field Duplicate
HT	Holding Time
ICB	Initial Calibration – Bad Linearity or Curve Function
ICH	Initial Calibration – High Relative Response Factors
ICL	Initial Calibration – Low Relative Response Factors
IR15	Ion ratio exceeds +/- 15% difference
ISH	Internal Standard – High Recovery
ISL	Internal Standard – Low Recovery
LD	Lab Duplicate Reproducibility
LR	Concentration Exceeds Linear Range
MBL	Method Blank Contamination
MDP	Matrix Spike/Matrix Spike Duplicate Precision
MI	Matrix interference obscuring the raw data

Value	Description
MSH	Matrix Spike and/or Matrix Spike Duplicate – High Recovery
MSL	Matrix Spike and/or Matrix Spike Duplicate – Low Recovery
OT	Other
PD	Pesticide Degradation
RE	Redundant Result - due to Reanalysis or Re-extraction
SD	Serial Dilution Reproducibility
SSH	Spiked Surrogate – High Recovery
SSL	Spiked Surrogate – Low Recovery
TBL	Trip Blank Contamination
TN	Tune

ENVIRONMENTAL
Data Services, Inc.

DATA VALIDATION SUMMARY REPORT
NALF FENTRESS, VIRGINIA

Client: CH2M HILL, Inc., Corvallis, Oregon
SDG: 1700311
Laboratory: Vista Analytical Laboratory, El Dorado Hills, California
Site: NALF Fentress, CTO-WE01, Virginia
Date: July 17, 2017

PFCs			
EDS ID	Client Sample ID	Laboratory Sample ID	Matrix
1	OF-SOW-091A-0317	1700311-01	Water
2	OF-SOW-091D-0317	1700311-02	Water
3	OF-SOW-091DP-0317	1700311-03	Water
4	OF-EB030817	1700311-04	Water
5	OF-SOW-091K-0317	1700311-05	Water
6	OF-SOW-091M-0317	1700311-06	Water
7	OF-FB030817	1700311-07	Water
8	OF-SOW-091L-0317	1700311-08	Water
8MS	OF-SOW-091L-0317MS	1700311-08MS	Water
8MSD	OF-SOW-091L-0317MSD	1700311-08MSD	Water
9	OF14-GW05-0317	1700311-09	Water

A full data validation was performed on the analytical data for seven water samples, one aqueous equipment blank sample and one aqueous field blank sample collected on March 8, 2017 by CH2M HILL at the NALF Fentress site in Chesapeake, Virginia. The samples were analyzed under the EPA Method "Determination of Selected Perfluorinated Alkyl Acids in Drinking Water by Solid Phase Extraction and Liquid Chromatography/Tandem Mass Spectrometry (LC/MS/MS)".

Specific method references are as follows:

Analysis	*Method References*
PFCs	USEPA Method 537 Modified

The data have been validated according to the protocols and quality control (QC) requirements of the analytical method, and the U.S. Department of Defense (DoD) Quality Systems Manual (QSM), Version 5.0 (July 2013) and the USEPA National Functional Guidelines for Organic Data Review as follows:

- The USEPA "Contract Laboratories Program National Functional Guidelines for Superfund Organic Methods Data Review," August 2014;
- and the reviewer's professional judgment.

The following data quality indicators were reviewed for this report:

Organics

- Date Completeness, Case Narrative & Custody Documentation
- Holding times
- Liquid Chromatography/Mass Spectrometry (LC/MS) Tuning
- Initial and continuing calibration summaries
- Method blank and field QC blank contamination
- Surrogate Spike recoveries
- Matrix Spike/Matrix Spike Duplicate (MS/MSD) recoveries
- Laboratory Control Sample/Laboratory Control Sample Duplicate (LCS/LCSD) recoveries
- Internal standard area and retention time summary forms
- Target Compound Identification
- Compound Quantitation
- Field Duplicate sample precision

A full (Level IV) data validation was performed with this review including a recalculation of 10% of the detected results in the samples.

Data Usability Assessment

There were no rejections of data.

Overall the data is acceptable for the intended purposes as qualified for the data quality indicator criteria as detailed in this report.

Please note that any results qualified (U) due to blank contamination may be then qualified (J) due to another action. Therefore, the results may be qualified (UJ) due to the culmination of the blank contaminations and actions from other exceedences of QC criteria.

Perfluorinated Compounds (PFCs)

Data Completeness, Case Narrative & Custody Documentation

- The case narrative and chain-of-custody documentation were included in the data package as required. All criteria were met.

Holding Times

- All samples were extracted within 14 days for water samples and analyzed within 28 days.

LC/MS Tuning

- All criteria were met.

Initial Calibration

- All relative standard deviation (%RSD) and/or correlation coefficients criteria were met.

Continuing Calibration

- All percent difference (%D) and RRF criteria were met.

Method Blank

- The method blanks were free of contamination.

Field QC Blank

- The field blank samples exhibited the following contamination.

Blank ID	Compound	Conc. ng/L	Qualifier	Affected Samples
OF-EB030817	PFOS	1.54	None	See FB
OF-FB030817	PFOS	1.67	U	1, 8

Surrogate Spike Recoveries

- All samples exhibited acceptable surrogate %R values.

Matrix Spike/Matrix Spike Duplicate (MS/MSD) Recoveries

- The MS/MSD samples exhibited acceptable percent recoveries (%R) and RPD values.

Laboratory Control Samples

- The LCS samples exhibited acceptable percent recoveries (%R).

Internal Standard (IS) Area Performance

- All internal standards met response and retention time (RT) criteria except for the following.

Sample ID	Internal Standard	%R	Qualifier
2	13C3-PFBS	186%	J
	13C4-PFHpA	175%	J
3	13C3-PFBS	192%	J
	13C4-PFHpA	173%	J
	13C8-PFOS	299%	J
6	13C3-PFBS	178%	J
	13C4-PFHpA	163%	J
	13C8-PFOS	165%	J

Target Compound Identification

- All mass spectra and quantitation criteria were met.

Compound Quantitation

- All criteria were met.

Field Duplicate Sample Precision

- Field duplicate results are summarized below. The precision was acceptable.

Compound	OF-SOW-091D-0317 ng/L	OF-SOW-091DP-0317 ng/L	RPD	Qualifier
PFBS	91.4	83.1	10%	None
PFHpA	47.5	48.1	1%	
PFHxS	2260	2300	2%	
PFOA	701	740	5%	
PFOS	1940	1650	16%	
PFNA	4.77	7.09	39%	None - <5X LOQ

Please contact the undersigned at (757) 564-0090 if you have any questions or need further information.

Signed: Nancy Weaver Dated: 7/17/17

Nancy Weaver
Senior Chemist

Data Qualifier	Definition
U	The analyte was analyzed for, but was not detected above the level of the reported sample quantitation limit.
J	The analyte is an estimated quantity. The associated numerical value is the approximate concentration of the analyte in the sample.
NJ	The analysis has been "tentatively identified" or "presumptively" as present and the associated numerical value is the estimated concentration in the samples.
UJ	The analyte was analyzed for but was not detected. The reported quantitation limit is approximate and may be inaccurate or imprecise.
R	The data are unusable. The sample results are rejected due to serious deficiencies in meeting QC criteria. The analyte may or may not be present in the samples.

1

Sample ID: OF-SOW-091A-0317

Modified EPA Method 537

Client Data		Sample Data		Laboratory Data			
Name:	CH2M Hill	Matrix:	Aqueous	Lab Sample:	1700311-01	Date Received:	09-Mar-2017 9:23
Project:	Fentress Phase II PFC Investigation	Sample Size:	0.119 L	QC Batch:	B7C0050	Date Extracted:	10-Mar-2017 9:14
Date Collected:	08-Mar-2017 10:05			Date Analyzed:	17-Mar-17 17:53	Column:	BEH C18
Location:							

Analyte	Conc. (ng/L)	DL	LOD	LOQ	Qualifiers
PFBS	**ND**	**1.88**	**4.20**	**8.42**	
PFHpA	ND	0.622	2.10	8.42	
PFHxS	**4.10**	**0.997**	**2.10**	**8.42**	**J**
PFOA	3.79	0.685	2.10	8.42	J
PFOS	**4.18** u	**0.849**	**0.945**	**8.42**	FBL J
PFNA	ND	0.852	2.10	8.42	

	Labeled Standard	%R	LCL-UCL	Qualifiers
IS	**13C3-PFBS**	**107**	**60 - 150**	
IS	13C4-PFHpA	96.8	60 - 150	
IS	**18O2-PFHxS**	**96.7**	**60 - 150**	
IS	13C2-PFOA	108	60 - 150	
IS	**13C8-PFOS**	**111**	**60 - 150**	
IS	13C5-PFNA	112	50 - 150	

LCL-UCL - Lower control limit - upper control limit
Results reported to DL
When reported, PFBS, PFHxS, PFOA and PFOS include both linear and branched isomers
Only the linear isomer is reported for all other analytes

NW 7/27/17

2

Sample ID: OF-SOW-091D-0317

Modified EPA Method 537

Client Data		Sample Data		Laboratory Data			
Name:	CH2M Hill	Matrix:	Aqueous	Lab Sample:	1700311-02	Date Received:	09-Mar-2017 9:23
Project:	Fentress Phase II PFC Investigation	Sample Size:	0.123 L	QC Batch:	B7C0050	Date Extracted:	10-Mar-2017 9:14
Date Collected:	08-Mar-2017 11:10			Date Analyzed:	17-Mar-17 17:15 Column: BEH C18		
Location:					17-Mar-17 18:06 Column: BEH C18		

Analyte	Conc. (ng/L)	DL	LOD	LOQ	Qualifiers
PFBS	91.4 J	1.81	4.07	8.11	ISH
PFHpA	47.5 J	0.599	2.03	8.11	ISH
PFHxS	2260	4.80	10.2	40.6	D
PFOA	701	0.660	2.03	8.11	
PFOS	1940	4.09	4.57	40.6	D
PFNA	4.77	0.821	2.03	8.11	J

	Labeled Standard	%R	LCL-UCL	Qualifiers
IS	13C3-PFBS	186	60 - 150	H
IS	13C4-PFHpA	175	60 - 150	H
IS	18O2-PFHxS	97.8	60 - 150	D
IS	13C2-PFOA	102	60 - 150	
IS	13C8-PFOS	108	60 - 150	D
IS	13C5-PFNA	110	50 - 150	

LCL-UCL - Lower control limit - upper control limit
Results reported to DL.
When reported, PFBS, PFHxS, PFOA and PFOS include both linear and branched isomers.
Only the linear isomer is reported for all other analytes.

MW 7/17/17

3

Sample ID: OF-SOW-091DP-0317 — **Modified EPA Method 537**

Client Data		Sample Data		Laboratory Data			
Name:	CH2M Hill	Matrix:	Aqueous	Lab Sample:	1700311-03	Date Received:	09-Mar-2017 9:23
Project:	Fentress Phase II PFC Investigation	Sample Size:	0.124 L	QC Batch:	B7C0050	Date Extracted:	10-Mar-2017 9:14
Date Collected:	08-Mar-2017 11:15			Date Analyzed:	17-Mar-17 18:18 Column: BEH C18		
Location:					20-Mar-17 15:22 Column: BEH C18		

Analyte	Conc. (ng/L)	DL	LOD	LOQ	Qualifiers
PFBS	83.1 J	1.80	4.03	8.05	ISH
PFHpA	48.1 J	0.595	2.02	8.05	ISH
PFHxS	2300	9.53	20.2	80.5	D
PFOA	740	0.655	2.02	8.05	
PFOS	1650 J	8.12	9.07	80.5	ISH D
PFNA	7.09	0.815	2.02	8.05	J

	Labeled Standard	%R	LCL-UCL	Qualifiers
IS	13C3-PFBS	192	60 - 150	H
IS	13C4-PFHpA	173	60 - 150	H
IS	18O2-PFHxS	114	60 - 150	D
IS	13C2-PFOA	97.2	60 - 150	
IS	13C8-PFOS	299	60 - 150	D, H
IS	13C5-PFNA	99.7	50 - 150	

LCL-UCL - Lower control limit - upper control limit
Results reported to DL.
When reported, PFBS, PFHxS, PFOA and PFOS include both linear and branched isomers.
Only the linear isomer is reported for all other analytes.

MW 7/17/17

4

Sample ID: OF-EB030817

Modified EPA Method 537

Client Data		Sample Data		Laboratory Data			
Name:	CH2M Hill	Matrix:	Aqueous	Lab Sample:	1700311-04	Date Received:	09-Mar-2017 9:23
Project:	Fentress Phase II PFC Investigation	Sample Size:	0.122 L	QC Batch:	B7C0050	Date Extracted:	10-Mar-2017 9:14
Date Collected:	08-Mar-2017 11:45			Date Analyzed:	17-Mar-17 18:31	Column:	BEH C18
Location:							

Analyte	Conc. (ng/L)	DL	LOD	LOQ	Qualifiers
PFBS	**ND**	**1.83**	**4.10**	**8.19**	
PFHpA	ND	0.605	2.05	8.19	
PFHxS	**ND**	**0.969**	**2.05**	**8.19**	
PFOA	ND	0.666	2.05	8.19	
PFOS	**1.54**	**0.826**	**0.922**	**8.19**	J
PFNA	ND	0.829	2.05	8.19	

	Labeled Standard	%R	LCL-UCL	Qualifiers
IS	**13C3-PFBS**	**118**	**60 - 150**	
IS	13C4-PFHpA	112	60 - 150	
IS	**18O2-PFHxS**	**108**	**60 - 150**	
IS	13C2-PFOA	106	60 - 150	
IS	**13C8-PFOS**	**113**	**60 - 150**	
IS	13C5-PFNA	110	50 - 150	

LCL-UCL - Lower control limit - upper control limit
Results reported to DL
When reported, PFBS, PFHxS, PFOA and PFOS include both linear and branched isomers.
Only the linear isomer is reported for all other analytes.

NW 7/17/17

5

Sample ID: OF-SOW-091K-0317 — **Modified EPA Method 537**

Client Data		Sample Data		Laboratory Data			
Name:	CH2M Hill	Matrix:	Aqueous	Lab Sample:	1700311-05	Date Received:	09-Mar-2017 9:23
Project:	Fentress Phase II PFC Investigation	Sample Size:	0.121 L	QC Batch:	B7C0050	Date Extracted:	10-Mar-2017 9:14
Date Collected:	08-Mar-2017 11:55			Date Analyzed:	17-Mar-17 19:21	Column:	BEH C18
Location:							

Analyte	Conc. (ng/L)	DL	LOD	LOQ	Qualifiers
PFBS	ND	1.85	4.13	8.26	
PFHpA	ND	0.610	2.07	8.26	
PFHxS	7.48	0.977	2.07	8.26	J
PFOA	2.53	0.672	2.07	8.26	J
PFOS	9.98	0.833	0.930	8.26	
PFNA	ND	0.836	2.07	8.26	

	Labeled Standard	%R	LCL-UCL	Qualifiers
IS	13C3-PFBS	118	60 - 150	
IS	13C4-PFHpA	106	60 - 150	
IS	18O2-PFHxS	120	60 - 150	
IS	13C2-PFOA	109	60 - 150	
IS	13C8-PFOS	124	60 - 150	
IS	13C5-PFNA	116	50 - 150	

LCL-UCL - Lower control limit - upper control limit
Results reported to DL
When reported, PFBS, PFHxS, PFOA and PFOS include both linear and branched isomers
Only the linear isomer is reported for all other analytes

MW 7/7/17

6

Sample ID: OF-SOW-091M-0317

Modified EPA Method 537

Client Data		Sample Data		Laboratory Data			
Name:	CH2M Hill	Matrix:	Aqueous	Lab Sample:	1700311-06	Date Received:	09-Mar-2017 9:23
Project:	Fentress Phase II PFC Investigation	Sample Size:	0.128 L	QC Batch:	B7C0050	Date Extracted:	10-Mar-2017 9:14
Date Collected:	08-Mar-2017 12:35			Date Analyzed:	17-Mar-17 19:34 Column: BEH C18		
Location:					20-Mar-17 15:35 Column: BEH C18		

Analyte	Conc. (ng/L)	DL	LOD	LOQ	Qualifiers
PFBS	48.2 J	1.75	3.91	7.82	J,S,H
PFHpA	33.1 J	0.578	1.95	7.82	J,S,H
PFHxS	1470	9.26	19.5	78.2	D
PFOA	956	0.637	1.95	7.82	
PFOS	2350 J	7.89	8.79	78.2	J,S,H D
PFNA	7.13	0.792	1.95	7.82	J

	Labeled Standard	%R	LCL-UCL	Qualifiers
IS	13C3-PFBS	178	60 - 150	H
IS	13C4-PFHpA	163	60 - 150	H
IS	18O2-PFHxS	113	60 - 150	D
IS	13C2-PFOA	108	60 - 150	
IS	13C8-PFOS	165	60 - 150	D, H
IS	13C5-PFNA	123	50 - 150	

LCL-UCL - Lower control limit - upper control limit
Results reported to DL
When reported, PFBS, PFHxS, PFOA and PFOS include both linear and branched isomers
Only the linear isomer is reported for all other analytes

MW 7/17/17

7

Sample ID: OF-FB030817

Modified EPA Method 537

Client Data
Name: CH2M Hill
Project: Fentress Phase II PFC Investigation
Date Collected: 08-Mar-2017 13:00
Location:

Sample Data
Matrix: Aqueous
Sample Size: 0.125 L

Laboratory Data
Lab Sample: 1700311-07 Date Received: 09-Mar-2017 9:23
QC Batch: B7C0050 Date Extracted: 10-Mar-2017 9:14
Date Analyzed: 17-Mar-17 19:46 Column: BEH C18

Analyte	Conc. (ng/L)	DL	LOD	LOQ	Qualifiers
PFBS	ND	1.79	4.00	7.98	
PFHpA	ND	0.589	2.00	7.98	
PFHxS	ND	0.945	2.00	7.98	
PFOA	ND	0.649	2.00	7.98	
PFOS	1.67	0.805	0.900	7.98	J
PFNA	ND	0.808	2.00	7.98	

	Labeled Standard	%R	LCL-UCL	Qualifiers
IS	13C3-PFBS	133	60 - 150	
IS	13C4-PFHpA	125	60 - 150	
IS	18O2-PFHxS	120	60 - 150	
IS	13C2-PFOA	109	60 - 150	
IS	13C8-PFOS	110	60 - 150	
IS	13C5-PFNA	111	50 - 150	

LCL-UCL - Lower control limit - upper control limit
Results reported to DL.
When reported, PFBS, PFHxS, PFOA and PFOS include both linear and branched isomers.
Only the linear isomer is reported for all other analytes.

MW 7/17/17

8

Sample ID: OF-SOW-091L-0317 — **Modified EPA Method 537**

Client Data		Sample Data		Laboratory Data			
Name:	CH2M Hill	Matrix:	Aqueous	Lab Sample:	1700311-08	Date Received:	09-Mar-2017 9:23
Project:	Fentress Phase II PFC Investigation	Sample Size:	0.119 L	QC Batch:	B7C0050	Date Extracted:	10-Mar-2017 9:14
Date Collected:	08-Mar-2017 13:20			Date Analyzed:	17-Mar-17 19:59	Column:	BEH C18
Location:							

Analyte	Conc. (ng/L)	DL	LOD	LOQ	Qualifiers
PFBS	ND	1.87	4.20	8.37	
PFHpA	ND	0.618	2.10	8.37	
PFHxS	1.28	0.991	2.10	8.37	J
PFOA	ND	0.681	2.10	8.37	
PFOS	2.43 u	0.844	0.945	8.37	FBL
PFNA	ND	0.847	2.10	8.37	

	Labeled Standard	%R	LCL-UCL	Qualifiers
IS	13C3-PFBS	115	60 - 150	
IS	13C4-PFHpA	109	60 - 150	
IS	18O2-PFHxS	108	60 - 150	
IS	13C2-PFOA	110	60 - 150	
IS	13C8-PFOS	106	60 - 150	
IS	13C5-PFNA	106	50 - 150	

LCL-UCL - Lower control limit - upper control limit
Results reported to DL.
When reported, PFBS, PFHxS, PFOA and PFOS include both linear and branched isomers.
Only the linear isomer is reported for all other analytes.

NW 7/7/17

9

Sample ID: OF14-GW05-0317

Modified EPA Method 537

Client Data
Name: CH2M Hill
Project: Fentress Phase II PFC Investigation
Date Collected: 08-Mar-2017 15:10
Location:

Sample Data
Matrix: Aqueous
Sample Size: 0.122 L

Laboratory Data
Lab Sample: 1700311-09 Date Received: 09-Mar-2017 9:23
QC Batch: B7C0050 Date Extracted: 10-Mar-2017 9:14
Date Analyzed: 17-Mar-17 20:11 Column: BEH C18

Analyte	Conc. (ng/L)	DL	LOD	LOQ	Qualifiers
PFBS	ND	1.83	4.10	8.18	
PFHpA	ND	0.604	2.05	8.18	
PFHxS	7.76	0.968	2.05	8.18	J
PFOA	2.55	0.666	2.05	8.18	J
PFOS	ND	0.825	0.922	8.18	
PFNA	ND	0.828	2.05	8.18	

	Labeled Standard	%R	LCL-UCL	Qualifiers
IS	13C3-PFBS	120	60 - 150	
IS	13C4-PFHpA	114	60 - 150	
IS	18O2-PFHxS	118	60 - 150	
IS	13C2-PFOA	101	60 - 150	
IS	13C8-PFOS	100	60 - 150	
IS	13C5-PFNA	110	50 - 150	

LCL-UCL - Lower control limit - upper control limit
Results reported to DL
When reported, PFBS, PFHxS, PFOA and PFOS include both linear and branched isomers
Only the linear isomer is reported for all other analytes

MW 7/17/17

ENVIRONMENTAL
Data Services, Inc.

DATA VALIDATION SUMMARY REPORT
NALF FENTRESS, VIRGINIA

Client: CH2M HILL, Inc., Corvallis, Oregon
SDG: 1700458
Laboratory: Vista Analytical Laboratory, El Dorado Hills, California
Site: NALF Fentress, CTO-WE01, Virginia
Date: July 17, 2017

PFCs			
EDS ID	Client Sample ID	Laboratory Sample ID	Matrix
1	OF-MW34D-0417	1700458-01	Water
1MS	OF-MW34D-0417MS	1700458-01MS	Water
1MSD	OF-MW34D-0417MSD	1700458-01MSD	Water
2	OF-MW32D-0417	1700458-02	Water
3	OF-MW32DP-0417	1700458-03	Water
4	OF-EB041417	1700458-04	Water
5	OF-FB041417	1700458-05	Water

A full data validation was performed on the analytical data for three water samples, one aqueous equipment blank sample and one aqueous field blank sample collected on April 14, 2017 by CH2M HILL at the NALF Fentress site in Chesapeake, Virginia. The samples were analyzed under the EPA Method "Determination of Selected Perfluorinated Alkyl Acids in Drinking Water by Solid Phase Extraction and Liquid Chromatography/Tandem Mass Spectrometry (LC/MS/MS)".

Specific method references are as follows:

Analysis	*Method References*
PFCs	USEPA Method 537 Modified

The data have been validated according to the protocols and quality control (QC) requirements of the analytical method, and the U.S. Department of Defense (DoD) Quality Systems Manual (QSM), Version 5.0 (July 2013) and the USEPA National Functional Guidelines for Organic Data Review as follows:

- The USEPA "Contract Laboratories Program National Functional Guidelines for Superfund Organic Methods Data Review," August 2014;
- and the reviewer's professional judgment.

The following data quality indicators were reviewed for this report:

Organics

- Date Completeness, Case Narrative & Custody Documentation

- Holding times
- Liquid Chromatography/Mass Spectrometry (LC/MS) Tuning
- Initial and continuing calibration summaries
- Method blank and field QC blank contamination
- Surrogate Spike recoveries
- Matrix Spike/Matrix Spike Duplicate (MS/MSD) recoveries
- Laboratory Control Sample/Laboratory Control Sample Duplicate (LCS/LCSD) recoveries
- Internal standard area and retention time summary forms
- Target Compound Identification
- Compound Quantitation
- Field Duplicate sample precision

A full (Level IV) data validation was performed with this review including a recalculation of 10% of the detected results in the samples.

Data Usability Assessment

There were no rejections of data.

Overall the data is acceptable for the intended purposes. There were no qualifications.

Perfluorinated Compounds (PFCs)

Data Completeness, Case Narrative & Custody Documentation

- The case narrative and chain-of-custody documentation were included in the data package as required. All criteria were met.

Holding Times

- All samples were extracted within 14 days for water samples and analyzed within 28 days.

LC/MS Tuning

- All criteria were met.

Initial Calibration

- All relative standard deviation (%RSD) and/or correlation coefficients criteria were met.

Continuing Calibration

- All percent difference (%D) and RRF criteria were met.

Method Blank

- The method blanks were free of contamination.

Field QC Blank

- The field blank samples were free of contamination.

Blank ID	Compound	Conc. ng/L	Qualifier	Affected Samples
OF-EB041417	None - ND	-	-	-
OF-FB041417	None - ND	-	-	-

Surrogate Spike Recoveries

- All samples exhibited acceptable surrogate %R values.

Matrix Spike/Matrix Spike Duplicate (MS/MSD) Recoveries

- The MS/MSD samples exhibited acceptable percent recoveries (%R) and RPD values.

Laboratory Control Samples

- The LCS samples exhibited acceptable percent recoveries (%R).

Internal Standard (IS) Area Performance

- All internal standards met response and retention time (RT) criteria.

Target Compound Identification

- All mass spectra and quantitation criteria were met.

Compound Quantitation

- All criteria were met.

Field Duplicate Sample Precision

- Field duplicate results are summarized below. The precision was acceptable.

Compound	OF-MW32D-0417 ng/L	OF-MW32DP-0417 ng/L	RPD	Qualifier
PFOS	1.97	2.10	6%	None

Please contact the undersigned at (757) 564-0090 if you have any questions or need further information.

Signed: Nancy Weaver Dated: 7/17/17

Nancy Weaver
Senior Chemist

Data Qualifier	Definition
U	The analyte was analyzed for, but was not detected above the level of the reported sample quantitation limit.
J	The analyte is an estimated quantity. The associated numerical value is the approximate concentration of the analyte in the sample.
NJ	The analysis has been "tentatively identified" or "presumptively" as present and the associated numerical value is the estimated concentration in the samples.
UJ	The analyte was analyzed for but was not detected. The reported quantitation limit is approximate and may be inaccurate or imprecise.
R	The data are unusable. The sample results are rejected due to serious deficiencies in meeting QC criteria. The analyte may or may not be present in the samples.

Sample ID: OF-MW34D-0417

Modified EPA Method 537

Client Data		Sample Data		Laboratory Data			
Name:	CH2M Hill	Matrix:	Aqueous	Lab Sample:	1700458-01	Date Received:	15-Apr-2017 9:22
Project:		Sample Size:	0.125 L	QC Batch:	B7D0088	Date Extracted:	19-Apr-2017 15:40
Date Collected:	14-Apr-2017 9:35			Date Analyzed:	19-Apr-17 18:56	Column:	BEH C18
Location:							

Analyte	Conc. (ng/L)	DL	LOD	LOQ	Qualifiers
PFBS	ND	1.79	4.00	8.00	
PFHpA	ND	0.591	2.00	8.00	
PFHxS	ND	0.947	2.00	8.00	
PFOA	ND	0.651	2.00	8.00	
PFOS	ND	0.807	0.900	8.00	
PFNA	ND	0.810	2.00	8.00	

	Labeled Standard	%R	LCL-UCL	Qualifiers
IS	13C3-PFBS	109	60 - 150	
IS	13C4-PFHpA	78.1	60 - 150	
IS	18O2-PFHxS	94.1	60 - 150	
IS	13C2-PFOA	84.2	60 - 150	
IS	13C8-PFOS	86.2	60 - 150	
IS	13C5-PFNA	94.6	50 - 150	

LCL-UCL - Lower control limit - upper control limit
Results reported to DL
When reported, PFBS, PFHxS, PFOA and PFOS include both linear and branched isomers
Only the linear isomer is reported for all other analytes

NW 7/7/17

2

Sample ID: OF-MW32D-0417

Modified EPA Method 537

Client Data
Name: CH2M Hill
Project:
Date Collected: 14-Apr-2017 10:50
Location:

Sample Data
Matrix: Aqueous
Sample Size: 0.123 L

Laboratory Data
Lab Sample: 1700458-02 Date Received: 15-Apr-2017 9:22
QC Batch: B7D0088 Date Extracted: 19-Apr-2017 15:40
Date Analyzed: 19-Apr-17 19:34 Column: BEH C18

Analyte	Conc. (ng/L)	DL	LOD	LOQ	Qualifiers
PFBS	ND	1.82	4.07	8.15	
PFHpA	ND	0.602	2.03	8.15	
PFHxS	ND	0.965	2.03	8.15	
PFOA	ND	0.663	2.03	8.15	
PFOS	1.97	0.822	0.915	8.15	J
PFNA	ND	0.825	2.03	8.15	

	Labeled Standard	%R	LCL-UCL	Qualifiers
IS	13C3-PFBS	107	60 - 150	
IS	13C4-PFHpA	87.4	60 - 150	
IS	18O2-PFHxS	95.5	60 - 150	
IS	13C2-PFOA	88.9	60 - 150	
IS	13C8-PFOS	92.5	60 - 150	
IS	13C5-PFNA	89.5	50 - 150	

LCL-UCL - Lower control limit - upper control limit
Results reported to DL
When reported, PFBS, PFHxS, PFOA and PFOS include both linear and branched isomers.
Only the linear isomer is reported for all other analytes.

MW 7/17/17

3

Sample ID: OF-MW32DP-0417 — **Modified EPA Method 537**

Client Data		Sample Data		Laboratory Data			
Name:	CH2M Hill	Matrix:	Aqueous	Lab Sample:	1700458-03	Date Received:	15-Apr-2017 9:22
Project:		Sample Size:	0.122 L	QC Batch:	B7D0088	Date Extracted:	19-Apr-2017 15:40
Date Collected:	14-Apr-2017 10:55			Date Analyzed:	19-Apr-17 19:47	Column:	BEH C18
Location:							

Analyte	Conc. (ng/L)	DL	LOD	LOQ	Qualifiers
PFBS	**ND**	**1.84**	**4.10**	**8.22**	
PFHpA	ND	0.607	2.05	8.22	
PFHxS	**ND**	**0.973**	**2.05**	**8.22**	
PFOA	ND	0.669	2.05	8.22	
PFOS	**2.10**	**0.829**	**0.922**	**8.22**	J
PFNA	ND	0.832	2.05	8.22	

	Labeled Standard	%R	LCL-UCL	Qualifiers
IS	13C3-PFBS	102	60 - 150	
IS	13C4-PFHpA	86.6	60 - 150	
IS	18O2-PFHxS	94.1	60 - 150	
IS	13C2-PFOA	82.1	60 - 150	
IS	13C8-PFOS	75.6	60 - 150	
IS	13C5-PFNA	92.9	50 - 150	

LCL-UCL - Lower control limit - upper control limit
Results reported to DL.
When reported, PFBS, PFHxS, PFOA and PFOS include both linear and branched isomers.
Only the linear isomer is reported for all other analytes.

mw 7/17/17

4

Sample ID: OF-EB041417

Modified EPA Method 537

Client Data
Name: CH2M Hill
Project:
Date Collected: 14-Apr-2017 11:00
Location:

Sample Data
Matrix: Aqueous
Sample Size: 0.120 L

Laboratory Data
Lab Sample: 1700458-04 Date Received: 15-Apr-2017 9:22
QC Batch: B7D0088 Date Extracted: 19-Apr-2017 15:40
Date Analyzed: 19-Apr-17 20:38 Column: BEH C18

Analyte	Conc. (ng/L)	DL	LOD	LOQ	Qualifiers
PFBS	ND	1.86	4.17	8.32	
PFHpA	ND	0.615	2.08	8.32	
PFHxS	ND	0.985	2.08	8.32	
PFOA	ND	0.677	2.08	8.32	
PFOS	ND	0.840	0.938	8.32	
PFNA	ND	0.843	2.08	8.32	

	Labeled Standard	%R	LCL-UCL	Qualifiers
IS	13C3-PFBS	104	60 - 150	
IS	13C4-PFHpA	87.6	60 - 150	
IS	18O2-PFHxS	96.3	60 - 150	
IS	13C2-PFOA	84.2	60 - 150	
IS	13C8-PFOS	99.0	60 - 150	
IS	13C5-PFNA	92.0	50 - 150	

LCL-UCL - Lower control limit - upper control limit
Results reported to DL
When reported, PFBS, PFHxS, PFOA and PFOS include both linear and branched isomers.
Only the linear isomer is reported for all other analytes.

NW 7/17/17

5

Sample ID: OF-FB041417

Modified EPA Method 537

Client Data
Name: CH2M Hill
Project:
Date Collected: 14-Apr-2017 11:05
Location:

Sample Data
Matrix: Aqueous
Sample Size: 0.119 L

Laboratory Data
Lab Sample: 1700458-05 Date Received: 15-Apr-2017 9:22
QC Batch: B7D0088 Date Extracted: 19-Apr-2017 15:40
Date Analyzed: 19-Apr-17 20:50 Column: BEH C18

Analyte	Conc. (ng/L)	DL	LOD	LOQ	Qualifiers
PFBS	ND	1.88	4.20	8.41	
PFHpA	ND	0.621	2.10	8.41	
PFHxS	ND	0.996	2.10	8.41	
PFOA	ND	0.685	2.10	8.41	
PFOS	ND	0.849	0.945	8.41	
PFNA	ND	0.852	2.10	8.41	

	Labeled Standard	%R	LCL-UCL	Qualifiers
IS	13C3-PFBS	101	60 - 150	
IS	13C4-PFHpA	83.2	60 - 150	
IS	18O2-PFHxS	98.5	60 - 150	
IS	13C2-PFOA	84.7	60 - 150	
IS	13C8-PFOS	85.5	60 - 150	
IS	13C5-PFNA	90.1	50 - 150	

LCL-UCL - Lower control limit - upper control limit
Results reported to DL
When reported, PFBS, PFHxS, PFOA and PFOS include both linear and branched isomers.
Only the linear isomer is reported for all other analytes.

NW 7/17/17

ENVIRONMENTAL
Data Services, Inc.

DATA VALIDATION SUMMARY REPORT
NALF FENTRESS, VIRGINIA

Client: CH2M HILL, Inc., Corvallis, Oregon
SDG: 1700681
Laboratory: Vista Analytical Laboratory, El Dorado Hills, California
Site: NALF Fentress, CTO-WE01, Virginia
Date: July 17, 2017

PFCs			
EDS ID	Client Sample ID	Laboratory Sample ID	Matrix
1	OF17-MW02-0517	1700681-01	Water
2	OF17-MW03-0517	1700681-02	Water
2MS	OF17-MW03-0517MS	1700681-02MS	Water
2MSD	OF17-MW03-0517MSD	1700681-02MSD	Water
3	OF17-MW01-0617	1700681-03	Water
4	OF17-MW01P-0617	1700681-04	Water
5	OF17-FB060117	1700681-05	Water
6	OF17-MW04-0617	1700681-06	Water
7	OF17-EB060117	1700681-07	Water

A full data validation was performed on the analytical data for five water samples, one aqueous equipment blank sample and one aqueous field blank sample collected on May 31-June 1, 2017 by CH2M HILL at the NALF Fentress site in Chesapeake, Virginia. The samples were analyzed under the EPA Method "Determination of Selected Perfluorinated Alkyl Acids in Drinking Water by Solid Phase Extraction and Liquid Chromatography/Tandem Mass Spectrometry (LC/MS/MS)".

Specific method references are as follows:

Analysis	*Method References*
PFCs	USEPA Method 537 Modified

The data have been validated according to the protocols and quality control (QC) requirements of the analytical method, and the U.S. Department of Defense (DoD) Quality Systems Manual (QSM), Version 5.0 (July 2013) and the USEPA National Functional Guidelines for Organic Data Review as follows:

- The USEPA "Contract Laboratories Program National Functional Guidelines for Superfund Organic Methods Data Review," August 2014;
- and the reviewer's professional judgment.

The following data quality indicators were reviewed for this report:

Organics

- Date Completeness, Case Narrative & Custody Documentation
- Holding times
- Liquid Chromatography/Mass Spectrometry (LC/MS) Tuning
- Initial and continuing calibration summaries
- Method blank and field QC blank contamination
- Surrogate Spike recoveries
- Matrix Spike/Matrix Spike Duplicate (MS/MSD) recoveries
- Laboratory Control Sample/Laboratory Control Sample Duplicate (LCS/LCSD) recoveries
- Internal standard area and retention time summary forms
- Target Compound Identification
- Compound Quantitation
- Field Duplicate sample precision

A full (Level IV) data validation was performed with this review including a recalculation of 10% of the detected results in the samples.

Data Usability Assessment

There were no rejections of data.

Overall the data is acceptable for the intended purposes as qualified for the data quality indicator criteria as detailed in this report.

Please note that any results qualified (U) due to blank contamination may be then qualified (J) due to another action. Therefore, the results may be qualified (UJ) due to the culmination of the blank contaminations and actions from other exceedences of QC criteria.

Perfluorinated Compounds (PFCs)

Data Completeness, Case Narrative & Custody Documentation

- The case narrative and chain-of-custody documentation were included in the data package as required. All criteria were met.

Holding Times

- All samples were extracted within 14 days for water samples and analyzed within 28 days.

LC/MS Tuning

- All criteria were met.

Initial Calibration

- All relative standard deviation (%RSD) and/or correlation coefficients criteria were met.

Continuing Calibration

- All percent difference (%D) and RRF criteria were met.

Method Blank

- The method blanks were free of contamination.

Field QC Blank

- The field blank samples were free of contamination.

Blank ID	Compound	Conc. ng/L	Qualifier	Affected Samples
OF17-EB060117	None - ND	-	-	-
OF17-FB060117	None - ND	-	-	-

Surrogate Spike Recoveries

- All samples exhibited acceptable surrogate %R values.

Matrix Spike/Matrix Spike Duplicate (MS/MSD) Recoveries

- The MS/MSD samples exhibited acceptable percent recoveries (%R) and RPD values except for the following.

MS/MSD Sample ID	Compound	MS %R/MSD %R/RPD	Qualifier	Affected Samples
2	PFBS	66%/228%/110	None	4X Rule Applies
	PFHpA	-11.2%/263%/218	None	
	PFHxS	1480%/6220%/123	None	
	PFOA	219%/-172%/1660	None	
	PFOS	1930%/-405%/306	None	
	PFNA	53.9%/OK/31.3	None	

Laboratory Control Samples

- The LCS samples exhibited acceptable percent recoveries (%R).

Internal Standard (IS) Area Performance

- All internal standards met response and retention time (RT) criteria except for the following.

Sample ID	Internal Standard	%R	Qualifier
2	18C2-PFHxS	162%	J
3	13C3-PFBS	158%	J
4	13C3-PFBS	157%	J
6	13C3-PFBS	164%	J

Target Compound Identification

- All mass spectra and quantitation criteria were met.

Compound Quantitation

- EDS Sample ID #6 exhibited a high concentration of PFOS over the calibration range of the instrument and was flagged (E) by the laboratory. The sample was not diluted and reanalyzed and the PFOS result has been qualified as estimated (J).

Field Duplicate Sample Precision

- Field duplicate results are summarized below. The precision was acceptable.

Compound	OF17-MW01-0617 ng/L	OF17-MW01P-0617 ng/L	RPD	Qualifier
PFBS	181	184	2%	None
PFHpA	1390	1500	8%	
PFHxS	4590	3640	23%	
PFOA	1840	1710	7%	
PFOS	14000	13000	7%	
PFNA	403	388	4%	

Please contact the undersigned at (757) 564-0090 if you have any questions or need further information.

Signed: Nancy Weaver Dated: 7/17/17

Nancy Weaver
Senior Chemist

Data Qualifier	Definition
U	The analyte was analyzed for, but was not detected above the level of the reported sample quantitation limit.
J	The analyte is an estimated quantity. The associated numerical value is the approximate concentration of the analyte in the sample.
NJ	The analysis has been "tentatively identified" or "presumptively" as present and the associated numerical value is the estimated concentration in the samples.
UJ	The analyte was analyzed for but was not detected. The reported quantitation limit is approximate and may be inaccurate or imprecise.
R	The data are unusable. The sample results are rejected due to serious deficiencies in meeting QC criteria. The analyte may or may not be present in the samples.

Vista Analytical Laboratory

Sample ID: OF17-MW02-0517

Modified EPA Method 537

Client Data		Sample Data		Laboratory Data			
Name:	CH2M Hill	Matrix:	Aqueous	Lab Sample:	1700681-01	Date Received:	02-Jun-2017 9:00
Project:	674207.51.51	Sample Size:	0.116 L	QC Batch:	B7F0010	Date Extracted:	08-Jun-2017 8:19
Date Collected:	31-May-2017 12:20			Date Analyzed:	09-Jun-17 06:53 Column: BEH C18		
Location:	NALF SITE 17				23-Jun-17 14:24 Column: BEH C18		

Analyte	Conc. (ng/L)	DL	LOD	LOQ	Qualifiers
PFBS	67.9	1.94	5.39	8.65	
PFHpA	672	0.639	5.39	8.65	
PFHxS	3850	25.6	135	216	D
PFOA	816	0.704	5.39	8.65	
PFOS	8770	8.73	53.9	86.5	D
PFNA	292	0.876	5.39	8.65	

	Labeled Standard	%R	LCL-UCL	Qualifiers
IS	13C3-PFBS	146	50 - 150	
IS	13C4-PFHpA	125	50 - 150	
IS	18O2-PFHxS	94.1	50 - 150	D
IS	13C2-PFOA	107	50 - 150	
IS	13C8-PFOS	102	50 - 150	D
IS	13C5-PFNA	118	50 - 150	

LCL-UCL - Lower control limit - upper control limit
Results reported to DL
When reported, PFBS, PFHxS, PFOA and PFOS include both linear and branched isomers
Only the linear isomer is reported for all other analytes

MW 7/17/17

Vista Analytical Laboratory

Sample ID: OF17-MW03-0517

Modified EPA Method 537

Client Data		Sample Data		Laboratory Data			
Name:	CH2M Hill	Matrix:	Aqueous	Lab Sample:	1700681-02	Date Received:	02-Jun-2017 9:00
Project:	674207.51.51	Sample Size:	0.114 L	QC Batch:	B7F0010	Date Extracted:	08-Jun-2017 8:19
Date Collected:	31-May-2017 14:05			Date Analyzed:	09-Jun-17 07:04 Column: BEH C18		
Location:	NALF SITE 17				16-Jun-17 08:29 Column: BEH C18		

Analyte	Conc. (ng/L)	DL	LOD	LOQ	Qualifiers
PFBS	739	1.97	5.48	8.79	
PFHpA	1750	16.2	137	220	D
PFHxS	11100 J	52.0	274	439	ISH D
PFOA	2760	17.9	137	220	D
PFOS	10400	22.2	137	220	D
PFNA	714	0.890	5.48	8.79	

	Labeled Standard	%R	LCL-UCL	Qualifiers
IS	13C3-PFBS	148	50 - 150	
IS	13C4-PFHpA	102	50 - 150	D
IS	18O2-PFHxS	162	50 - 150	D, H
IS	13C2-PFOA	96.7	50 - 150	D
IS	13C8-PFOS	114	50 - 150	D
IS	13C5-PFNA	128	50 - 150	

LCL-UCL - Lower control limit - upper control limit
Results reported to DL
When reported, PFBS, PFHxS, PFOA and PFOS include both linear and branched isomers
Only the linear isomer is reported for all other analytes

MW 7/17/17

Vista 3
Analytical Laboratory

Sample ID: OF17-MW01-0617

Modified EPA Method 537

Client Data		Sample Data		Laboratory Data			
Name:	CH2M Hill	Matrix:	Aqueous	Lab Sample:	1700681-03	Date Received:	02-Jun-2017 9:00
Project:	674207.51.51	Sample Size:	0.114 L	QC Batch:	B7F0010	Date Extracted:	08-Jun-2017 8:19
Date Collected:	01-Jun-2017 11:45			Date Analyzed:	09-Jun-17 07:39 Column: BEH C18		
Location:	NALF SITE 17				23-Jun-17 14:35 Column: BEH C18		

Analyte	Conc. (ng/L)	DL	LOD	LOQ	Qualifiers
PFBS	181 J	1.95	5.48	8.74	JSH
PFHpA	1390	32.3	274	437	D
PFHxS	4590	51.7	274	437	D
PFOA	1840	35.5	274	437	D
PFOS	14000	17.6	110	175	D
PFNA	403	0.884	5.48	8.74	

	Labeled Standard	%R	LCL-UCL	Qualifiers
IS	13C3-PFBS	158	50 - 150	H
IS	13C4-PFHpA	102	50 - 150	D
IS	18O2-PFHxS	67.6	50 - 150	D
IS	13C2-PFOA	113	50 - 150	D
IS	13C8-PFOS	129	50 - 150	D
IS	13C5-PFNA	120	50 - 150	

LCL-UCL - Lower control limit - upper control limit
Results reported to DL.
When reported, PFBS, PFHxS, PFOA and PFOS include both linear and branched isomers
Only the linear isomer is reported for all other analytes

MW 7/17/17

Vista Analytical Laboratory 4

Sample ID: OF17-MW01P-0617

Modified EPA Method 537

Client Data		Sample Data		Laboratory Data			
Name:	CH2M Hill	Matrix:	Aqueous	Lab Sample:	1700681-04	Date Received:	02-Jun-2017 9:00
Project:	674207.51.51	Sample Size:	0.122 L	QC Batch:	B7F0010	Date Extracted:	08-Jun-2017 8:19
Date Collected:	01-Jun-2017 11:50			Date Analyzed:	09-Jun-17 08:27 Column: BEH C18		
Location:	NALF SITE 17				16-Jun-17 06:22 Column: BEH C18		

Analyte	Conc. (ng/L)	DL	LOD	LOQ	Qualifiers
PFBS	184 J	1.84	5.12	8.22	ISH
PFHpA	1500	12.1	102	164	D
PFHxS	3640	48.6	256	411	D
PFOA	1710	13.4	102	164	D
PFOS	13000	16.6	102	164	D
PFNA	388	0.832	5.12	8.22	

	Labeled Standard	%R	LCL-UCL	Qualifiers
IS	13C3-PFBS	157	50 - 150	H
IS	13C4-PFHpA	100	50 - 150	D
IS	18O2-PFHxS	111	50 - 150	D
IS	13C2-PFOA	112	50 - 150	D
IS	13C8-PFOS	121	50 - 150	D
IS	13C5-PFNA	124	50 - 150	

LCL-UCL - Lower control limit - upper control limit
Results reported to DL
When reported, PFBS, PFHxS, PFOA and PFOS include both linear and branched isomers
Only the linear isomer is reported for all other analytes

MW 7/17/17

Vista 5
Analytical Laboratory

Sample ID: OF17-FB060117

Modified EPA Method 537

Client Data

Name:	CH2M Hill
Project:	674207.51.51
Date Collected:	01-Jun-2017 12:30
Location:	NALF SITE 17

Sample Data

Matrix:	Aqueous
Sample Size:	0.121 L

Laboratory Data

Lab Sample:	1700681-05	Date Received:	02-Jun-2017 9:00
QC Batch:	B7F0010	Date Extracted:	08-Jun-2017 8:19
Date Analyzed:	09-Jun-17 08:38 Column: BEH C18		

Analyte	Conc. (ng/L)	DL	LOD	LOQ	Qualifiers
PFBS	ND	1.85	5.17	8.26	
PFHpA	ND	0.610	5.17	8.26	
PFHxS	ND	0.977	5.17	8.26	
PFOA	ND	0.672	5.17	8.26	
PFOS	ND	0.833	5.17	8.26	
PFNA	ND	0.836	5.17	8.26	

	Labeled Standard	%R	LCL-UCL	Qualifiers
IS	13C3-PFBS	143	50 - 150	
IS	13C4-PFHpA	120	50 - 150	
IS	18O2-PFHxS	128	50 - 150	
IS	13C2-PFOA	108	50 - 150	
IS	13C8-PFOS	119	50 - 150	
IS	13C5-PFNA	111	50 - 150	

LCL-UCL - Lower control limit - upper control limit
Results reported to DL.
When reported, PFBS, PFHxS, PFOA and PFOS include both linear and branched isomers.
Only the linear isomer is reported for all other analytes.

MW 7/7/17

Sample ID: OF17-MW04-0617

Modified EPA Method 537

Client Data		Sample Data		Laboratory Data			
Name:	CH2M Hill	Matrix:	Aqueous	Lab Sample:	1700681-06	Date Received:	02-Jun-2017 9:00
Project:	674207.51.51	Sample Size:	0.116 L	QC Batch:	B7F0010	Date Extracted:	08-Jun-2017 8:19
Date Collected:	01-Jun-2017 13:10			Date Analyzed:	09-Jun-17 08:49 Column: BEH C18		
Location:	NALF SITE 17				16-Jun-17 06:46 Column: BEH C18		

Analyte	Conc. (ng/L)	DL	LOD	LOQ	Qualifiers
PFBS	156 J	1.93	5.39	8.61	ISH
PFHpA	2340	6.36	53.9	86.1	~~D~~
PFHxS	3770	51.0	269	431	~~D~~
PFOA	3400	7.01	53.9	86.1	~~D~~
PFOS	44500 J	43.4	269	431	LR ~~E, D~~
PFNA	627	0.872	5.39	8.61	

	Labeled Standard	%R	LCL-UCL	Qualifiers
IS	13C3-PFBS	164	50 - 150	~~H~~
IS	13C4-PFHpA	108	50 - 150	~~D~~
IS	18O2-PFHxS	108	50 - 150	~~D~~
IS	13C2-PFOA	119	50 - 150	~~D~~
IS	13C8-PFOS	140	50 - 150	~~D~~
IS	13C5-PFNA	128	50 - 150	

LCL-UCL - Lower control limit - upper control limit
Results reported to DL
When reported, PFBS, PFHxS, PFOA and PFOS include both linear and branched isomers
Only the linear isomer is reported for all other analytes

new 7/17/17

Vista 7
Analytical Laboratory

Sample ID: OF-EB060117

Modified EPA Method 537

Client Data		Sample Data		Laboratory Data			
Name:	CH2M Hill	Matrix:	Aqueous	Lab Sample:	1700681-07	Date Received:	02-Jun-2017 9:00
Project:	674207.51.51	Sample Size:	0.118 L	QC Batch:	B7F0010	Date Extracted:	08-Jun-2017 8:19
Date Collected:	01-Jun-2017 13:20			Date Analyzed:	09-Jun-17 09:01	Column:	BEH C18
Location:	NALF SITE 17						

Analyte	Conc. (ng/L)	DL	LOD	LOQ	Qualifiers
PFBS	ND	1.89	5.30	8.45	
PFHpA	ND	0.624	5.30	8.45	
PFHxS	ND	1.00	5.30	8.45	
PFOA	ND	0.688	5.30	8.45	
PFOS	ND	0.852	5.30	8.45	
PFNA	ND	0.856	5.30	8.45	

	Labeled Standard	%R	LCL-UCL	Qualifiers
IS	13C3-PFBS	141	50 - 150	
IS	13C4-PFHpA	133	50 - 150	
IS	18O2-PFHxS	133	50 - 150	
IS	13C2-PFOA	109	50 - 150	
IS	13C8-PFOS	126	50 - 150	
IS	13C5-PFNA	129	50 - 150	

LCL-UCL - Lower control limit - upper control limit
Results reported to DL
When reported, PFBS, PFHxS, PFOA and PFOS include both linear and branched isomers
Only the linear isomer is reported for all other analytes

NW 7/17/17

ENVIRONMENTAL
Data Services, Inc.

DATA VALIDATION SUMMARY REPORT
NALF FENTRESS, VIRGINIA

Client: CH2M HILL, Inc., Corvallis, Oregon
SDG: 320-26216-1
Laboratory: Test America, Sacramento, California
Site: NALF Fentress, CTO-WE01, Virginia
Date: April 1, 2017

PFCs			
EDS ID	Client Sample ID	Laboratory Sample ID	Matrix
1	OF-SS05-0217	320-26216-1	Soil
1DL	OF-SS05-0217DL	320-26216-1DL	Soil
2	OF-SB05-0203-0217	320-26216-2	Soil
2DL	OF-SB05-0203-0217DL	320-26216-2DL	Soil
3	OF-SS04-0217	320-26216-3	Soil
3MS	OF-SS04-0217MS	320-26216-3MS	Soil
3MSD	OF-SS04-0217MSD	320-26216-3MSD	Soil
4	OF-SB04-0102-0217	320-26216-4	Soil
4DL	OF-SB04-0102-0217DL	320-26216-4DL	Soil
5	OFPOL-SB03-0102-0217	320-26216-5	Soil
5DL	OFPOL-SB03-0102-0217DL	320-26216-5DL	Soil
6	OFPOL-SS03-0217	320-26216-6	Soil
7	OFPOL-SS07-0217	320-26216-7	Soil
8	OFPOL-SB07-0102-0217	320-26216-8	Soil
8DL	OFPOL-SB07-0102-0217DL	320-26216-8DL	Soil
9	OFPOL-SB07P-0102-0217	320-26216-9	Soil
10	OF-SLG01-0217	320-26216-10	Soil
11	OFPOL-SS04-0217	320-26216-11	Soil
11DL	OFPOL-SS04-0217DL	320-26216-11DL	Soil
12	OFPOL-SB04-0203-0217	320-26216-12	Soil
12DL	OFPOL-SB04-0203-0217DL	320-26216-12DL	Soil
13	OF-SS02-0217	320-26216-13	Soil
14	OF-SB02-0203-0217	320-26216-14	Soil
15	OF-SS03-0217	320-26216-15	Soil
15DL	OF-SS03-0217DL	320-26216-15DL	Soil
16	OF-SB03-0203-0217	320-26216-16	Soil
16DL	OF-SB03-0203-0217DL	320-26216-16DL	Soil
17	OF-SS01-0217	320-26216-17	Soil
18	OF-SS01P-0217	320-26216-18	Soil
19	OF-SB01-0405-0217	320-26216-19	Soil
20	OF-EB022817	320-26216-20	Water
21	OF-FB022817	320-26216-21	Water

A full data validation was performed on the analytical data for nineteen soil samples, one aqueous equipment blank sample and one aqueous field blank sample collected on February 28, 2017 by CH2M HILL at the NALF Fentress site in Chesapeake, Virginia. The samples were analyzed under the EPA Method "Determination of Selected Perfluorinated Alkyl Acids in Drinking Water by Solid Phase Extraction and Liquid Chromatography/Tandem Mass Spectrometry (LC/MS/MS)".

Specific method references are as follows:

Analysis	*Method References*
PFCs	USEPA Method 537 Rev 1.1 Modified

The data have been validated according to the protocols and quality control (QC) requirements of the analytical method, and the U.S. Department of Defense (DoD) Quality Systems Manual (QSM), Version 5.0 (July 2013) and the USEPA National Functional Guidelines for Organic Data Review as follows:

- The USEPA "Contract Laboratories Program National Functional Guidelines for Superfund Organic Methods Data Review," August 2014;
- and the reviewer's professional judgment.

The following data quality indicators were reviewed for this report:

Organics

- Date Completeness, Case Narrative & Custody Documentation
- Holding times
- Liquid Chromatography/Mass Spectrometry (LC/MS) Tuning
- Initial and continuing calibration summaries
- Method blank and field QC blank contamination
- Surrogate Spike recoveries
- Matrix Spike/Matrix Spike Duplicate (MS/MSD) recoveries
- Laboratory Control Sample/Laboratory Control Sample Duplicate (LCS/LCSD) recoveries
- Internal standard area and retention time summary forms
- Target Compound Identification
- Compound Quantitation
- Field Duplicate sample precision

A full (Level IV) data validation was performed with this review including a recalculation of 10% of the detected results in the samples.

Data Usability Assessment

There were no rejections of data.

Overall the data is acceptable for the intended purposes as qualified for the deficiencies detailed in this report.

Please note that any results qualified (U) due to blank contamination may be then qualified (J) due to another action. Therefore, the results may be qualified (UJ) due to the culmination of the blank contaminations and actions from other exceedences of QC criteria.

Perfluorinated Compounds (PFCs)

Data Completeness, Case Narrative & Custody Documentation

- The case narrative and chain-of-custody documentation were included in the data package as required. All criteria were met.

Holding Times

- All samples were extracted within 14 days for water and soil samples and analyzed within 28 days.

LC/MS Tuning

- All criteria were met.

Initial Calibration

- All relative standard deviation (%RSD) and/or correlation coefficients criteria were met.

Continuing Calibration

- All percent difference (%D) and RRF criteria were met.

Method Blank

- The method blanks were free of contamination.

Field QC Blank

- The field and equipment blank samples were free of contamination.

Surrogate Spike Recoveries

- All samples exhibited acceptable surrogate %R values.

Matrix Spike/Matrix Spike Duplicate (MS/MSD) Recoveries

- The MS/MSD samples exhibited acceptable %R and RPD values except for the following.

MS/MSD ID	Surrogate	MS %R/MSD %R/RPD	Qualifier
3	PFOS	-82%/59%/OK	None - 4X Rule Applies

Laboratory Control Samples

- The LCS samples exhibited acceptable percent recoveries (%R).

Internal Standard (IS) Area Performance

- All internal standards met response and retention time (RT) criteria.

Target Compound Identification

- All mass spectra and quantitation criteria were met.

Compound Quantitation

- Nine samples exhibited high concentrations of PFOS. The samples were diluted and reanalyzed and the dilution results for PFOS should be used for these samples.
- EDS Sample #10 was analyzed at a 10X dilution due to high concentrations of target compounds. The reporting limits were adjusted according. No action was required.

Field Duplicate Sample Precision

- Field duplicate results are summarized below. The precision was unacceptable for four compounds in samples OFPOL-SB07-0102-0217 and OFPOL-SB07P-0102-0217 and these results have been qualified as estimated (J).

Compound	OFPOL-SB07-0102-0217 ug/kg	OFPOL-SB07P-0102-0217 ug/kg	RPD	Qualifier
PFHxS	2.9	1.7	52%	J
PFHpA	5.3	3.9	30%	None
PFOA	7.9	5.4	38%	J
PFOS	57	32	56%	J
PFNA	9.2	5.7	47%	J

Compound	OF-SS01-0217 ug/kg	OFL-SS01P-0217 ug/kg	RPD	Qualifier
PFHxS	0.92	0.95	3%	None
PFHpA	0.15	0.12	22%	
PFOA	0.51	0.49	4%	
PFOS	13	9.9	27%	
PFNA	0.31	0.26	18%	

Please contact the undersigned at (757) 564-0090 if you have any questions or need further information.

Signed: Nancy Weaver Dated: 4/4/17

Nancy Weaver
Senior Chemist

Data Qualifier	Definition
U	The analyte was analyzed for, but was not detected above the level of the reported sample quantitation limit.
J	The analyte is an estimated quantity. The associated numerical value is the approximate concentration of the analyte in the sample.
NJ	The analysis has been "tentatively identified" or "presumptively" as present and the associated numerical value is the estimated concentration in the samples.
UJ	The analyte was analyzed for but was not detected. The reported quantitation limit is approximate and may be inaccurate or imprecise.
R	The data are unusable. The sample results are rejected due to serious deficiencies in meeting QC criteria. The analyte may or may not be present in the samples.

FORM I
LCMS ORGANICS ANALYSIS DATA SHEET

Lab Name: TestAmerica Sacramento | Job No.: 320-26216-1

SDG No.:

Client Sample ID: OF-SS05-0217 | Lab Sample ID: 320-26216-1

Matrix: Solid | Lab File ID: 2017.03.09B_005.d

Analysis Method: 537 (Modified) | Date Collected: 02/28/2017 08:40

Extraction Method: SHAKE | Date Extracted: 03/04/2017 10:05

Sample wt/vol: 5.01(g) | Date Analyzed: 03/09/2017 16:11

Con. Extract Vol.: 1(mL) | Dilution Factor: 1

Injection Volume: 2(uL) | GC Column: GeminiC18 3x100 ID: 3(mm)

% Moisture: 24.4 | GPC Cleanup:(Y/N) N

Analysis Batch No.: 154221 | Units: ug/Kg

CAS NO.	COMPOUND NAME	RESULT	Q	LOQ	LOD	DL
375-73-5	Perfluorobutanesulfonic acid (PFBS)	1.5	M	0.53	0.40	0.14
355-46-4	Perfluorohexanesulfonic acid (PFHxS)	30	M	0.66	0.40	0.16
375-85-9	Perfluoroheptanoic acid (PFHpA)	15		0.66	0.40	0.12
335-67-1	Perfluorooctanoic acid (PFOA)	7.9	M	0.66	0.40	0.13
1763-23-1	*Perfluorooctanesulfonic acid (PFOS)*	390 ~~310~~	J M	13 ~~0.66~~	7.9 ~~0.40~~	3.3 ~~0.17~~
375-95-1	Perfluorononanoic acid (PFNA)	4.4	M	0.66	0.40	0.11

CAS NO.	ISOTOPE DILUTION	%REC	Q	LIMITS
STL00994	18O2 PFHxS	93		25-150
STL01892	13C4-PFHpA	106		25-150
STL00990	13C4 PFOA	112		25-150
STL00991	13C4 PFOS	51		25-150
STL00995	13C5 PFNA	60		25-150

FORM I
LCMS ORGANICS ANALYSIS DATA SHEET

1DL

Lab Name: TestAmerica Sacramento | Job No.: 320-26216-1

SDG No.:

Client Sample ID: OF-SS05-0217 DL | Lab Sample ID: 320-26216-1 DL

Matrix: Solid | Lab File ID: 2017.03.13A_009.d

Analysis Method: 537 (Modified) | Date Collected: 02/28/2017 08:40

Extraction Method: SHAKE | Date Extracted: 03/04/2017 10:05

Use original results

Sample wt/vol: 5.01(g) | Date Analyzed: 03/13/2017 12:17

Con. Extract Vol.: 1(mL) | Dilution Factor: 20

Injection Volume: 2(uL) | GC Column: GeminiC18 3x100 ID: 3(mm)

% Moisture: 24.4 | GPC Cleanup: (Y/N) N

Analysis Batch No.: 154721 | Units: ug/Kg

CAS NO.	COMPOUND NAME	RESULT	Q	LOQ	LOD	DL
375-73-5	*Perfluorobutanesulfonic acid (PFBS)*	*7.9*	*U M*	*11*	*7.9*	*2.7*
355-46-4	*Perfluorohexanesulfonic acid (PFHxS)*	*34*	*D*	*13*	*7.9*	*3.1*
375-85-9	*Perfluoroheptanoic acid (PFHpA)*	*15*	*D*	*13*	*7.9*	*2.3*
335-67-1	*Perfluorooctanoic acid (PFOA)*	*9.2*	*J D M*	*13*	*7.9*	*2.7*
1763-23-1	Perfluorooctanesulfonic acid (PFOS)	390	D M	13	7.9	3.3
375-95-1	*Perfluorononanoic acid (PFNA)*	*4.7*	*J D*	*13*	*7.9*	*2.2*

CAS NO.	ISOTOPE DILUTION	%REC	Q	LIMITS
STL00994	18O2 PFHxS	86		25-150
STL01892	13C4-PFHpA	99		25-150
STL00990	13C4 PFOA	87		25-150
STL00991	13C4 PFOS	61		25-150
STL00995	13C5 PFNA	76		25-150

FORM I
LCMS ORGANICS ANALYSIS DATA SHEET

2.

Lab Name: TestAmerica Sacramento | Job No.: 320-26216-1

SDG No.:

Client Sample ID: OF-SB05-0203-0217 | Lab Sample ID: 320-26216-2

Matrix: Solid | Lab File ID: 2017.03.09B_006.d

Analysis Method: 537 (Modified) | Date Collected: 02/28/2017 09:05

Extraction Method: SHAKE | Date Extracted: 03/04/2017 10:05

Sample wt/vol: 4.96(g) | Date Analyzed: 03/09/2017 16:19

Con. Extract Vol.: 1(mL) | Dilution Factor: 1

Injection Volume: 2(uL) | GC Column: GeminiC18 3x100 ID: 3(mm)

% Moisture: 18.2 | GPC Cleanup:(Y/N) N

Analysis Batch No.: 154221 | Units: ug/Kg

CAS NO.	COMPOUND NAME	RESULT	Q	LOQ	LOD	DL
375-73-5	Perfluorobutanesulfonic acid (PFBS)	0.75		0.49	0.37	0.13
355-46-4	Perfluorohexanesulfonic acid (PFHxS)	6.5	M	0.62	0.37	0.15
375-85-9	Perfluoroheptanoic acid (PFHpA)	3.2		0.62	0.37	0.11
335-67-1	Perfluorooctanoic acid (PFOA)	1.5	M	0.62	0.37	0.13
1763-23-1	*Perfluorooctanesulfonic acid (PFOS)*	68 ~~64~~ ~~J~~ M		3.1 ~~0.62~~	1.8 ~~0.37~~	0.78 ~~0.16~~
375-95-1	Perfluorononanoic acid (PFNA)	0.73	M	0.62	0.37	0.10

CAS NO.	ISOTOPE DILUTION	%REC	Q	LIMITS
STL00994	18O2 PFHxS	101		25-150
STL01892	13C4-PFHpA	128		25-150
STL00990	13C4 PFOA	123		25-150
STL00991	13C4 PFOS	75		25-150
STL00995	13C5 PFNA	86		25-150

FORM I

LCMS ORGANICS ANALYSIS DATA SHEET

2DL

Lab Name: TestAmerica Sacramento Job No.: 320-26216-1

SDG No.:

Client Sample ID: OF-SB05-0203-0217 DL Lab Sample ID: 320-26216-2 DL

Matrix: Solid Lab File ID: 2017.03.13A_010.d

Analysis Method: 537 (Modified) Date Collected: 02/28/2017 09:05

Extraction Method: SHAKE Date Extracted: 03/04/2017 10:05

Use original results

Sample wt/vol: 4.96(g) Date Analyzed: 03/13/2017 12:24

Con. Extract Vol.: 1(mL) Dilution Factor: 5

Injection Volume: 2(uL) GC Column: GeminiC18 3x100 ID: 3(mm)

% Moisture: 18.2 GPC Cleanup: (Y/N) N

Analysis Batch No.: 154721 Units: ug/Kg

CAS NO.	COMPOUND NAME	RESULT	Q	LOQ	LOD	DL
375-73-5	*Perfluorobutanesulfonic acid (PFBS)*	*0.67*	*J D*	*2.5*	1.8	*0.63*
355-46-4	*Perfluorohexanesulfonic acid (PFHxS)*	*6.2*	*D M*	*3.1*	1.8	*0.73*
375-85-9	*Perfluoroheptanoic acid (PFHpA)*	*3.2*	*D*	*3.1*	1.8	*0.54*
335-67-1	*Perfluorooctanoic acid (PFOA)*	*1.5*	*J D M*	*3.1*	1.8	*0.63*
1763-23-1	Perfluorooctanesulfonic acid (PFOS)	68	D M	3.1	1.8	0.78
375-95-1	*Perfluorononanoic acid (PFNA)*	*0.80*	*J D*	*3.1*	1.8	*0.51*

CAS NO.	ISOTOPE DILUTION	%REC	Q	LIMITS
STL00994	18O2 PFHxS	99		25-150
STL01892	13C4-PFHpA	113		25-150
STL00990	13C4 PFOA	111		25-150
STL00991	13C4 PFOS	73		25-150
STL00995	13C5 PFNA	91		25-150

FORM I
LCMS ORGANICS ANALYSIS DATA SHEET

3

Lab Name: TestAmerica Sacramento | Job No.: 320-26216-1

SDG No.:

Client Sample ID: OF-SS04-0217 | Lab Sample ID: 320-26216-3

Matrix: Solid | Lab File ID: 2017.03.09B_007.d

Analysis Method: 537 (Modified) | Date Collected: 02/28/2017 09:35

Extraction Method: SHAKE | Date Extracted: 03/04/2017 10:05

Sample wt/vol: 5.03(g) | Date Analyzed: 03/09/2017 16:26

Con. Extract Vol.: 1(mL) | Dilution Factor: 1

Injection Volume: 2(uL) | GC Column: GeminiC18 3x100 ID: 3(mm)

% Moisture: 14.9 | GPC Cleanup:(Y/N) N

Analysis Batch No.: 154221 | Units: ug/Kg

CAS NO.	COMPOUND NAME	RESULT	Q	LOQ	LOD	DL
375-73-5	Perfluorobutanesulfonic acid (PFBS)	0.20	J M	0.47	0.35	0.12
355-46-4	Perfluorohexanesulfonic acid (PFHxS)	2.9	M	0.58	0.35	0.14
375-85-9	Perfluoroheptanoic acid (PFHpA)	0.36	J	0.58	0.35	0.10
335-67-1	Perfluorooctanoic acid (PFOA)	0.94	M	0.58	0.35	0.12
1763-23-1	Perfluorooctanesulfonic acid (PFOS)	26	J M	0.58	0.35	0.15
375-95-1	Perfluorononanoic acid (PFNA)	0.82	M	0.58	0.35	0.097

CAS NO.	ISOTOPE DILUTION	%REC	Q	LIMITS
STL00994	18O2 PFHxS	94		25-150
STL01892	13C4-PFHpA	119		25-150
STL00990	13C4 PFOA	94		25-150
STL00991	13C4 PFOS	45		25-150
STL00995	13C5 PFNA	61		25-150

FORM I
LCMS ORGANICS ANALYSIS DATA SHEET

4

Lab Name: TestAmerica Sacramento Job No.: 320-26216-1

SDG No.:

Client Sample ID: OF-SB04-0102-0217 Lab Sample ID: 320-26216-4

Matrix: Solid Lab File ID: 2017.03.09B_010.d

Analysis Method: 537 (Modified) Date Collected: 02/28/2017 09:50

Extraction Method: SHAKE Date Extracted: 03/04/2017 10:05

Sample wt/vol: 4.97(g) Date Analyzed: 03/09/2017 16:49

Con. Extract Vol.: 1(mL) Dilution Factor: 1

Injection Volume: 2(uL) GC Column: GeminiC18 3x100 ID: 3(mm)

% Moisture: 14.6 GPC Cleanup:(Y/N) N

Analysis Batch No.: 154221 Units: ug/Kg

CAS NO.	COMPOUND NAME	RESULT	Q	LOQ	LOD	DL
375-73-5	Perfluorobutanesulfonic acid (PFBS)	0.12	J M	0.47	0.35	0.12
355-46-4	Perfluorohexanesulfonic acid (PFHxS)	2.5	M	0.59	0.35	0.14
375-85-9	Perfluoroheptanoic acid (PFHpA)	1.8		0.59	0.35	0.10
335-67-1	Perfluorooctanoic acid (PFOA)	3.2	M	0.59	0.35	0.12
1763-23-1	*Perfluorooctanesulfonic acid (PFOS)*	63 ~~61~~	J M	2.9 ~~0.59~~	1.8 ~~0.35~~	0.74 ~~0.15~~
375-95-1	Perfluorononanoic acid (PFNA)	1.1	M	0.59	0.35	0.098

CAS NO.	ISOTOPE DILUTION	%REC	Q	LIMITS
STL00994	18O2 PFHxS	106		25-150
STL01892	13C4-PFHpA	133		25-150
STL00990	13C4 PFOA	126		25-150
STL00991	13C4 PFOS	79		25-150
STL00995	13C5 PFNA	103		25-150

4DL

FORM I
LCMS ORGANICS ANALYSIS DATA SHEET

Lab Name: TestAmerica Sacramento | Job No.: 320-26216-1

SDG No.:

Client Sample ID: OF-SB04-0102-0217 DL | Lab Sample ID: 320-26216-4 DL

Matrix: Solid | Lab File ID: 2017.03.13A_011.d

Analysis Method: 537 (Modified) | Date Collected: 02/28/2017 09:50

Extraction Method: SHAKE | Date Extracted: 03/04/2017 10:05

Sample wt/vol: 4.97(g) | Date Analyzed: 03/13/2017 12:32

Con. Extract Vol.: 1(mL) | Dilution Factor: 5

Injection Volume: 2(uL) | GC Column: GeminiC18 3x100 ID: 3(mm)

% Moisture: 14.6 | GPC Cleanup:(Y/N) N

Analysis Batch No.: 154721 | Units: ug/Kg

Use original results

CAS NO.	COMPOUND NAME	RESULT	Q	LOQ	LOD	DL
375-73-5	*Perfluorobutanesulfonic acid (PFBS)*	*1.8*	*U M*	*2.4*	1.8	*0.61*
355-46-4	*Perfluorohexanesulfonic acid (PFHxS)*	*2.4*	*J D*	*2.9*	1.8	*0.70*
375-85-9	*Perfluoroheptanoic acid (PFHpA)*	*1.7*	*J D*	*2.9*	1.8	*0.52*
335-67-1	*Perfluorooctanoic acid (PFOA)*	*3.3*	*D M*	*2.9*	1.8	*0.60*
1763-23-1	Perfluorooctanesulfonic acid (PFOS)	63	D M	2.9	1.8	0.74
375-95-1	*Perfluorononanoic acid (PFNA)*	*1.3*	*J D*	*2.9*	1.8	*0.49*

CAS NO.	ISOTOPE DILUTION	%REC	Q	LIMITS
STL00994	18O2 PFHxS	103		25-150
STL01892	13C4 PFHpA	128		25-150
STL00990	13C4 PFOA	118		25-150
STL00991	13C4 PFOS	81		25-150
STL00995	13C5 PFNA	102		25-150

5

FORM I
LCMS ORGANICS ANALYSIS DATA SHEET

Lab Name: TestAmerica Sacramento | Job No.: 320-26216-1

SDG No.:

Client Sample ID: OFPOL-SB03-0102-0217 | Lab Sample ID: 320-26216-5

Matrix: Solid | Lab File ID: 2017.03.09B_011.d

Analysis Method: 537 (Modified) | Date Collected: 02/28/2017 10:15

Extraction Method: SHAKE | Date Extracted: 03/04/2017 10:05

Sample wt/vol: 5.05(g) | Date Analyzed: 03/09/2017 16:56

Con. Extract Vol.: 1(mL) | Dilution Factor: 1

Injection Volume: 2(uL) | GC Column: GeminiC18 3x100 ID: 3(mm)

% Moisture: 32.4 | GPC Cleanup:(Y/N) N

Analysis Batch No.: 154221 | Units: ug/Kg

CAS NO.	COMPOUND NAME	RESULT	Q	LOQ	LOD	DL
375-73-5	Perfluorobutanesulfonic acid (PFBS)	0.82	~~M~~	0.59	0.44	0.15
355-46-4	Perfluorohexanesulfonic acid (PFHxS)	12	~~M~~	0.73	0.44	0.17
375-85-9	Perfluoroheptanoic acid (PFHpA)	0.90		0.73	0.44	0.13
335-67-1	Perfluorooctanoic acid (PFOA)	7.5	~~M~~	0.73	0.44	0.15
1763-23-1	*Perfluorooctanesulfonic acid (PFOS)*	110 ~~100~~	~~M J~~	3.7 ~~0.73~~	2.2 ~~0.44~~	0.92 ~~0.18~~
375-95-1	Perfluorononanoic acid (PFNA)	0.60	J ~~M~~	0.73	0.44	0.12

CAS NO.	ISOTOPE DILUTION	%REC	Q	LIMITS
STL00994	18O2 PFHxS	103		25-150
STL01892	13C4-PFHpA	107		25-150
STL00990	13C4 PFOA	106		25-150
STL00991	13C4 PFOS	77		25-150
STL00995	13C5 PFNA	86		25-150

SDL

FORM I
LCMS ORGANICS ANALYSIS DATA SHEET

Lab Name: TestAmerica Sacramento | Job No.: 320-26216-1

SDG No.:

Client Sample ID: OFPOL-SB03-0102-0217 DL | Lab Sample ID: 320-26216-5 DL

Matrix: Solid | Lab File ID: 2017.03.13A_012.d

Analysis Method: 537 (Modified) | Date Collected: 02/28/2017 10:15

Extraction Method: SHAKE | Date Extracted: 03/04/2017 10:05

Sample wt/vol: 5.05(g) | Date Analyzed: 03/13/2017 12:39

Con. Extract Vol.: 1(mL) | Dilution Factor: 5

Injection Volume: 2(uL) | GC Column: GeminiC18 3x100 ID: 3(mm)

% Moisture: 32.4 | GPC Cleanup: (Y/N) N

Analysis Batch No.: 154721 | Units: ug/Kg

Use original results

CAS NO.	COMPOUND NAME	RESULT	Q	LOQ	LOD	DL
375-73-5	*Perfluorobutanesulfonic acid (PFBS)*	2.2	U M	2.9	2.2	0.75
355-46-4	*Perfluorohexanesulfonic acid (PFHxS)*	12	D	3.7	2.2	0.86
375-85-9	*Perfluoroheptanoic acid (PFHpA)*	0.87	J D	3.7	2.2	0.64
335-67-1	*Perfluorooctanoic acid (PFOA)*	7.6	D M	3.7	2.2	0.75
1763-23-1	Perfluorooctanesulfonic acid (PFOS)	110	D M	3.7	2.2	0.92
375-95-1	*Perfluorononanoic acid (PFNA)*	0.68	J D M	3.7	2.2	0.61

CAS NO.	ISOTOPE DILUTION	%REC	Q	LIMITS
STL00994	18O2 PFHxS	118		25-150
STL01892	13C4-PFHpA	129		25-150
STL00990	13C4 PFOA	130		25-150
STL00991	13C4 PFOS	100		25-150
STL00995	13C5 PFNA	120		25-150

6

FORM I
LCMS ORGANICS ANALYSIS DATA SHEET

Lab Name: TestAmerica Sacramento | Job No.: 320-26216-1

SDG No.:

Client Sample ID: OFPOL-SS03-0217 | Lab Sample ID: 320-26216-6

Matrix: Solid | Lab File ID: 2017.03.09B_012.d

Analysis Method: 537 (Modified) | Date Collected: 02/28/2017 10:30

Extraction Method: SHAKE | Date Extracted: 03/04/2017 10:05

Sample wt/vol: 4.57(g) | Date Analyzed: 03/09/2017 17:04

Con. Extract Vol.: 1(mL) | Dilution Factor: 1

Injection Volume: 2(uL) | GC Column: GeminiC18 3x100 ID: 3(mm)

% Moisture: 17.3 | GPC Cleanup:(Y/N) N

Analysis Batch No.: 154221 | Units: ug/Kg

CAS NO.	COMPOUND NAME	RESULT	Q	LOQ	LOD	DL
375-73-5	Perfluorobutanesulfonic acid (PFBS)	0.46	J M	0.53	0.40	0.14
355-46-4	Perfluorohexanesulfonic acid (PFHxS)	8.0	M	0.66	0.40	0.16
375-85-9	Perfluoroheptanoic acid (PFHpA)	0.43	J	0.66	0.40	0.12
335-67-1	Perfluorooctanoic acid (PFOA)	4.5	M	0.66	0.40	0.13
1763-23-1	Perfluorooctanesulfonic acid (PFOS)	46	M	0.66	0.40	0.17
375-95-1	Perfluorononanoic acid (PFNA)	0.66	M	0.66	0.40	0.11

CAS NO.	ISOTOPE DILUTION	%REC	Q	LIMITS
STL00994	18O2 PFHxS	92		25-150
STL01892	13C4-PFHpA	80		25-150
STL00990	13C4 PFOA	72		25-150
STL00991	13C4 PFOS	78		25-150
STL00995	13C5 PFNA	65		25-150

FORM I
LCMS ORGANICS ANALYSIS DATA SHEET

Lab Name: TestAmerica Sacramento | Job No.: 320-26216-1

SDG No.:

Client Sample ID: OFPOL-SS07-0217 | Lab Sample ID: 320-26216-7

Matrix: Solid | Lab File ID: 2017.03.09B_014.d

Analysis Method: 537 (Modified) | Date Collected: 02/28/2017 10:45

Extraction Method: SHAKE | Date Extracted: 03/04/2017 10:05

Sample wt/vol: 5.08(g) | Date Analyzed: 03/09/2017 17:19

Con. Extract Vol.: 1(mL) | Dilution Factor: 1

Injection Volume: 2(uL) | GC Column: GeminiC18 3x100 ID: 3(mm)

% Moisture: 22.0 | GPC Cleanup:(Y/N) N

Analysis Batch No.: 154221 | Units: ug/Kg

CAS NO.	COMPOUND NAME	RESULT	Q	LOQ	LOD	DL
375-73-5	Perfluorobutanesulfonic acid (PFBS)	0.21	J M	0.51	0.38	0.13
355-46-4	Perfluorohexanesulfonic acid (PFHxS)	3.0	M	0.63	0.38	0.15
375-85-9	Perfluoroheptanoic acid (PFHpA)	3.7		0.63	0.38	0.11
335-67-1	Perfluorooctanoic acid (PFOA)	10	M	0.63	0.38	0.13
1763-23-1	Perfluorooctanesulfonic acid (PFOS)	39	M	0.63	0.38	0.16
375-95-1	Perfluorononanoic acid (PFNA)	5.0		0.63	0.38	0.10

CAS NO.	ISOTOPE DILUTION	%REC	Q	LIMITS
STL00994	18O2 PFHxS	98		25-150
STL01892	13C4-PFHpA	108		25-150
STL00990	13C4 PFOA	86		25-150
STL00991	13C4 PFOS	43		25-150
STL00995	13C5 PFNA	58		25-150

8

FORM I
LCMS ORGANICS ANALYSIS DATA SHEET

Lab Name: TestAmerica Sacramento | Job No.: 320-26216-1

SDG No.:

Client Sample ID: OFPOL-SB07-0102-0217 | Lab Sample ID: 320-26216-8

Matrix: Solid | Lab File ID: 2017.03.09B_015.d

Analysis Method: 537 (Modified) | Date Collected: 02/28/2017 11:00

Extraction Method: SHAKE | Date Extracted: 03/04/2017 10:05

Sample wt/vol: 4.99(g) | Date Analyzed: 03/09/2017 17:26

Con. Extract Vol.: 1(mL) | Dilution Factor: 1

Injection Volume: 2(uL) | GC Column: GeminiC18 3x100 ID: 3(mm)

% Moisture: 24.8 | GPC Cleanup:(Y/N) N

Analysis Batch No.: 154221 | Units: ug/Kg

CAS NO.	COMPOUND NAME	RESULT	Q	LOQ	LOD	DL	
375-73-5	Perfluorobutanesulfonic acid (PFBS)	0.40	U M	0.53	0.40	0.14	
355-46-4	Perfluorohexanesulfonic acid (PFHxS)	2.9	M J	0.67	0.40	0.16	FD
375-85-9	Perfluoroheptanoic acid (PFHpA)	5.3		0.67	0.40	0.12	
335-67-1	Perfluorooctanoic acid (PFOA)	7.9	M J	0.67	0.40	0.14	FD
1763-23-1	*Perfluorooctanesulfonic acid (PFOS)*	57 ~~54~~	M J	3.3 ~~0.67~~	2.0 ~~0.40~~	0.84 ~~0.17~~	↓
375-95-1	Perfluorononanoic acid (PFNA)	9.2	J	0.67	0.40	0.11	

CAS NO.	ISOTOPE DILUTION	%REC	Q	LIMITS
STL00994	18O2 PFHxS	97		25-150
STL01892	13C4-PFHpA	115		25-150
STL00990	13C4 PFOA	114		25-150
STL00991	13C4 PFOS	73		25-150
STL00995	13C5 PFNA	92		25-150

FORM I

LCMS ORGANICS ANALYSIS DATA SHEET

8DL

Lab Name: TestAmerica Sacramento Job No.: 320-26216-1

SDG No.:

Client Sample ID: OFPOL-SB07-0102-0217 DL Lab Sample ID: 320-26216-8 DL

Matrix: Solid Lab File ID: 2017.03.13A_013.d

Analysis Method: 537 (Modified) Date Collected: 02/28/2017 11:00

Extraction Method: SHAKE Date Extracted: 03/04/2017 10:05

Sample wt/vol: 4.99(g) Date Analyzed: 03/13/2017 12:47

Con. Extract Vol.: 1(mL) Dilution Factor: 5

Injection Volume: 2(uL) GC Column: GeminiC18 3x100 ID: 3(mm)

% Moisture: 24.8 GPC Cleanup:(Y/N) N

Analysis Batch No.: 154721 Units: ug/Kg

USE ORIGINAL results

CAS NO.	COMPOUND NAME	RESULT	Q	LOQ	LOD	DL
375-73-5	*Perfluorobutanesulfonic acid (PFBS)*	2.0	U	2.7	2.0	0.69
355-46-4	*Perfluorohexanesulfonic acid (PFHxS)*	2.9	J ~~B~~	3.3	2.0	0.79
375-85-9	*Perfluoroheptanoic acid (PFHpA)*	5.1	~~B~~	3.3	2.0	0.59
335-67-1	*Perfluorooctanoic acid (PFOA)*	8.1	~~D M~~	3.3	2.0	0.68
1763-23-1	Perfluorooctanesulfonic acid (PFOS)	57	~~D M~~	3.3	2.0	0.84
375-95-1	*Perfluorononanoic acid (PFNA)*	8.9	~~B~~	3.3	2.0	0.55

CAS NO.	ISOTOPE DILUTION	%REC	Q	LIMITS
STL00994	1802 PFHxS	107		25-150
STL01892	13C4-PFHpA	135		25-150
STL00990	13C4 PFOA	134		25-150
STL00991	13C4 PFOS	86		25-150
STL00995	13C5 PFNA	119		25-150

FORM I
LCMS ORGANICS ANALYSIS DATA SHEET

9

Lab Name: TestAmerica Sacramento | Job No.: 320-26216-1

SDG No.:

Client Sample ID: OFPOL-SB07P-0102-0217 | Lab Sample ID: 320-26216-9

Matrix: Solid | Lab File ID: 2017.03.09B_016.d

Analysis Method: 537 (Modified) | Date Collected: 02/28/2017 11:05

Extraction Method: SHAKE | Date Extracted: 03/04/2017 10:05

Sample wt/vol: 5.07(g) | Date Analyzed: 03/09/2017 17:34

Con. Extract Vol.: 1(mL) | Dilution Factor: 1

Injection Volume: 2(uL) | GC Column: GeminiC18 3x100 ID: 3(mm)

% Moisture: 8.9 | GPC Cleanup:(Y/N) N

Analysis Batch No.: 154221 | Units: ug/Kg

CAS NO.	COMPOUND NAME	RESULT	Q	LOQ	LOD	DL	
375-73-5	Perfluorobutanesulfonic acid (PFBS)	0.32	U M	0.43	0.32	0.11	
355-46-4	Perfluorohexanesulfonic acid (PFHxS)	1.7	M J	0.54	0.32	0.13	FD
375-85-9	Perfluoroheptanoic acid (PFHpA)	3.9		0.54	0.32	0.095	
335-67-1	Perfluorooctanoic acid (PFOA)	5.4	M J	0.54	0.32	0.11	FD
1763-23-1	Perfluorooctanesulfonic acid (PFOS)	32	M	0.54	0.32	0.14	
375-95-1	Perfluorononanoic acid (PFNA)	5.7		0.54	0.32	0.090	

CAS NO.	ISOTOPE DILUTION	%REC	Q	LIMITS
STL00994	18O2 PFHxS	102		25-150
STL01892	13C4-PFHpA	136		25-150
STL00990	13C4 PFOA	130		25-150
STL00991	13C4 PFOS	64		25-150
STL00995	13C5 PFNA	108		25-150

FORM I
LCMS ORGANICS ANALYSIS DATA SHEET

10

Lab Name: TestAmerica Sacramento
Job No.: 320-26216-1
SDG No.:
Client Sample ID: OF-SLG01-0217
Lab Sample ID: 320-26216-10
Matrix: Solid
Lab File ID: 2017.03.13A_014.d
Analysis Method: 537 (Modified)
Date Collected: 02/28/2017 12:15
Extraction Method: SHAKE
Date Extracted: 03/04/2017 10:05
Sample wt/vol: 5.02(g)
Date Analyzed: 03/13/2017 12:54
Con. Extract Vol.: 1(mL)
Dilution Factor: 10
Injection Volume: 2(uL)
GC Column: GeminiC18 3x100 ID: 3(mm)
% Moisture: 91.9
GPC Cleanup:(Y/N) N
Analysis Batch No.: 154721
Units: ug/Kg

CAS NO.	COMPOUND NAME	RESULT	Q	LOQ	LOD	DL
375-73-5	Perfluorobutanesulfonic acid (PFBS)	37	U M	49	37	13
355-46-4	Perfluorohexanesulfonic acid (PFHxS)	20	J D M	62	37	15
375-85-9	Perfluoroheptanoic acid (PFHpA)	25	J D	62	37	11
335-67-1	Perfluorooctanoic acid (PFOA)	280	D M	62	37	13
1763-23-1	Perfluorooctanesulfonic acid (PFOS)	700	D M	62	37	16
375-95-1	Perfluorononanoic acid (PFNA)	13	J D	62	37	10

CAS NO.	ISOTOPE DILUTION	%REC	Q	LIMITS
STL00994	18O2 PFHxS	116		25-150
STL01892	13C4-PFHpA	131		25-150
STL00990	13C4 PFOA	125		25-150
STL00991	13C4 PFOS	102		25-150
STL00995	13C5 PFNA	122		25-150

FORM I

LCMS ORGANICS ANALYSIS DATA SHEET

11

Lab Name: TestAmerica Sacramento | Job No.: 320-26216-1

SDG No.:

Client Sample ID: OFPOL-SS04-0217 | Lab Sample ID: 320-26216-11

Matrix: Solid | Lab File ID: 2017.03.09B_018.d

Analysis Method: 537 (Modified) | Date Collected: 02/28/2017 12:40

Extraction Method: SHAKE | Date Extracted: 03/04/2017 10:05

Sample wt/vol: 4.58(g) | Date Analyzed: 03/09/2017 17:49

Con. Extract Vol.: 1(mL) | Dilution Factor: 1

Injection Volume: 2(uL) | GC Column: GeminiC18 3x100 ID: 3(mm)

% Moisture: 35.5 | GPC Cleanup:(Y/N) N

Analysis Batch No.: 154221 | Units: ug/Kg

CAS NO.	COMPOUND NAME	RESULT	Q	LOQ	LOD	DL
375-73-5	Perfluorobutanesulfonic acid (PFBS)	0.44	J M	0.68	0.51	0.17
355-46-4	Perfluorohexanesulfonic acid (PFHxS)	8.7	M	0.85	0.51	0.20
375-85-9	Perfluoroheptanoic acid (PFHpA)	2.3		0.85	0.51	0.15
335-67-1	Perfluorooctanoic acid (PFOA)	9.9	M	0.85	0.51	0.17
1763-23-1	*Perfluorooctanesulfonic acid (PFOS)*	280 ~~220~~	~~M~~ J	8.5 ~~0.85~~	5.1 ~~0.51~~	2.1 ~~0.21~~
375-95-1	Perfluorononanoic acid (PFNA)	9.6	M	0.85	0.51	0.14

CAS NO.	ISOTOPE DILUTION	%REC	Q	LIMITS
STL00994	18O2 PFHxS	110		25-150
STL01892	13C4-PFHpA	129		25-150
STL00990	13C4 PFOA	123		25-150
STL00991	13C4 PFOS	64		25-150
STL00995	13C5 PFNA	76		25-150

FORM I

LCMS ORGANICS ANALYSIS DATA SHEET

11DL

Lab Name: TestAmerica Sacramento | Job No.: 320-26216-1

SDG No.:

Client Sample ID: OFPOL-SS04-0217 DL | Lab Sample ID: 320-26216-11 DL

Matrix: Solid | Lab File ID: 2017.03.13A_015.d

Analysis Method: 537 (Modified) | Date Collected: 02/28/2017 12:40

Extraction Method: SHAKE | Date Extracted: 03/04/2017 10:05

Use original results

Sample wt/vol: 4.58(g) | Date Analyzed: 03/13/2017 13:02

Con. Extract Vol.: 1(mL) | Dilution Factor: 10

Injection Volume: 2(uL) | GC Column: GeminiC18 3x100 ID: 3(mm)

% Moisture: 35.5 | GPC Cleanup: (Y/N) N

Analysis Batch No.: 154721 | Units: ug/Kg

CAS NO.	COMPOUND NAME	RESULT	Q	LOQ	LOD	DL
375-73-5	*Perfluorobutanesulfonic acid (PFBS)*	*5.1*	*U*	*6.8*	5.1	*1.7*
355-46-4	*Perfluorohexanesulfonic acid (PFHxS)*	*8.7*	~~D~~	*8.5*	5.1	*2.0*
375-85-9	*Perfluoroheptanoic acid (PFHpA)*	*2.4*	*J* ~~D~~	*8.5*	5.1	*1.5*
335-67-1	*Perfluorooctanoic acid (PFOA)*	*10*	~~D M~~	*8.5*	5.1	*1.7*
1763-23-1	Perfluorooctanesulfonic acid (PFOS)	280	~~D M~~	8.5	5.1	2.1
375-95-1	*Perfluorononanoic acid (PFNA)*	*10*	~~D~~	*8.5*	5.1	*1.4*

CAS NO.	ISOTOPE DILUTION	%REC	Q	LIMITS
STL00994	18O2 PFHxS	101		25-150
STL01892	13C4 PFHpA	123		25-150
STL00990	13C4 PFOA	112		25-150
STL00991	13C4 PFOS	77		25-150
STL00995	13C5 PFNA	93		25-150

12

FORM I
LCMS ORGANICS ANALYSIS DATA SHEET

Lab Name: TestAmerica Sacramento | Job No.: 320-26216-1

SDG No.:

Client Sample ID: OFPOL-SB04-0203-0217 | Lab Sample ID: 320-26216-12

Matrix: Solid | Lab File ID: 2017.03.09B_019.d

Analysis Method: 537 (Modified) | Date Collected: 02/28/2017 12:50

Extraction Method: SHAKE | Date Extracted: 03/04/2017 10:05

Sample wt/vol: 4.99(g) | Date Analyzed: 03/09/2017 17:56

Con. Extract Vol.: 1(mL) | Dilution Factor: 1

Injection Volume: 2(uL) | GC Column: GeminiC18 3x100 ID: 3(mm)

% Moisture: 12.6 | GPC Cleanup:(Y/N) N

Analysis Batch No.: 154221 | Units: ug/Kg

CAS NO.	COMPOUND NAME	RESULT	Q	LOQ	LOD	DL
375-73-5	Perfluorobutanesulfonic acid (PFBS)	0.34	U M	0.46	0.34	0.12
355-46-4	Perfluorohexanesulfonic acid (PFHxS)	1.2	M	0.57	0.34	0.14
375-85-9	Perfluoroheptanoic acid (PFHpA)	0.71		0.57	0.34	0.10
335-67-1	Perfluorooctanoic acid (PFOA)	1.5	M	0.57	0.34	0.12
1763-23-1	*Perfluorooctanesulfonic acid (PFOS)*	93 ~~87~~	M ~~J~~	2.9 ~~0.57~~	1.7 ~~0.34~~	0.72 ~~0.14~~
375-95-1	Perfluorononanoic acid (PFNA)	3.4		0.57	0.34	0.095

CAS NO.	ISOTOPE DILUTION	%REC	Q	LIMITS
STL00994	18O2 PFHxS	61		25-150
STL01892	13C4-PFHpA	83		25-150
STL00990	13C4 PFOA	81		25-150
STL00991	13C4 PFOS	49		25-150
STL00995	13C5 PFNA	61	M	25-150

FORM I
LCMS ORGANICS ANALYSIS DATA SHEET

1202

Lab Name: TestAmerica Sacramento Job No.: 320-26216-1

SDG No.:

Client Sample ID: OFPOL-SB04-0203-0217 DL Lab Sample ID: 320-26216-12 DL

Matrix: Solid Lab File ID: 2017.03.13A_017.d

Analysis Method: 537 (Modified) Date Collected: 02/28/2017 12:50

Extraction Method: SHAKE Date Extracted: 03/04/2017 10:05

Sample wt/vol: 4.99(g) Date Analyzed: 03/13/2017 13:17

Con. Extract Vol.: 1(mL) Dilution Factor: 5

Injection Volume: 2(uL) GC Column: GeminiC18 3x100 ID: 3(mm)

% Moisture: 12.6 GPC Cleanup: (Y/N) N

Analysis Batch No.: 154721 Units: ug/Kg

use original results

CAS NO.	COMPOUND NAME	RESULT	Q	LOQ	LOD	DL
375-73-5	Perfluorobutanesulfonic acid (PFBS)	1.7	U	2.3	1.7	0.59
355-46-4	Perfluorohexanesulfonic acid (PFHxS)	1.3	J p	2.9	1.7	0.68
375-85-9	Perfluoroheptanoic acid (PFHpA)	0.68	J p	2.9	1.7	0.50
335-67-1	Perfluorooctanoic acid (PFOA)	1.5	J p M	2.9	1.7	0.58
1763-23-1	Perfluorooctanesulfonic acid (PFOS)	93	D M	2.9	1.7	0.72
375-95-1	Perfluorononanoic acid (PFNA)	3.5	p	2.9	1.7	0.48

CAS NO.	ISOTOPE DILUTION	%REC	Q	LIMITS
STL00994	1802 PFHxS	60		25-150
STL01892	13C4-PFHpA	81		25-150
STL00990	13C4 PFOA	78		25-150
STL00991	13C4 PFOS	57		25-150
STL00995	13C5 PFNA	75		25-150

13

FORM I
LCMS ORGANICS ANALYSIS DATA SHEET

Lab Name: TestAmerica Sacramento | Job No.: 320-26216-1

SDG No.:

Client Sample ID: OF-SS02-0217 | Lab Sample ID: 320-26216-13

Matrix: Solid | Lab File ID: 2017.03.13A_018.d

Analysis Method: 537 (Modified) | Date Collected: 02/28/2017 13:05

Extraction Method: SHAKE | Date Extracted: 03/04/2017 10:05

Sample wt/vol: 5.05(g) | Date Analyzed: 03/13/2017 13:24

Con. Extract Vol.: 1(mL) | Dilution Factor: 1

Injection Volume: 2(uL) | GC Column: GeminiC18 3x100 ID: 3(mm)

% Moisture: 35.5 | GPC Cleanup:(Y/N) N

Analysis Batch No.: 154721 | Units: ug/Kg

CAS NO.	COMPOUND NAME	RESULT	Q	LOQ	LOD	DL
375-73-5	Perfluorobutanesulfonic acid (PFBS)	0.46	U M	0.61	0.46	0.16
355-46-4	Perfluorohexanesulfonic acid (PFHxS)	0.91	M	0.77	0.46	0.18
375-85-9	Perfluoroheptanoic acid (PFHpA)	0.44	J	0.77	0.46	0.14
335-67-1	Perfluorooctanoic acid (PFOA)	0.93	M	0.77	0.46	0.16
1763-23-1	Perfluorooctanesulfonic acid (PFOS)	40	M	0.77	0.46	0.19
375-95-1	Perfluorononanoic acid (PFNA)	1.6		0.77	0.46	0.13

CAS NO.	ISOTOPE DILUTION	%REC	Q	LIMITS
STL00994	18O2 PFHxS	123		25-150
STL01892	13C4-PFHpA	140		25-150
STL00990	13C4 PFOA	138		25-150
STL00991	13C4 PFOS	89		25-150
STL00995	13C5 PFNA	117		25-150

FORM I
LCMS ORGANICS ANALYSIS DATA SHEET

14

Lab Name: TestAmerica Sacramento | Job No.: 320-26216-1

SDG No.:

Client Sample ID: OF-SB02-0203-0217 | Lab Sample ID: 320-26216-14

Matrix: Solid | Lab File ID: 2017.03.09B_021.d

Analysis Method: 537 (Modified) | Date Collected: 02/28/2017 13:20

Extraction Method: SHAKE | Date Extracted: 03/04/2017 10:05

Sample wt/vol: 5.02(g) | Date Analyzed: 03/09/2017 18:11

Con. Extract Vol.: 1(mL) | Dilution Factor: 1

Injection Volume: 2(uL) | GC Column: GeminiC18 3x100 ID: 3(mm)

% Moisture: 12.2 | GPC Cleanup:(Y/N) N

Analysis Batch No.: 154221 | Units: ug/Kg

CAS NO.	COMPOUND NAME	RESULT	Q	LOQ	LOD	DL
375-73-5	Perfluorobutanesulfonic acid (PFBS)	0.34	U M	0.45	0.34	0.12
355-46-4	Perfluorohexanesulfonic acid (PFHxS)	0.34	J M	0.57	0.34	0.13
375-85-9	Perfluoroheptanoic acid (PFHpA)	0.31	J	0.57	0.34	0.10
335-67-1	Perfluorooctanoic acid (PFOA)	0.77	M	0.57	0.34	0.12
1763-23-1	Perfluorooctanesulfonic acid (PFOS)	30	M	0.57	0.34	0.14
375-95-1	Perfluorononanoic acid (PFNA)	1.0		0.57	0.34	0.094

CAS NO.	ISOTOPE DILUTION	%REC	Q	LIMITS
STL00994	18O2 PFHxS	103		25-150
STL01892	13C4-PFHpA	140		25-150
STL00990	13C4 PFOA	126		25-150
STL00991	13C4 PFOS	79		25-150
STL00995	13C5 PFNA	105		25-150

15

FORM I
LCMS ORGANICS ANALYSIS DATA SHEET

Lab Name: TestAmerica Sacramento | Job No.: 320-26216-1

SDG No.:

Client Sample ID: OF-SS03-0217 | Lab Sample ID: 320-26216-15

Matrix: Solid | Lab File ID: 2017.03.09B_022.d

Analysis Method: 537 (Modified) | Date Collected: 02/28/2017 13:35

Extraction Method: SHAKE | Date Extracted: 03/04/2017 10:05

Sample wt/vol: 5.02(g) | Date Analyzed: 03/09/2017 18:19

Con. Extract Vol.: 1(mL) | Dilution Factor: 1

Injection Volume: 2(uL) | GC Column: GeminiC18 3x100 ID: 3(mm)

% Moisture: 25.1 | GPC Cleanup:(Y/N) N

Analysis Batch No.: 154221 | Units: ug/Kg

CAS NO.	COMPOUND NAME	RESULT	Q	LOQ	LOD	DL
375-73-5	Perfluorobutanesulfonic acid (PFBS)	0.40	U M	0.53	0.40	0.14
355-46-4	Perfluorohexanesulfonic acid (PFHxS)	3.2	M	0.66	0.40	0.16
375-85-9	Perfluoroheptanoic acid (PFHpA)	0.55	J	0.66	0.40	0.12
335-67-1	Perfluorooctanoic acid (PFOA)	2.9	M	0.66	0.40	0.14
1763-23-1	*Perfluorooctanesulfonic acid (PFOS)*	240 ~~200~~	~~M J~~	6.6 ~~0.66~~	4.0 ~~0.40~~	1.7 ~~0.17~~
375-95-1	Perfluorononanoic acid (PFNA)	0.88	M	0.66	0.40	0.11

CAS NO.	ISOTOPE DILUTION	%REC	Q	LIMITS
STL00994	18O2 PFHxS	105		25-150
STL01892	13C4-PFHpA	143		25-150
STL00990	13C4 PFOA	137		25-150
STL00991	13C4 PFOS	45		25-150
STL00995	13C5 PFNA	76		25-150

15DL

FORM I
LCMS ORGANICS ANALYSIS DATA SHEET

Lab Name: TestAmerica Sacramento | Job No.: 320-26216-1

SDG No.:

Client Sample ID: OF-SS03-0217 DL | Lab Sample ID: 320-26216-15 DL

Matrix: Solid | Lab File ID: 2017.03.13A_019.d

Analysis Method: 537 (Modified) | Date Collected: 02/28/2017 13:35

Extraction Method: SHAKE | Date Extracted: 03/04/2017 10:05

Sample wt/vol: 5.02(g) | Date Analyzed: 03/13/2017 13:32

Use original results

Con. Extract Vol.: 1(mL) | Dilution Factor: 10

Injection Volume: 2(uL) | GC Column: GeminiC18 3x100 ID: 3(mm)

% Moisture: 25.1 | GPC Cleanup:(Y/N) N

Analysis Batch No.: 154721 | Units: ug/Kg

CAS NO.	COMPOUND NAME	RESULT	Q	LOQ	LOD	DL
375-73-5	*Perfluorobutanesulfonic acid (PFBS)*	*4.0*	*U M*	*5.3*	*4.0*	*1.4*
355-46-4	*Perfluorohexanesulfonic acid (PFHxS)*	*3.2*	*J D*	*6.6*	*4.0*	*1.6*
375-85-9	*Perfluoroheptanoic acid (PFHpA)*	*4.0*	*U*	*6.6*	*4.0*	*1.2*
335-67-1	*Perfluorooctanoic acid (PFOA)*	*3.0*	*J D M*	*6.6*	*4.0*	*1.4*
1763-23-1	Perfluorooctanesulfonic acid (PFOS)	240	D	6.6	4.0	1.7
375-95-1	*Perfluorononanoic acid (PFNA)*	*4.0*	*U*	*6.6*	*4.0*	*1.1*

CAS NO.	ISOTOPE DILUTION	%REC	Q	LIMITS
STL00994	18O2 PFHxS	89		25-150
STL01892	13C4-PFHpA	122		25-150
STL00990	13C4 PFOA	109		25-150
STL00991	13C4 PFOS	49		25-150
STL00995	13C5 PFNA	84		25-150

FORM I
LCMS ORGANICS ANALYSIS DATA SHEET

16

Lab Name: TestAmerica Sacramento | Job No.: 320-26216-1

SDG No.:

Client Sample ID: OF-SB03-0203-0217 | Lab Sample ID: 320-26216-16

Matrix: Solid | Lab File ID: 2017.03.09B_023.d

Analysis Method: 537 (Modified) | Date Collected: 02/28/2017 13:45

Extraction Method: SHAKE | Date Extracted: 03/04/2017 10:05

Sample wt/vol: 5.07(g) | Date Analyzed: 03/09/2017 18:26

Con. Extract Vol.: 1(mL) | Dilution Factor: 1

Injection Volume: 2(uL) | GC Column: GeminiC18 3x100 ID: 3(mm)

% Moisture: 16.4 | GPC Cleanup:(Y/N) N

Analysis Batch No.: 154221 | Units: ug/Kg

CAS NO.	COMPOUND NAME	RESULT	Q	LOQ	LOD	DL
375-73-5	Perfluorobutanesulfonic acid (PFBS)	0.26	J M	0.47	0.35	0.12
355-46-4	Perfluorohexanesulfonic acid (PFHxS)	4.3	M	0.59	0.35	0.14
375-85-9	Perfluoroheptanoic acid (PFHpA)	0.29	J M	0.59	0.35	0.10
335-67-1	Perfluorooctanoic acid (PFOA)	1.7	M	0.59	0.35	0.12
1763-23-1	*Perfluorooctanesulfonic acid (PFOS)*	240 ~~210~~	M ~~J~~	5.9 ~~0.59~~	3.5 ~~0.35~~	1.5 ~~0.15~~
375-95-1	Perfluorononanoic acid (PFNA)	1.6	M	0.59	0.35	0.098

CAS NO.	ISOTOPE DILUTION	%REC	Q	LIMITS
STL00994	1802 PFHxS	96		25-150
STL01892	13C4-PFHpA	130		25-150
STL00990	13C4 PFOA	118		25-150
STL00991	13C4 PFOS	45		25-150
STL00995	13C5 PFNA	59		25-150

16DL

FORM I
LCMS ORGANICS ANALYSIS DATA SHEET

Lab Name: TestAmerica Sacramento | Job No.: 320-26216-1

SDG No.:

Client Sample ID: OF-SB03-0203-0217 DL | Lab Sample ID: 320-26216-16 DL

Matrix: Solid | Lab File ID: 2017.03.13A_020.d

Analysis Method: 537 (Modified) | Date Collected: 02/28/2017 13:45

Extraction Method: SHAKE | Date Extracted: 03/04/2017 10:05

Sample wt/vol: 5.07(g) | Date Analyzed: 03/13/2017 13:39

Use original results

Con. Extract Vol.: 1(mL) | Dilution Factor: 10

Injection Volume: 2(uL) | GC Column: GeminiC18 3x100 ID: 3(mm)

% Moisture: 16.4 | GPC Cleanup: (Y/N) N

Analysis Batch No.: 154721 | Units: ug/Kg

CAS NO.	COMPOUND NAME	RESULT	Q	LOQ	LOD	DL
375-73-5	Perfluorobutanesulfonic acid (PFBS)	3.5	U	4.7	3.5	1.2
355-46-4	Perfluorohexanesulfonic acid (PFHxS)	4.3	J D	5.9	3.5	1.4
375-85-9	Perfluoroheptanoic acid (PFHpA)	3.5	U	5.9	3.5	1.0
335-67-1	Perfluorooctanoic acid (PFOA)	1.8	J D M	5.9	3.5	1.2
1763-23-1	Perfluorooctanesulfonic acid (PFOS)	240	D	5.9	3.5	1.5
375-95-1	Perfluorononanoic acid (PFNA)	1.8	J D	5.9	3.5	0.98

CAS NO.	ISOTOPE DILUTION	%REC	Q	LIMITS
STL00994	1802 PFHxS	88		25-150
STL01892	13C4-PFHpA	108		25-150
STL00990	13C4 PFOA	96		25-150
STL00991	13C4 PFOS	47		25-150
STL00995	13C5 PFNA	71		25-150

FORM I
LCMS ORGANICS ANALYSIS DATA SHEET

17

Lab Name: TestAmerica Sacramento | Job No.: 320-26216-1

SDG No.:

Client Sample ID: OF-SS01-0217 | Lab Sample ID: 320-26216-17

Matrix: Solid | Lab File ID: 2017.03.09B_025.d

Analysis Method: 537 (Modified) | Date Collected: 02/28/2017 14:10

Extraction Method: SHAKE | Date Extracted: 03/04/2017 10:05

Sample wt/vol: 5.03(g) | Date Analyzed: 03/09/2017 18:41

Con. Extract Vol.: 1(mL) | Dilution Factor: 1

Injection Volume: 2(uL) | GC Column: GeminiC18 3x100 ID: 3(mm)

% Moisture: 24.5 | GPC Cleanup:(Y/N) N

Analysis Batch No.: 154221 | Units: ug/Kg

CAS NO.	COMPOUND NAME	RESULT	Q	LOQ	LOD	DL
375-73-5	Perfluorobutanesulfonic acid (PFBS)	0.39	U M	0.53	0.39	0.14
355-46-4	Perfluorohexanesulfonic acid (PFHxS)	0.92	M	0.66	0.39	0.16
375-85-9	Perfluoroheptanoic acid (PFHpA)	0.15	J M	0.66	0.39	0.12
335-67-1	Perfluorooctanoic acid (PFOA)	0.51	J M	0.66	0.39	0.13
1763-23-1	Perfluorooctanesulfonic acid (PFOS)	13	M	0.66	0.39	0.17
375-95-1	Perfluorononanoic acid (PFNA)	0.31	J M	0.66	0.39	0.11

CAS NO.	ISOTOPE DILUTION	%REC	Q	LIMITS
STL00994	18O2 PFHxS	110		25-150
STL01892	13C4-PFHpA	122		25-150
STL00990	13C4 PFOA	122		25-150
STL00991	13C4 PFOS	80		25-150
STL00995	13C5 PFNA	105		25-150

FORM I
LCMS ORGANICS ANALYSIS DATA SHEET

18

Lab Name: TestAmerica Sacramento | Job No.: 320-26216-1

SDG No.:

Client Sample ID: OF-SS01P-0217 | Lab Sample ID: 320-26216-18

Matrix: Solid | Lab File ID: 2017.03.09B_026.d

Analysis Method: 537 (Modified) | Date Collected: 02/28/2017 14:15

Extraction Method: SHAKE | Date Extracted: 03/04/2017 10:05

Sample wt/vol: 5.06(g) | Date Analyzed: 03/09/2017 18:49

Con. Extract Vol.: 1(mL) | Dilution Factor: 1

Injection Volume: 2(uL) | GC Column: GeminiC18 3x100 ID: 3(mm)

% Moisture: 15.2 | GPC Cleanup:(Y/N) N

Analysis Batch No.: 154221 | Units: ug/Kg

CAS NO.	COMPOUND NAME	RESULT	Q	LOQ	LOD	DL
375-73-5	Perfluorobutanesulfonic acid (PFBS)	0.35	U M	0.47	0.35	0.12
355-46-4	Perfluorohexanesulfonic acid (PFHxS)	0.95	M	0.58	0.35	0.14
375-85-9	Perfluoroheptanoic acid (PFHpA)	0.12	J	0.58	0.35	0.10
335-67-1	Perfluorooctanoic acid (PFOA)	0.49	J M	0.58	0.35	0.12
1763-23-1	Perfluorooctanesulfonic acid (PFOS)	9.9	M	0.58	0.35	0.15
375-95-1	Perfluorononanoic acid (PFNA)	0.26	J	0.58	0.35	0.097

CAS NO.	ISOTOPE DILUTION	%REC	Q	LIMITS
STL00994	18O2 PFHxS	91		25-150
STL01892	13C4-PFHpA	121		25-150
STL00990	13C4 PFOA	90		25-150
STL00991	13C4 PFOS	41		25-150
STL00995	13C5 PFNA	58		25-150

FORM I
LCMS ORGANICS ANALYSIS DATA SHEET

19

Lab Name: TestAmerica Sacramento | Job No.: 320-26216-1

SDG No.:

Client Sample ID: OF-SB01-0405-0217 | Lab Sample ID: 320-26216-19

Matrix: Solid | Lab File ID: 2017.03.09B_027.d

Analysis Method: 537 (Modified) | Date Collected: 02/28/2017 14:20

Extraction Method: SHAKE | Date Extracted: 03/04/2017 10:05

Sample wt/vol: 5.01(g) | Date Analyzed: 03/09/2017 18:56

Con. Extract Vol.: 1(mL) | Dilution Factor: 1

Injection Volume: 2(uL) | GC Column: GeminiC18 3x100 ID: 3(mm)

% Moisture: 23.0 | GPC Cleanup:(Y/N) N

Analysis Batch No.: 154221 | Units: ug/Kg

CAS NO.	COMPOUND NAME	RESULT	Q	LOQ	LOD	DL
375-73-5	Perfluorobutanesulfonic acid (PFBS)	0.39	U	0.52	0.39	0.13
355-46-4	Perfluorohexanesulfonic acid (PFHxS)	0.24	J M	0.65	0.39	0.15
375-85-9	Perfluoroheptanoic acid (PFHpA)	0.39	U	0.65	0.39	0.11
335-67-1	Perfluorooctanoic acid (PFOA)	0.39	U M	0.65	0.39	0.13
1763-23-1	Perfluorooctanesulfonic acid (PFOS)	0.25	J M	0.65	0.39	0.16
375-95-1	Perfluorononanoic acid (PFNA)	0.39	U	0.65	0.39	0.11

CAS NO.	ISOTOPE DILUTION	%REC	Q	LIMITS
STL00994	18O2 PFHxS	95		25-150
STL01892	13C4-PFHpA	134		25-150
STL00990	13C4 PFOA	105		25-150
STL00991	13C4 PFOS	39		25-150
STL00995	13C5 PFNA	63		25-150

FORM I
LCMS ORGANICS ANALYSIS DATA SHEET

Lab Name: TestAmerica Sacramento
Job No.: 320-26216-1
SDG No.:
Client Sample ID: OF-EB022817
Lab Sample ID: 320-26216-20
Matrix: Water
Lab File ID: 2017.03.07_537C_020.d
Analysis Method: 537
Date Collected: 02/28/2017 15:15
Extraction Method: 537
Date Extracted: 03/04/2017 12:07
Sample wt/vol: 279.5(mL)
Date Analyzed: 03/07/2017 18:52
Con. Extract Vol.: 1.00(mL)
Dilution Factor: 1
Injection Volume: 2(uL)
GC Column: GeminiC18 3x100 ID: 3(mm)
% Moisture:
GPC Cleanup:(Y/N) N
Analysis Batch No.: 153777
Units: ug/L

CAS NO.	COMPOUND NAME	RESULT	Q	LOQ	LOD	DL
375-85-9	Perfluoroheptanoic acid (PFHpA)	0.011	U	0.013	0.011	0.0041
335-67-1	Perfluorooctanoic acid (PFOA)	0.021	U	0.027	0.021	0.0084
375-95-1	Perfluorononanoic acid (PFNA)	0.021	U	0.027	0.021	0.010
375-73-5	Perfluorobutanesulfonic acid (PFBS)	0.098	U	0.13	0.098	0.043
355-46-4	Perfluorohexanesulfonic acid (PFHxS)	0.032	U	0.040	0.032	0.011
1763-23-1	Perfluorooctanesulfonic acid (PFOS)	0.043	U	0.054	0.043	0.014

FORM I
LCMS ORGANICS ANALYSIS DATA SHEET

Lab Name: TestAmerica Sacramento | Job No.: 320-26216-1

SDG No.:

Client Sample ID: OF-FB022817 | Lab Sample ID: 320-26216-21

Matrix: Water | Lab File ID: 2017.03.07_537C_021.d

Analysis Method: 537 | Date Collected: 02/28/2017 15:20

Extraction Method: 537 | Date Extracted: 03/04/2017 12:07

Sample wt/vol: 272.6(mL) | Date Analyzed: 03/07/2017 18:56

Con. Extract Vol.: 1.00(mL) | Dilution Factor: 1

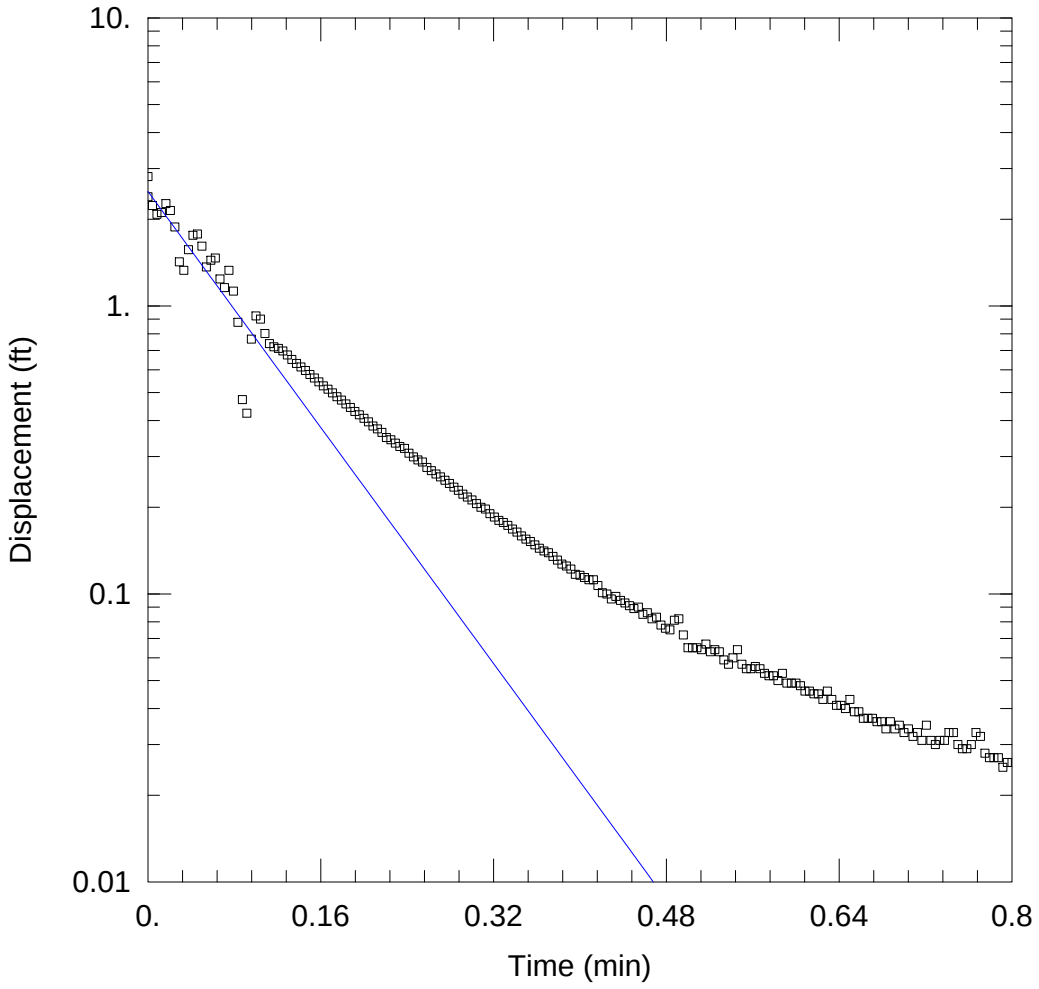
Injection Volume: 2(uL) | GC Column: GeminiC18 3x100 ID: 3(mm)

% Moisture: | GPC Cleanup:(Y/N) N

Analysis Batch No.: 153777 | Units: ug/L

CAS NO.	COMPOUND NAME	RESULT	Q	LOQ	LOD	DL
375-85-9	Perfluoroheptanoic acid (PFHpA)	0.011	U	0.014	0.011	0.0042
335-67-1	Perfluorooctanoic acid (PFOA)	0.022	U	0.028	0.022	0.0086
375-95-1	Perfluorononanoic acid (PFNA)	0.022	U	0.028	0.022	0.010
375-73-5	Perfluorobutanesulfonic acid (PFBS)	0.10	U	0.13	0.10	0.044
355-46-4	Perfluorohexanesulfonic acid (PFHxS)	0.033	U	0.041	0.033	0.011
1763-23-1	Perfluorooctanesulfonic acid (PFOS)	0.044	U	0.055	0.044	0.014

Appendix G
Slug Test Results



WELL TEST ANALYSIS

Data Set: C:\...\MW09 SLUG IN 1_2017_09-15_19-07.aqt
Date: 09/19/18 Time: 11:00:33

PROJECT INFORMATION

Company: CH2M
Client: NAVY CLEAN
Location: FENTRESS
Test Well: OF-MW09
Test Date: 9-15-17

AQUIFER DATA

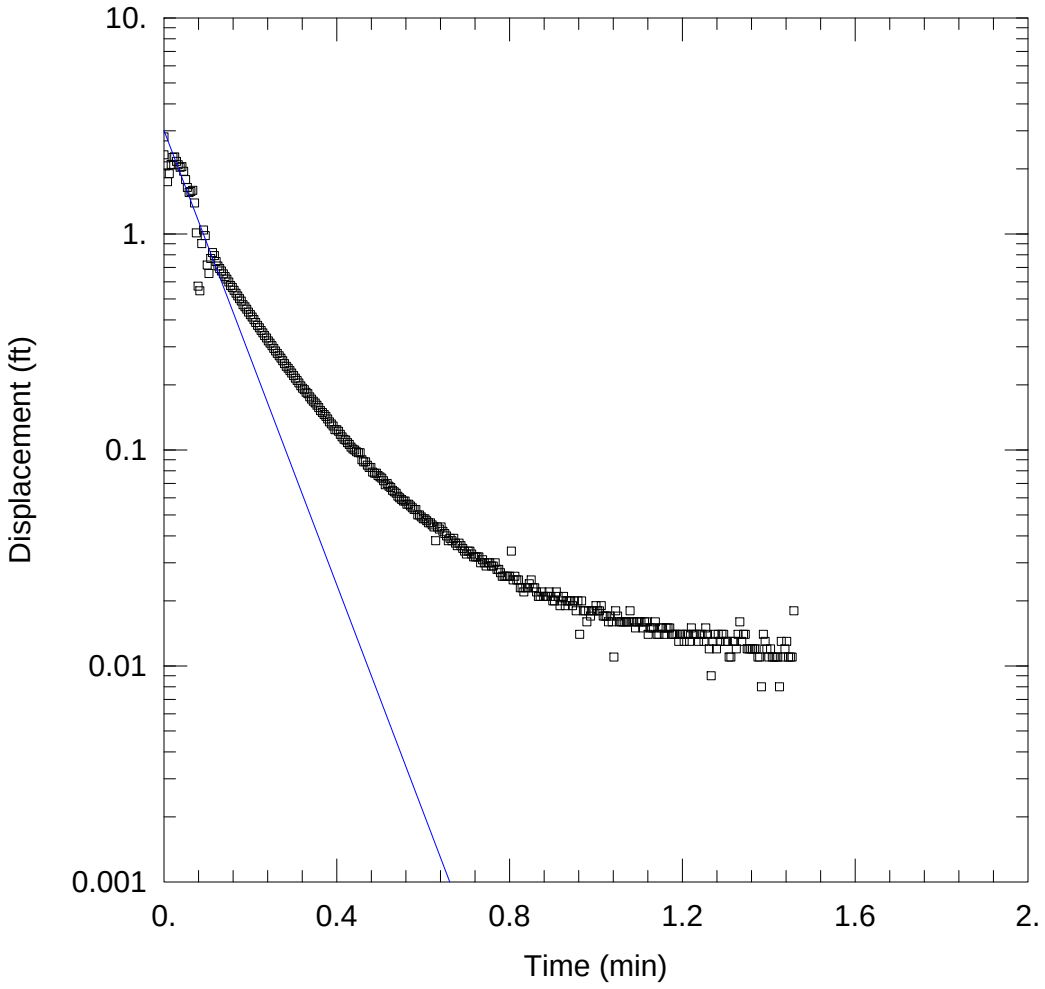
Saturated Thickness: 18.84 ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (New Well)

Initial Displacement: 2.813 ft
Total Well Penetration Depth: 18.84 ft
Casing Radius: 0.083 ft
Static Water Column Height: 18.84 ft
Screen Length: 10. ft
Well Radius: 0.083 ft

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice
K = 0.007215 ft/min
y0 = 2.497 ft



WELL TEST ANALYSIS

Data Set: C:\...\MW09 SLUG IN 2_2017-09-15_19-06-22-010.aqt
Date: 09/19/18 Time: 10:59:30

PROJECT INFORMATION

Company: CH2M
Client: NAVY CLEAN
Location: FENTRESS
Test Well: OF-MW09
Test Date: 9-15-17

AQUIFER DATA

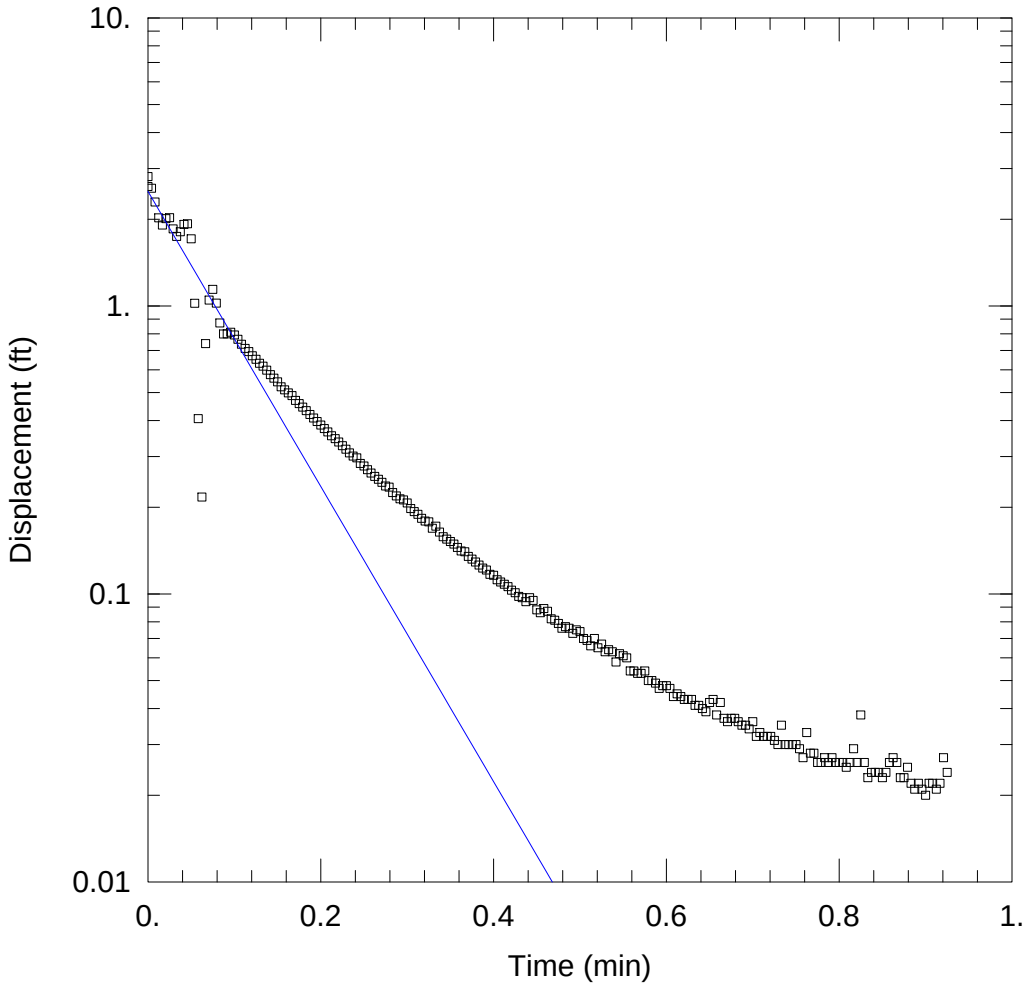
Saturated Thickness: 18.84 ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (New Well)

Initial Displacement: 2.813 ft
Total Well Penetration Depth: 18.84 ft
Casing Radius: 0.083 ft
Static Water Column Height: 18.84 ft
Screen Length: 10. ft
Well Radius: 0.083 ft

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice
K = 0.007407 ft/min
y0 = 3.014 ft



WELL TEST ANALYSIS

Data Set: C:\...\MW09 SLUG IN 3_2017-09-15_19-05-32-567.aqt
Date: 09/19/18 Time: 11:01:49

PROJECT INFORMATION

Company: CH2M
Client: NAVY CLEAN
Location: FENTRESS
Test Well: OF-MW09
Test Date: 9-15-17

AQUIFER DATA

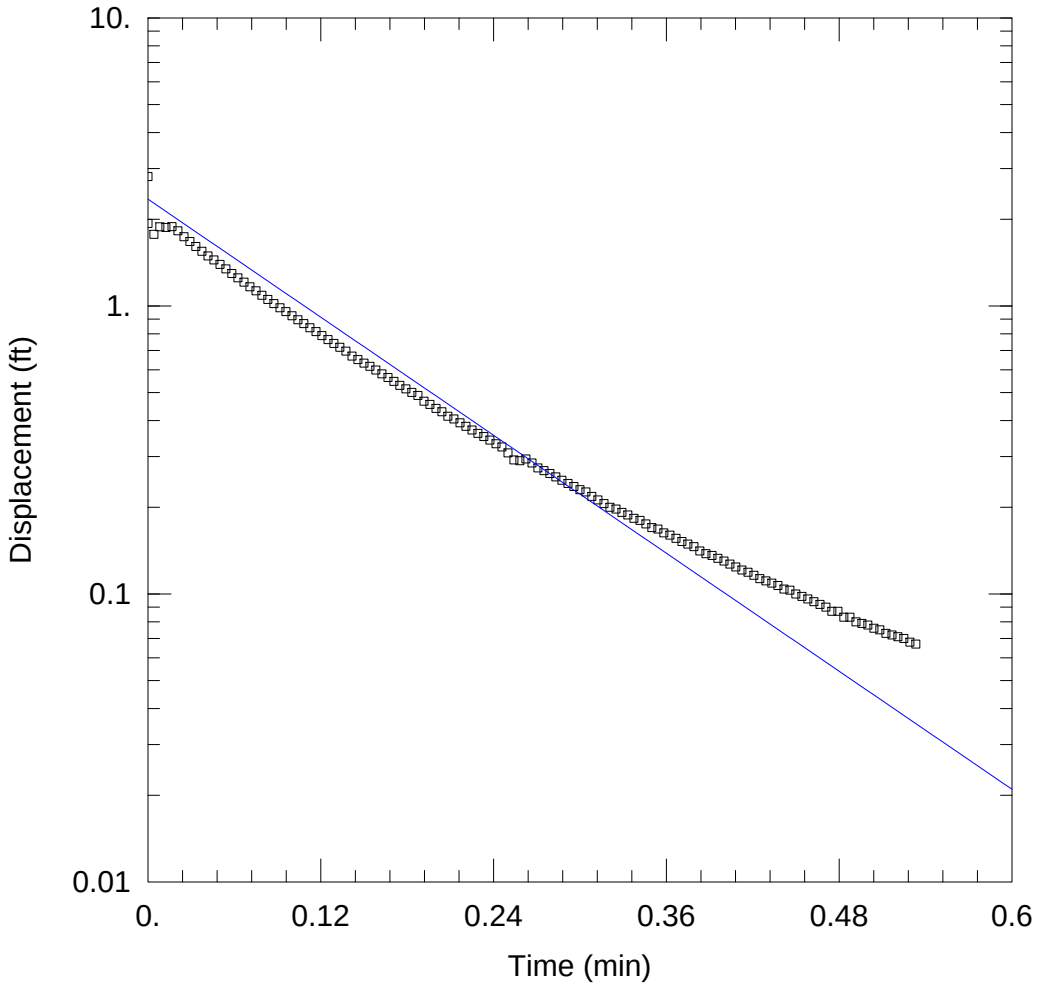
Saturated Thickness: 18.84 ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (New Well)

Initial Displacement: 2.813 ft
Total Well Penetration Depth: 18.84 ft
Casing Radius: 0.083 ft
Static Water Column Height: 18.84 ft
Screen Length: 10. ft
Well Radius: 0.083 ft

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice
K = 0.007215 ft/min
y0 = 2.497 ft



WELL TEST ANALYSIS

Data Set: C:\...\MW09 SLUG OUT 1_2017-09-15_19-06-48-756.aqt
Date: 09/19/18 Time: 11:03:21

PROJECT INFORMATION

Company: CH2M
Client: NAVY CLEAN
Location: FENTRESS
Test Well: OF-MW09
Test Date: 9-15-17

AQUIFER DATA

Saturated Thickness: 18.86 ft Anisotropy Ratio (Kz/Kr): 1.

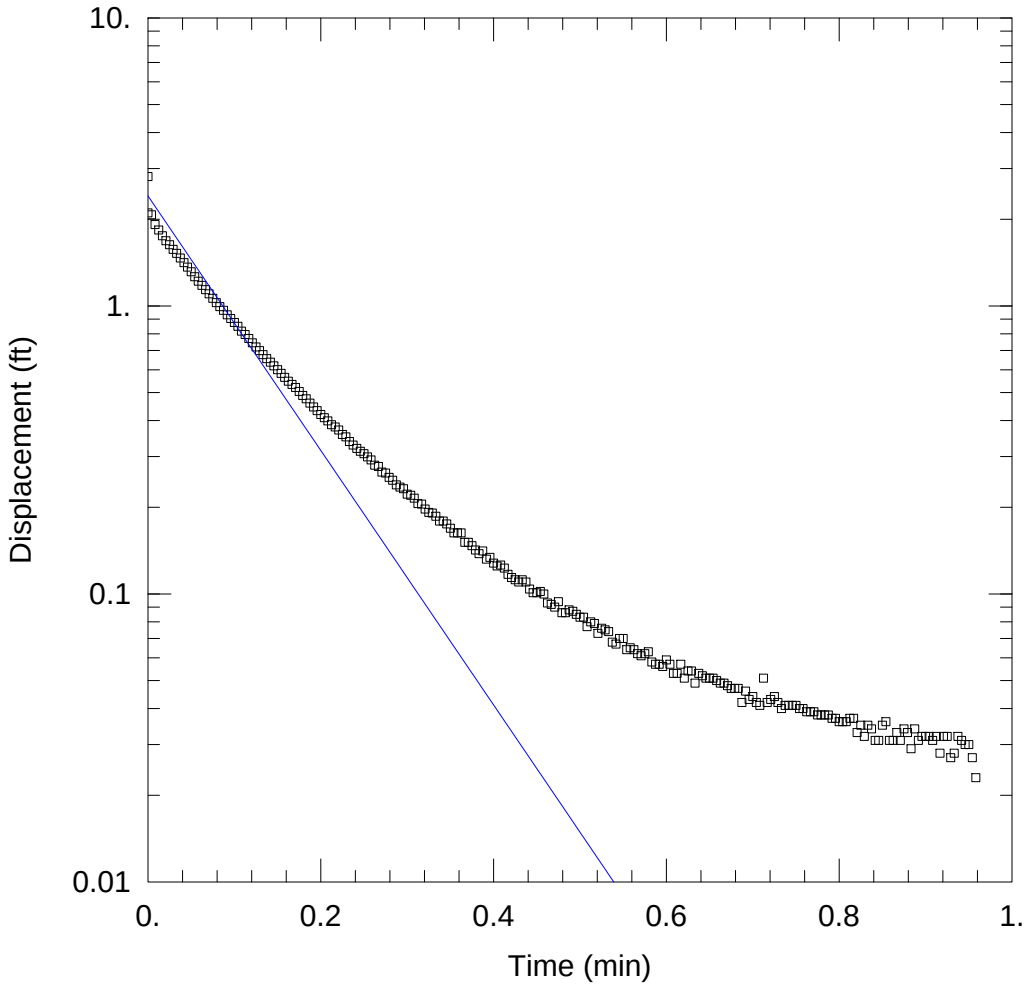
WELL DATA (New Well)

Initial Displacement: 2.813 ft
Total Well Penetration Depth: 18.86 ft
Casing Radius: 0.083 ft
Static Water Column Height: 18.86 ft
Screen Length: 10. ft
Well Radius: 0.083 ft

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 0.00481 ft/min y0 = 2.347 ft



WELL TEST ANALYSIS

Data Set: C:\...\MW09 SLUG OUT 2_2017-09-15_19-06-02-006.aqt
Date: 09/19/18 Time: 11:04:09

PROJECT INFORMATION

Company: CH2M
Client: NAVY CLEAN
Location: FENTRESS
Test Well: OF-MW09
Test Date: 9-15-17

AQUIFER DATA

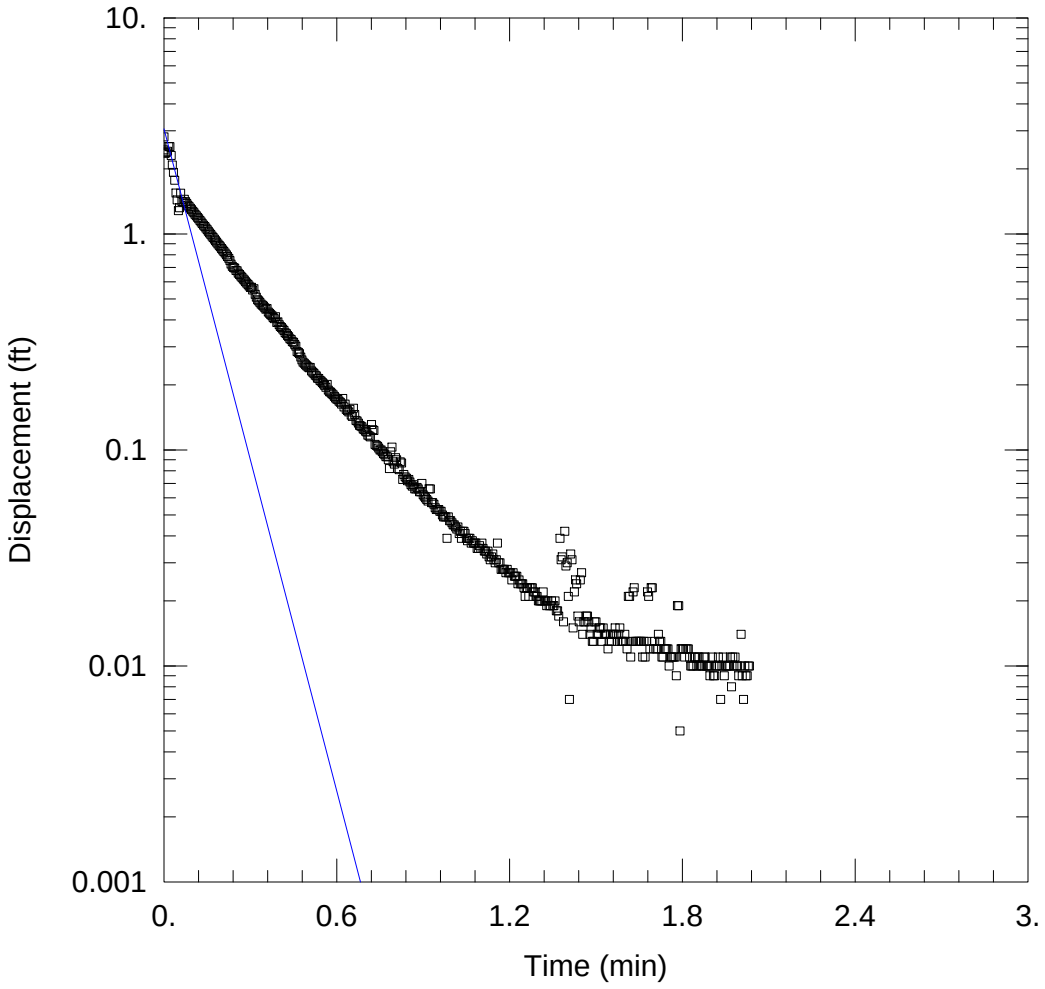
Saturated Thickness: 18.86 ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (New Well)

Initial Displacement: 2.813 ft
Total Well Penetration Depth: 18.86 ft
Casing Radius: 0.083 ft
Static Water Column Height: 18.86 ft
Screen Length: 10. ft
Well Radius: 0.083 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 0.006223 ft/min
y0 = 2.409 ft



WELL TEST ANALYSIS

Data Set: C:\...\MW09D SLUG IN 1_2017-09-15_19-09-16-180.aqt
Date: 09/19/18 Time: 11:05:06

PROJECT INFORMATION

Company: CH2M
Client: NAVY CLEAN
Location: FENTRESS
Test Well: OF-MW09D
Test Date: 9-15-17

AQUIFER DATA

Saturated Thickness: 36.45 ft Anisotropy Ratio (Kz/Kr): 1.

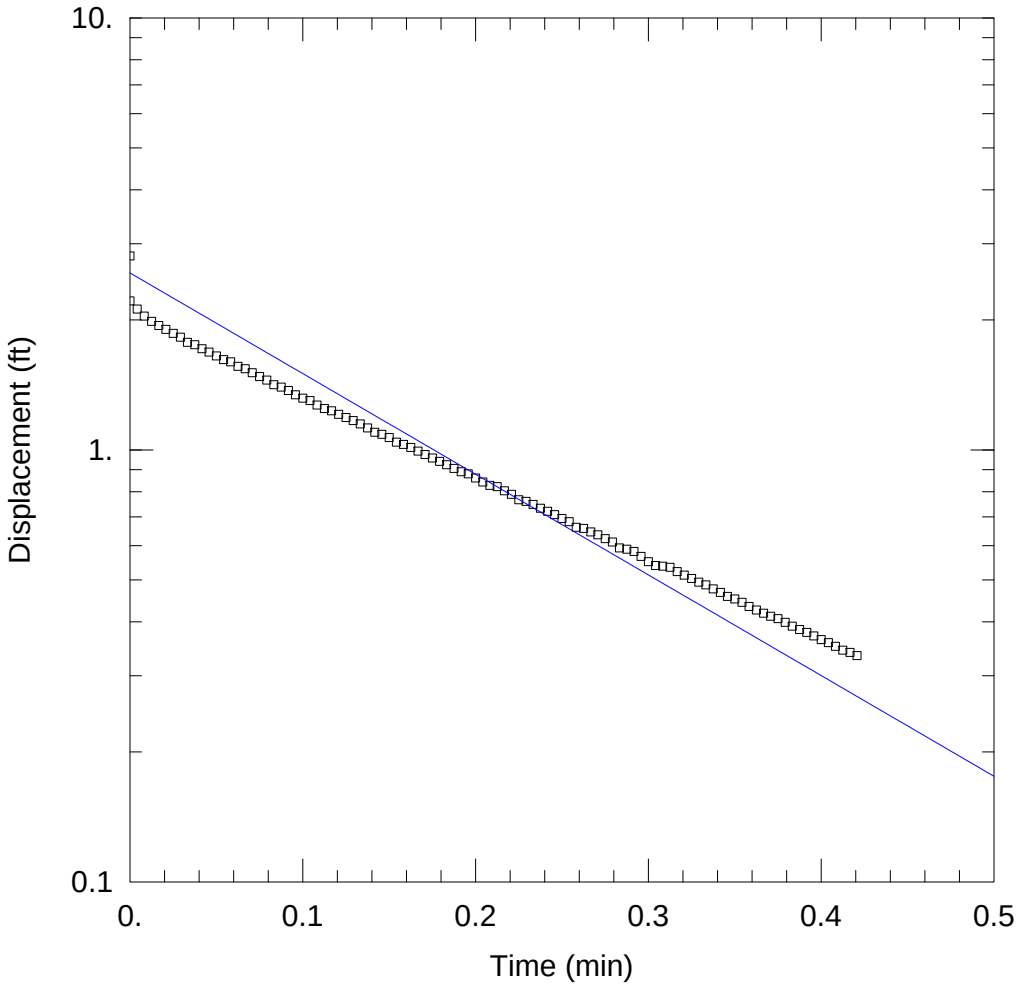
WELL DATA (New Well)

Initial Displacement: 2.813 ft
Total Well Penetration Depth: 36.45 ft
Casing Radius: 0.083 ft
Static Water Column Height: 36.45 ft
Screen Length: 10. ft
Well Radius: 0.083 ft

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice

K = 0.007911 ft/min
y0 = 3.066 ft



WELL TEST ANALYSIS

Data Set: C:\...\MW09D SLUG OUT 1_2017-09-15_19-08-51-825.aqt
Date: 09/19/18 Time: 11:09:10

PROJECT INFORMATION

Company: CH2M
Client: NAVY CLEAN
Location: FENTRESS
Test Well: OF-MW09D
Test Date: 9-15-17

AQUIFER DATA

Saturated Thickness: 36.47 ft Anisotropy Ratio (Kz/Kr): 1.

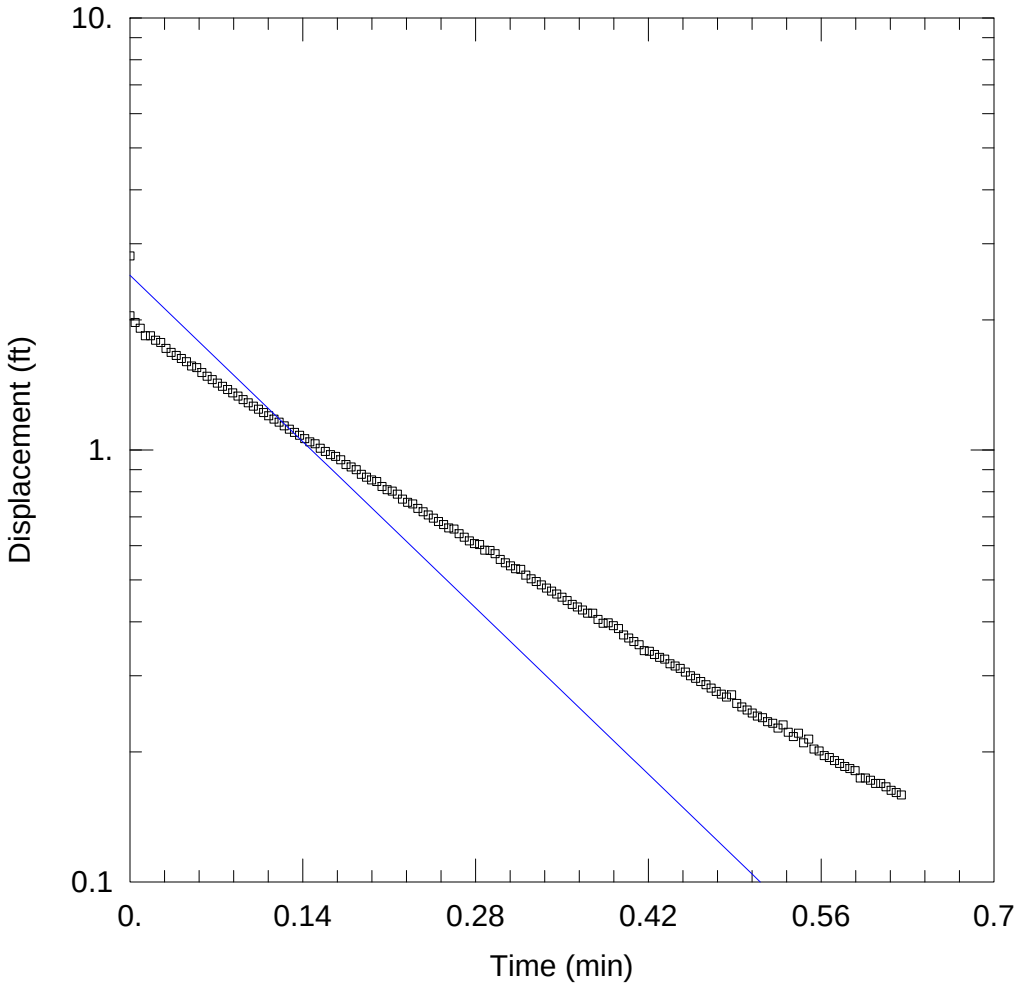
WELL DATA (New Well)

Initial Displacement: 2.813 ft
Total Well Penetration Depth: 16.48 ft
Casing Radius: 0.083 ft
Static Water Column Height: 16.48 ft
Screen Length: 10. ft
Well Radius: 0.083 ft

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice

K = 0.002806 ft/min
y0 = 2.569 ft



WELL TEST ANALYSIS

Data Set: C:\...\MW09D SLUG OUT 3_2017-09-15_19-07-32-341.aqt
Date: 09/19/18 Time: 11:10:34

PROJECT INFORMATION

Company: CH2M
Client: NAVY CLEAN
Location: FENTRESS
Test Well: OF-MW09D
Test Date: 9-15-17

AQUIFER DATA

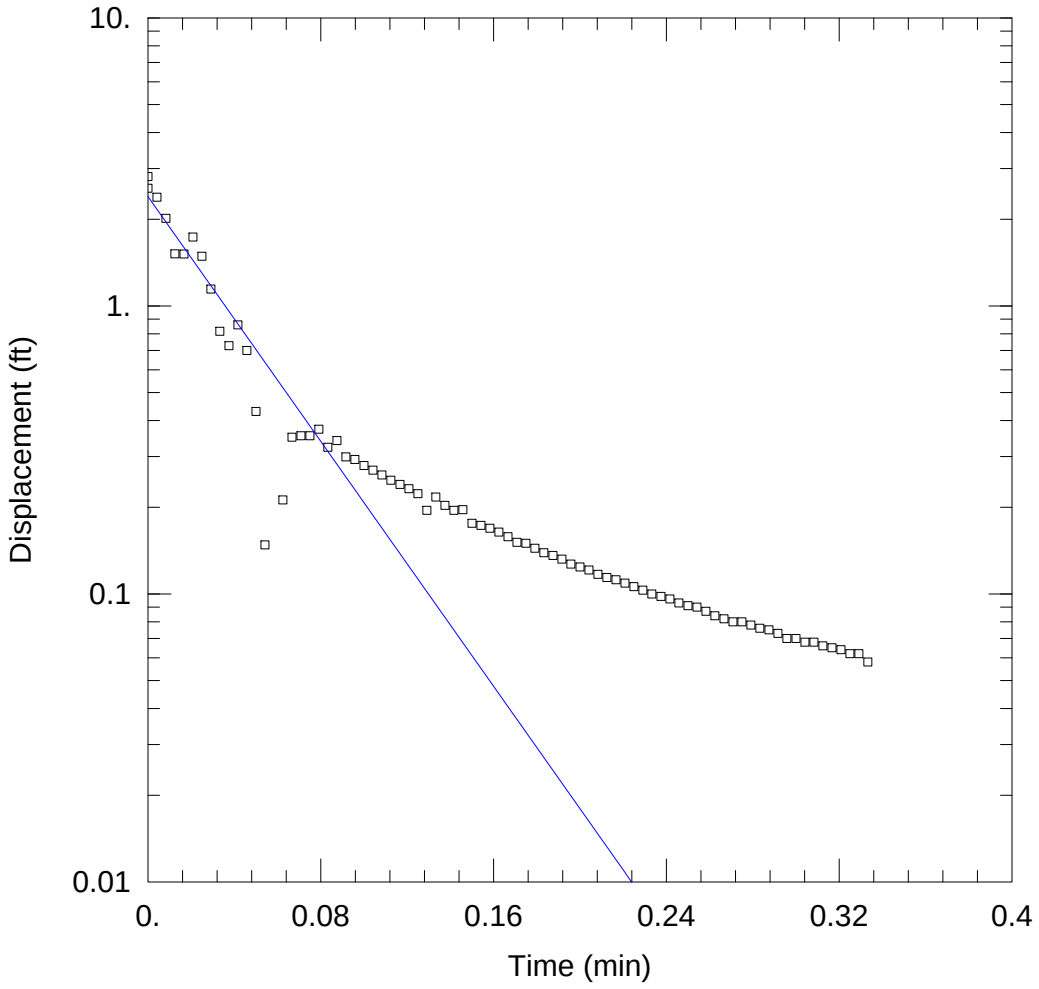
Saturated Thickness: 36.47 ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (New Well)

Initial Displacement: 2.813 ft
Total Well Penetration Depth: 36.47 ft
Casing Radius: 0.083 ft
Static Water Column Height: 36.47 ft
Screen Length: 10. ft
Well Radius: 0.083 ft

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice
K = 0.004257 ft/min
y0 = 2.536 ft



WELL TEST ANALYSIS

Data Set: C:\...\MW13 SLUG IN 3_2017-09-15_19-15-34-878.aqt
Date: 09/19/18 Time: 11:11:08

PROJECT INFORMATION

Company: CH2M
Client: NAVY CLEAN
Location: FENTRESS
Test Well: OF-MW13
Test Date: 9-15-17

AQUIFER DATA

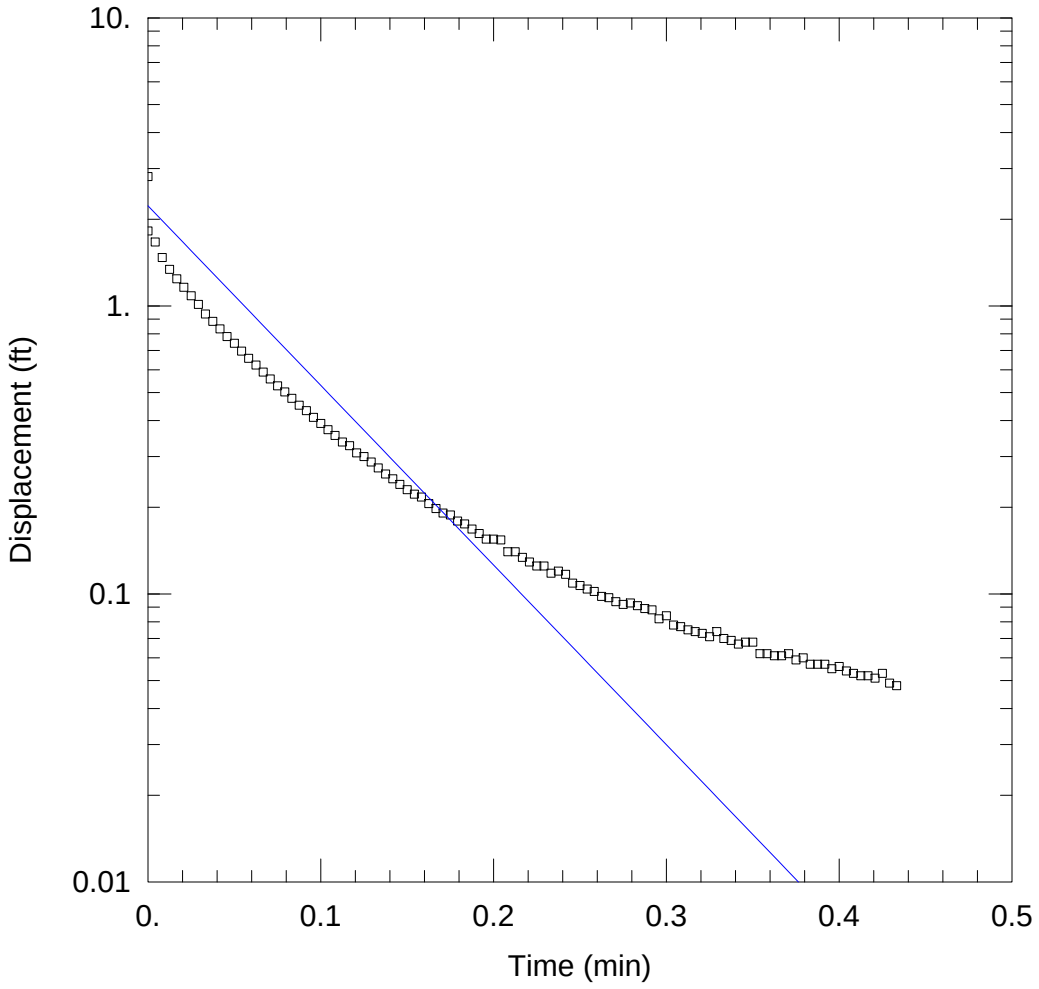
Saturated Thickness: 18.7 ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (New Well)

Initial Displacement: 2.813 ft
Total Well Penetration Depth: 18.7 ft
Casing Radius: 0.083 ft
Static Water Column Height: 18.7 ft
Screen Length: 10. ft
Well Radius: 0.083 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 0.01495 ft/min
y0 = 2.397 ft



WELL TEST ANALYSIS

Data Set: C:\...\MW13 SLUG OUT 1_2017-09-15_19-16-28-149.aqt
Date: 09/19/18 Time: 11:11:39

PROJECT INFORMATION

Company: CH2M
Client: NAVY CLEAN
Location: FENTRESS
Test Well: OF-MW13
Test Date: 9-15-17

AQUIFER DATA

Saturated Thickness: 18.72 ft Anisotropy Ratio (Kz/Kr): 1.

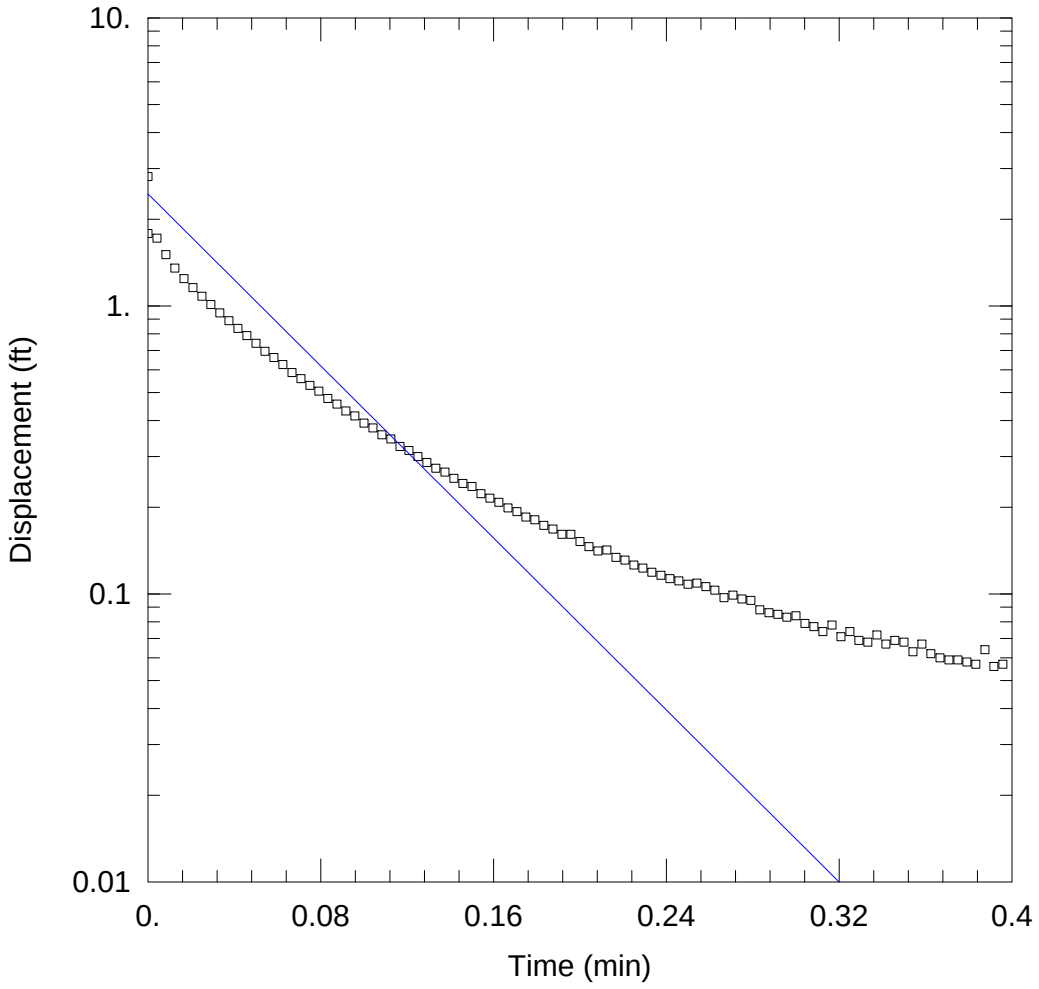
WELL DATA (New Well)

Initial Displacement: 2.813 ft
Total Well Penetration Depth: 18.72 ft
Casing Radius: 0.083 ft
Static Water Column Height: 18.72 ft
Screen Length: 10. ft
Well Radius: 0.083 ft

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 0.008775 ft/min y0 = 2.226 ft



WELL TEST ANALYSIS

Data Set: C:\...\MW13 SLUG OUT 2_2017-09-15_19-15-56-049.aqt
Date: 09/19/18 Time: 11:12:21

PROJECT INFORMATION

Company: CH2M
Client: NAVY CLEAN
Location: FENTRESS
Test Well: OF-MW13
Test Date: 9-15-17

AQUIFER DATA

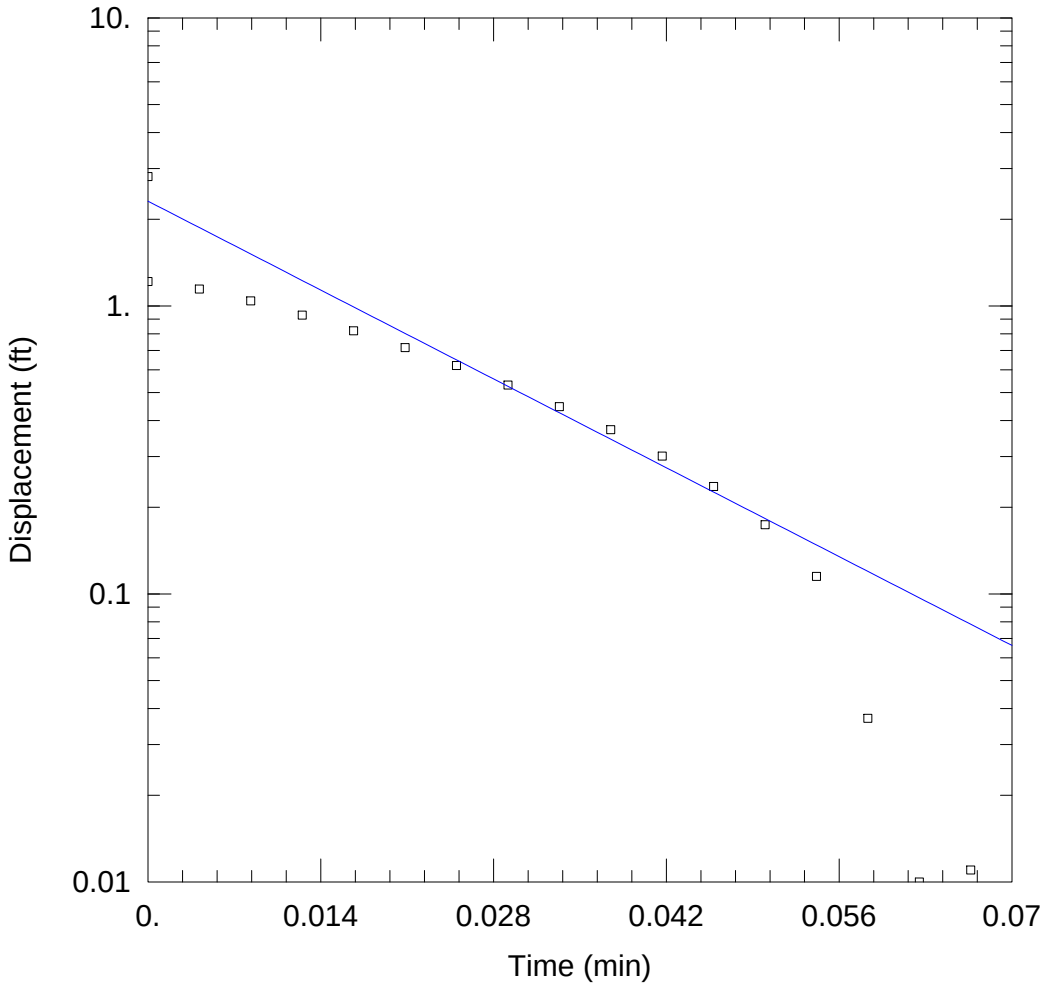
Saturated Thickness: 18.72 ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (New Well)

Initial Displacement: 2.813 ft
Total Well Penetration Depth: 18.72 ft
Casing Radius: 0.083 ft
Static Water Column Height: 18.72 ft
Screen Length: 10. ft
Well Radius: 0.083 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 0.01051 ft/min
y0 = 2.448 ft



WELL TEST ANALYSIS

Data Set: C:\...\MW13D SLUG OUT 2_2017-09-15_19-17-42-224.aqt
Date: 09/19/18 Time: 11:13:10

PROJECT INFORMATION

Company: CH2M
Client: NAVY CLEAN
Location: FENTRESS
Test Well: OF-MW13D
Test Date: 9-15-17

AQUIFER DATA

Saturated Thickness: 52.17 ft Anisotropy Ratio (Kz/Kr): 1.

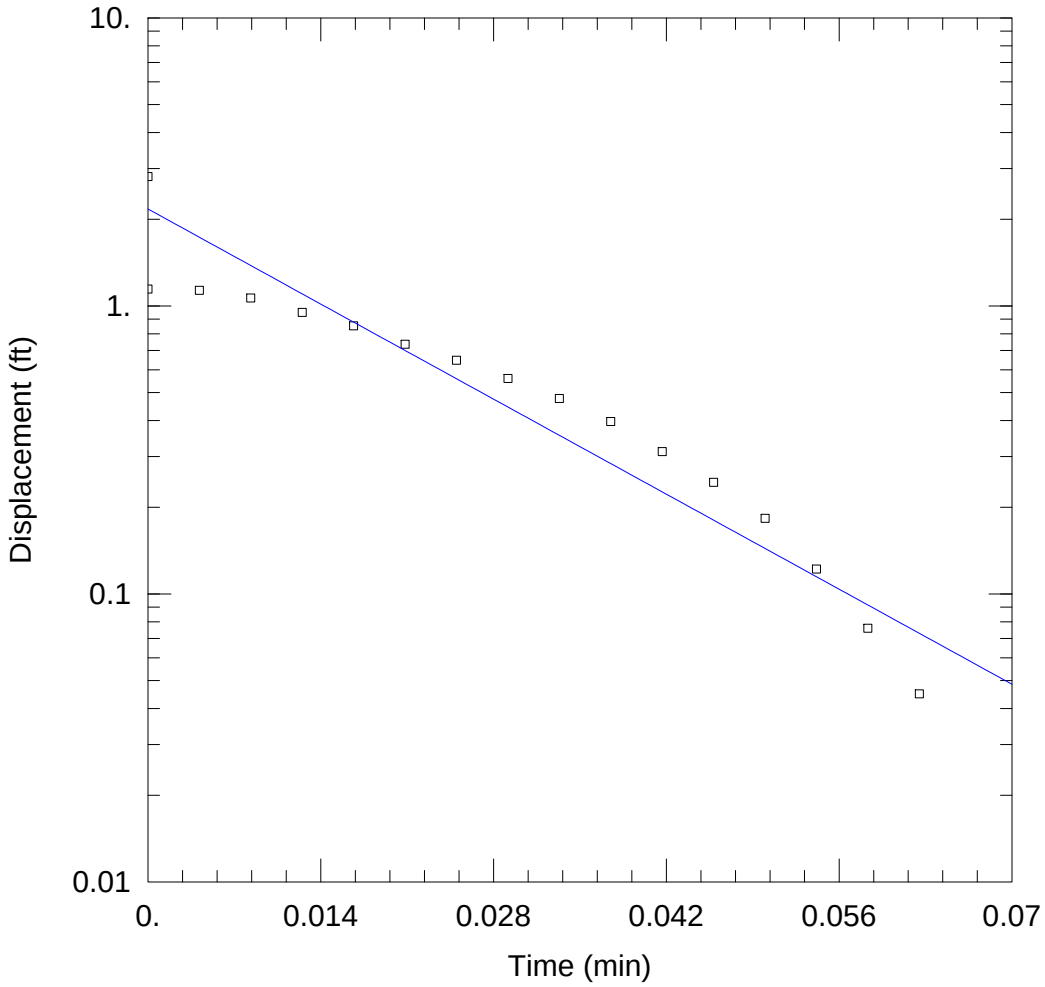
WELL DATA (New Well)

Initial Displacement: 2.813 ft
Total Well Penetration Depth: 52.17 ft
Casing Radius: 0.083 ft
Static Water Column Height: 52.17 ft
Screen Length: 10. ft
Well Radius: 0.083 ft

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice

K = 0.03573 ft/min
y0 = 2.311 ft



WELL TEST ANALYSIS

Data Set: C:\...\MW13D SLUG OUT 3_2017-09-15_19-17-02-540.aqt
Date: 09/19/18 Time: 11:13:58

PROJECT INFORMATION

Company: CH2M
Client: NAVY CLEAN
Location: FENTRESS
Test Well: OF-MW13D
Test Date: 9-15-17

AQUIFER DATA

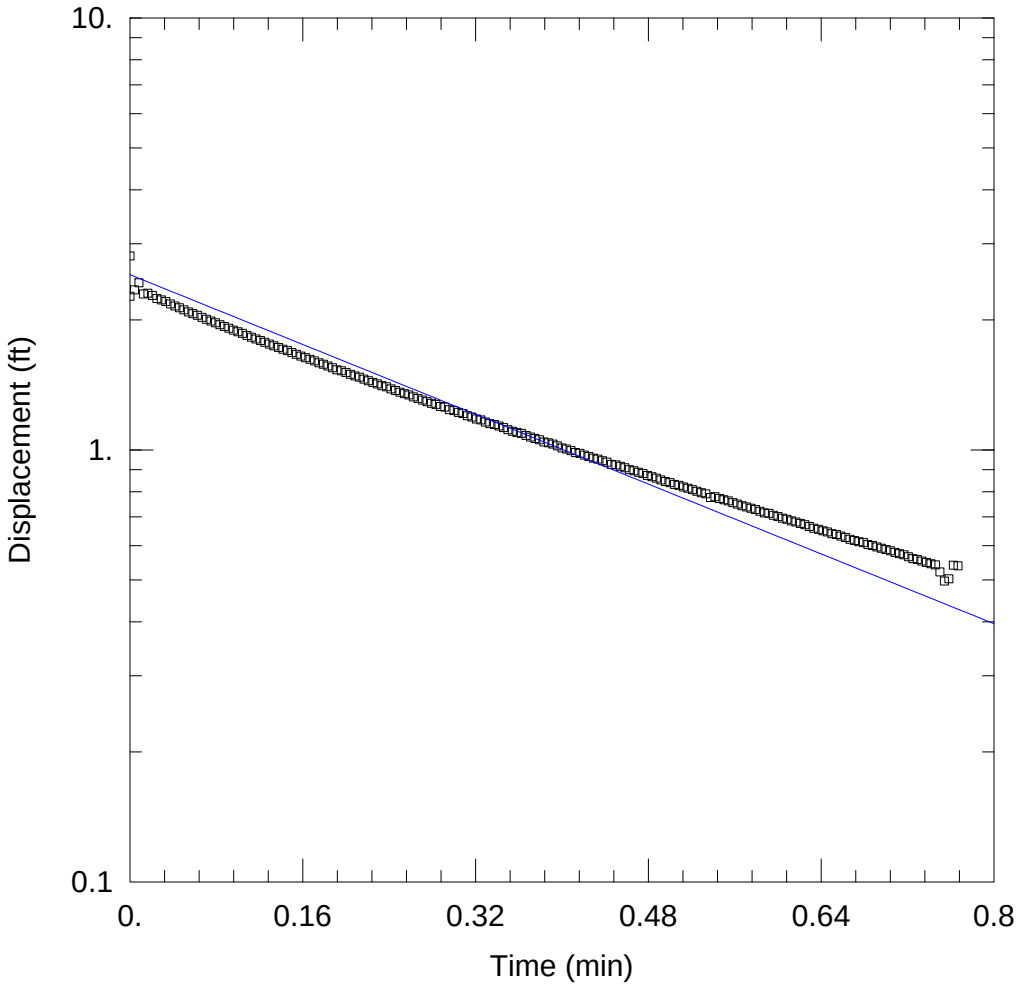
Saturated Thickness: 52.17 ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (New Well)

Initial Displacement: 2.813 ft
Total Well Penetration Depth: 52.17 ft
Casing Radius: 0.083 ft
Static Water Column Height: 52.17 ft
Screen Length: 10. ft
Well Radius: 0.083 ft

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice
K = 0.03822 ft/min
y0 = 2.171 ft



WELL TEST ANALYSIS

Data Set: C:\...\MW15 SLUG OUT 1_2017-09-15_19-11-41-813.aqt
Date: 09/19/18 Time: 11:15:03

PROJECT INFORMATION

Company: CH2M
Client: NAVY CLEAN
Location: FENTRESS
Test Well: OF-MW15
Test Date: 9-15-17

AQUIFER DATA

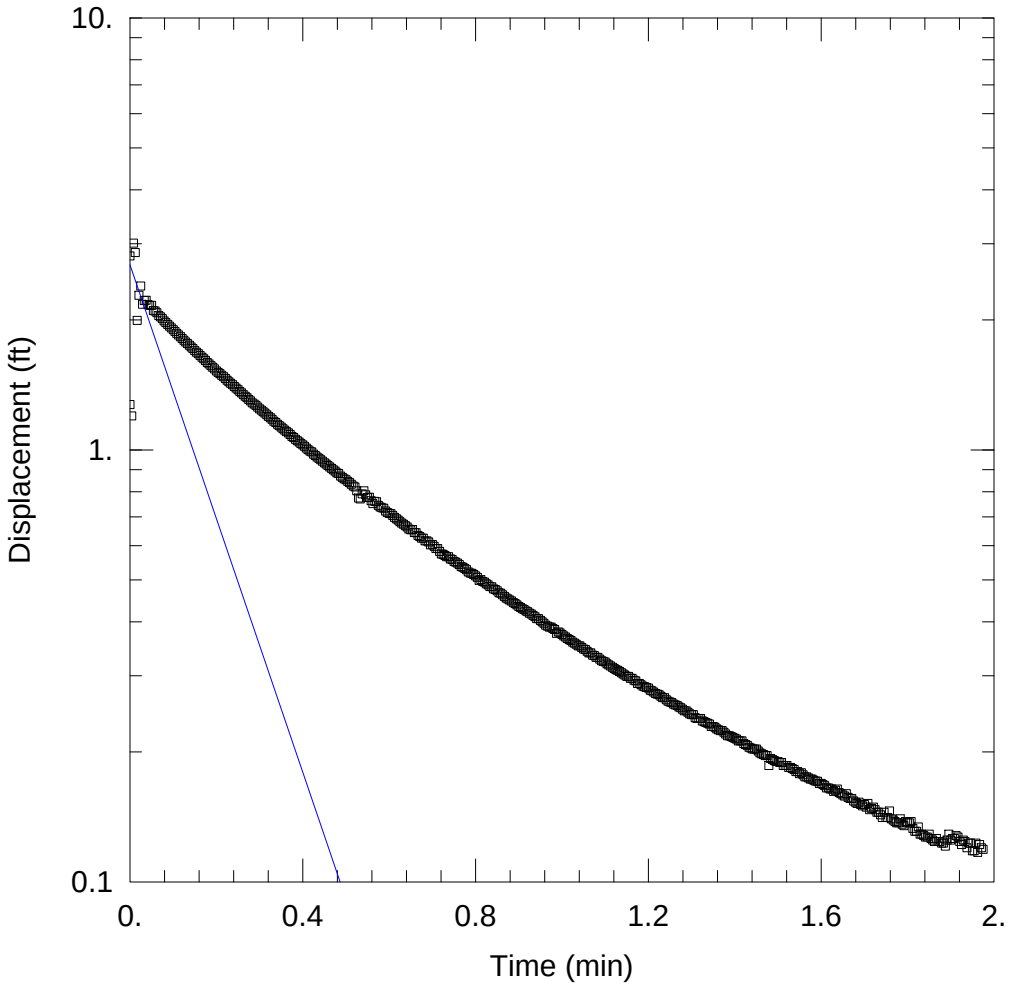
Saturated Thickness: 17.79 ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (New Well)

Initial Displacement: 2.813 ft
Total Well Penetration Depth: 17.79 ft
Casing Radius: 0.083 ft
Static Water Column Height: 17.79 ft
Screen Length: 10. ft
Well Radius: 0.083 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 0.00141 ft/min
y0 = 2.544 ft



WELL TEST ANALYSIS

Data Set: C:\...\MW15 SLUG OUT 2_2017-09-15_19-10-40-912.aqt
Date: 09/19/18 Time: 11:15:57

PROJECT INFORMATION

Company: CH2M
Client: NAVY CLEAN
Location: FENTRESS
Test Well: OF-MW15
Test Date: 9-15-17

AQUIFER DATA

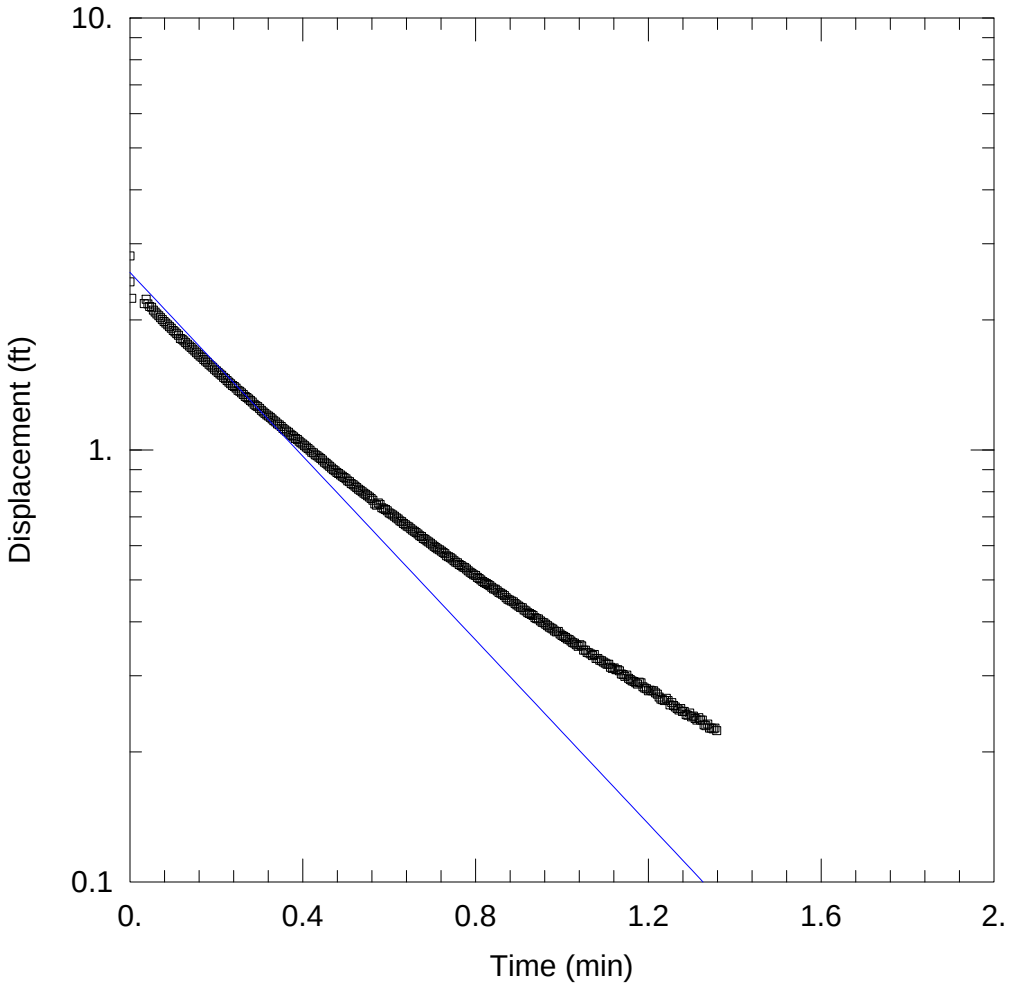
Saturated Thickness: 17.79 ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (New Well)

Initial Displacement: 2.813 ft
Total Well Penetration Depth: 17.79 ft
Casing Radius: 0.083 ft
Static Water Column Height: 17.79 ft
Screen Length: 10. ft
Well Radius: 0.083 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 0.004099 ft/min
y0 = 2.681 ft



WELL TEST ANALYSIS

Data Set: C:\...\MW15 SLUG OUT 3_2017-09-15_19-09-49-464.aqt
Date: 09/19/18 Time: 11:16:51

PROJECT INFORMATION

Company: CH2M
Client: NAVY CLEAN
Location: FENTRESS
Test Well: OF-MW15
Test Date: 9-15-17

AQUIFER DATA

Saturated Thickness: 17.77 ft Anisotropy Ratio (Kz/Kr): 1.

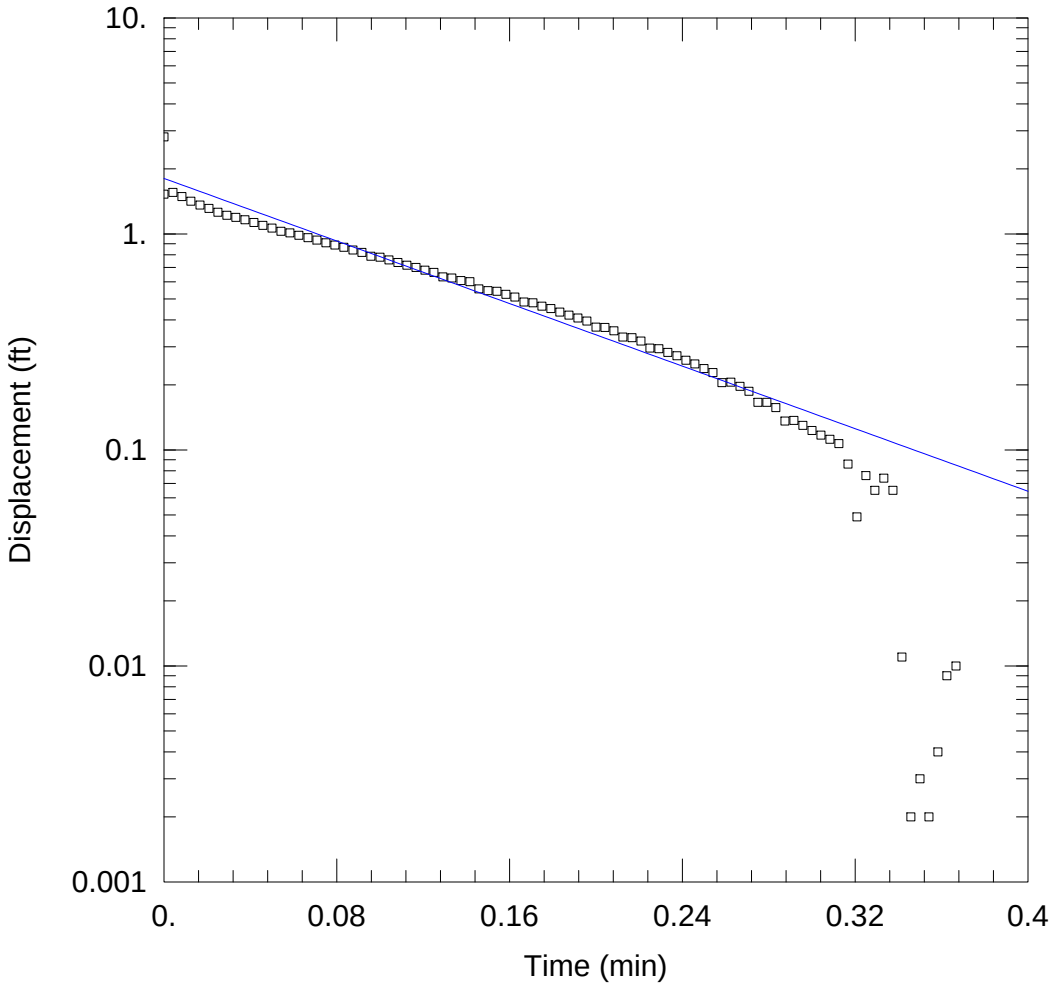
WELL DATA (New Well)

Initial Displacement: 2.813 ft
Total Well Penetration Depth: 17.77 ft
Casing Radius: 0.083 ft
Static Water Column Height: 17.77 ft
Screen Length: 10. ft
Well Radius: 0.083 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 0.001484 ft/min
y0 = 2.576 ft



WELL TEST ANALYSIS

Data Set: C:\...\MW15D SLUG OUT 2_2017-09-15_19-13-45-303.aqt
Date: 09/19/18 Time: 11:18:06

PROJECT INFORMATION

Company: CH2M
Client: NAVY CLEAN
Location: FENTRESS
Test Well: OF-MW15D
Test Date: 9-15-17

AQUIFER DATA

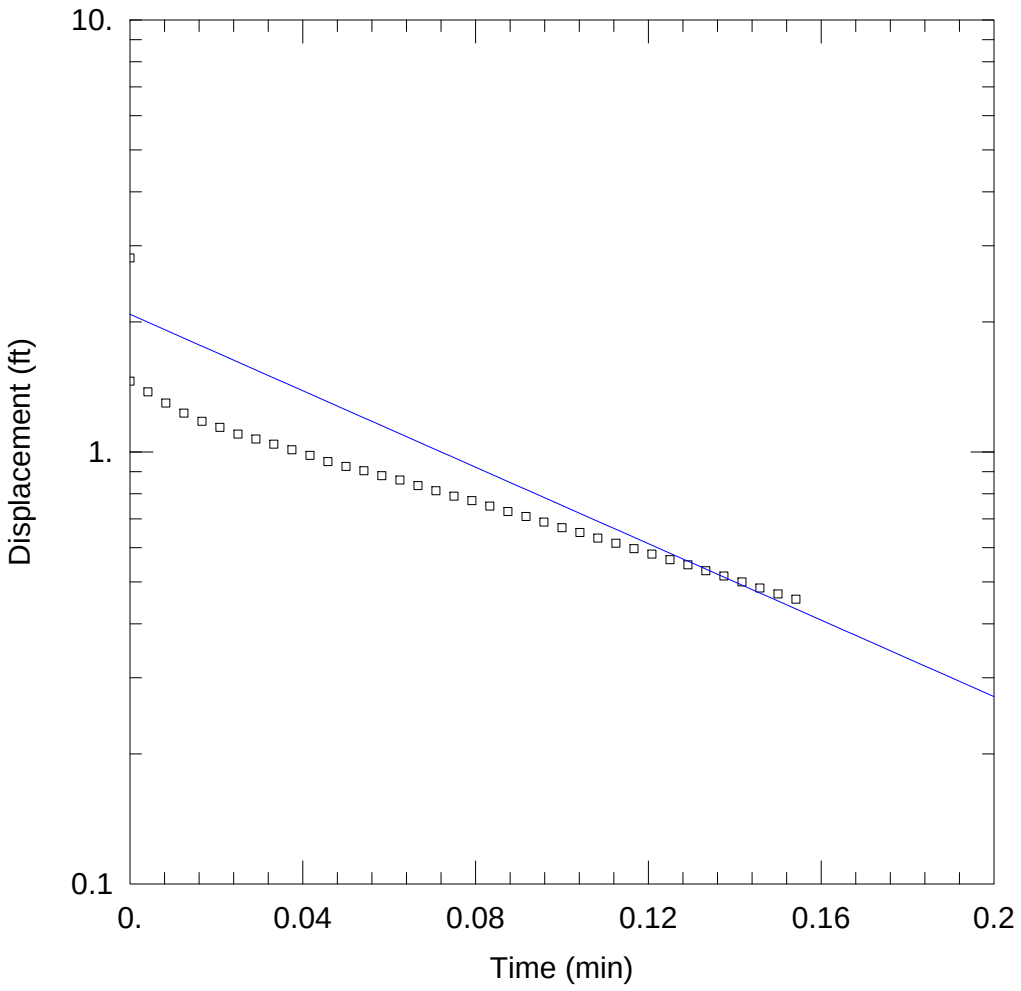
Saturated Thickness: 52.02 ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (New Well)

Initial Displacement: 2.813 ft
Total Well Penetration Depth: 52.02 ft
Casing Radius: 0.083 ft
Static Water Column Height: 52.02 ft
Screen Length: 10. ft
Well Radius: 0.083 ft

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice
K = 0.005869 ft/min
y0 = 1.807 ft



WELL TEST ANALYSIS

Data Set: C:\...\MW15D SLUG OUT 3_2017-09-15_19-12-36-717.aqt
Date: 09/19/18 Time: 11:18:47

PROJECT INFORMATION

Company: CH2M
Client: NAVY CLEAN
Location: FENTRESS
Test Well: OF-MW15D
Test Date: 9-15-17

AQUIFER DATA

Saturated Thickness: 52.07 ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (New Well)

Initial Displacement: 2.813 ft
Total Well Penetration Depth: 52.07 ft
Casing Radius: 0.083 ft
Static Water Column Height: 52.07 ft
Screen Length: 10. ft
Well Radius: 0.083 ft

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice
K = 0.007173 ft/min
y0 = 2.082 ft