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

Fort Carson, Colorado

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2 Hopkins Plaza
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Preliminary Assessment and Site Inspection of Per- and Polyfluoroalkyl Substances

Fort Carson, Colorado

Kimberley Schrupp, PMP
Site Inspection Project Manager, Arcadis U.S., Inc.

Rhonda Stone, PMP
Project Manager, Arcadis U.S., Inc.

Joseph Quinnan
Global Site Investigation Director, Arcadis U.S., Inc.
North America Emerging Contaminants Director
Technical Expert

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Prepared by:

Arcadis U.S., Inc.

7550 Teague Road

Suite 210

Hanover

Maryland 21076

Arcadis Ref.:

30001993

Date:

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CONTENTS

TABLES

FIGURES

APPENDICES

EXECUTIVE SUMMARY

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

FTC occupies approximately 220 square miles (approximately 142,560 acres). The installation is adjacent to the eastern flank of the Rocky Mountain front range and the Pike National Forest in central Colorado. The northern edge of the post is located in El Paso County, south of Colorado Springs, and the southern boundary is approximately 10 miles north of and parallel to US Highway 50 in Pueblo County. The Piñon Canyon Maneuver Site (PCMS) is located near Trinidad, approximately 150 miles by road southeast of FTC and encompasses 235,000 acres for training (FTC 2015). PCMS provides critical maneuver land for larger units stationed at FTC (FTC 2015; FTC 2017). There were twelve AOPIs which were sampled. The site visit occurred 22-24 May 2018 and sampling occurred in January, July, and December 2019, with an additional phase of sampling for aqueous film-forming foam (AFFF) storage areas in November 2020.

PAs were conducted at installations where PFAS-containing materials were used, stored, and/or disposed of as part of operational history (Army 2018). As a result of the PA at FTC, 12 AOPIs have been identified. The names of the AOPIs and the associated use, storage, and/or disposal of PFAS-containing materials types identified at FTC are summarized in **Table ES-1**, below.

Table ES-1. Summary of AOPIs Identified during the Preliminary Assessment

AOPI Name	PFAS Use/Storage/Disposal Types
Butts Army Airfield Former Fire Training Area (FFTA) (FTC-021, solid waste management unit [SWMU] 24)	Fire training areas
Former Nozzle Testing Area (Former Fire Station, Building 9600, BAAF)	Fire nozzle testing areas
PCMS Hill Ranch AFFF Storage Building 8110 Foam Storage Army National Guard (ARNG) Building 1982 Foam Storage	AFFF storage areas

AOPI Name	PFAS Use/Storage/Disposal Types
Building 9608 Temporary AFFF Storage Area (BAAF) Hangar 9633 (BAAF)	
Landfill 1 (FTC-005, SWMU 1) Grit/Oil Pit (FTC-020, SWMU 13)	Landfills
Former Sewage Treatment Lagoons (FTC-039, SWMU 23, BAAF) Fort Carson Sewage Treatment Plant (FTC-042, SWMU 22) Fort Carson Golf Course (FTC-034 and FTC-036, SWMUs 32 and 33)	Stormwater or sanitary sewer components

Based on the results of the PA at FTC, an SI for PFAS was conducted in accordance with CERCLA. Phase I and Phase II SI sampling was completed at FTC at all twelve AOPIs to evaluate presence or absence of PFAS. Phase I and Phase II SI sampling was completed at and/or downgradient of all twelve AOPIs and in areas peripheral to the AOPI source areas to determine presence or absence of PFAS at each of these AOPIs. The existing monitoring wells sampled at each AOPI typically included one or more source area (or near source area) wells and one or more downgradient wells.

Attempts to sample groundwater were made at all DPT borings, however refusal was encountered prior to groundwater. When refusal was met, typically between 22 to 28 feet below ground surface, the soil was dry and crumbly indicating groundwater would not be encountered at that depth. Based on the hydrogeology at Fort Carson, this is not unusual (see **Sections 2.6 and 2.7**). Therefore, groundwater was not collected during the Phase I and Phase II SI sampling events at the Fort Carson Sewage Treatment Plant (FTC-042, SWMU 22) or the Fort Carson Golf Course (FTC-034 and FTC-036, SWMUs 32 and 33), and presence or absence of PFAS in groundwater at these AOPIs is not known at this time. Groundwater was also not sampled at the Former Nozzle Testing Area sampling locations: DPT soil borings and monitoring well W89MW12. W89MW12, located downgradient of the Former Nozzle Testing Area and upgradient from the other BAAF AOPIs (Former FTA and Former STP Lagoons), was proposed for sampling contingent on its re-installation in late 2019 prior to sampling. The well was not re-installed at the time of sampling and was unable to be sampled. Therefore, presence or absence in groundwater at this AOPI was not determined during Phase I and Phase II SI sampling activities. However, W89MW12, was sampled in 2016 prior Phase I and Phase II SI sampling activities with 1,500 nanograms per liter (ng/L) PFOS, 610 ng/L PFOA, and 150 ng/L PFBS detected. Additionally, groundwater was collected during Phase I SI sampling from existing monitoring wells located farther downgradient, in the vicinity of the FFTA and Former Sewage Treatment Plant Lagoons.

The preliminary CSMs prepared for the PA were re-evaluated and updated, if necessary, as part of the SI. Following the Phase I and Phase II SI sampling, all 12 AOPIs were considered to have complete or potentially complete exposure pathways. Soil exposure pathways are complete at four AOPIs where PFAS were detected in soil and on-installation site workers were identified as potential receptors. The soil

exposure pathway is also complete for on-installation recreational users (e.g., golfers) at the Fort Carson Golf Course AOPI. Soil exposure pathways are potentially complete for on-installation site workers at the remaining six AOPIs. While the FTC AOPIs are downgradient of and not likely to affect the Strobel Well used as an additional source of potable water (i.e., other than that supplied from Colorado Springs Utilities) on-installation, and while there are no drinking water wells at PCMS Hill Ranch, the groundwater exposure pathways (via drinking water ingestion and dermal contact) are potentially complete to account for potential future use of the on-post groundwater downgradient of the AOPIs. Due to the potential for potable use of the off-post groundwater, the groundwater exposure pathway for off-installation drinking water receptors is potentially complete. Site workers could also contact constituents in surface water and sediment during maintenance activities at the Fort Carson Golf Course; therefore, these exposure pathways are potentially complete. For all 12 AOPIs, the surface water and sediment exposure pathways are potentially complete for on-installation recreational users and for off-installation receptors who could contact constituents in surface water and sediment in creeks and streams that receive runoff/surface water from FTC (i.e., downgradient of AOPIs).

Results from this PA/SI indicate further study in a remedial investigation for PFAS is warranted at FTC in accordance with the guidance provided by the OSD. **Table ES-2** below summarizes the sampling at FTC and rationale for recommendations for further study in a remedial investigation or no action at this time at each AOPI.

Table ES-2. Summary of PFOS, PFOA, and/or PFBS Sampling at FTC and Recommendations

AOPI Name	PFOS, PFOA, and/or PFBS detected greater than OSD Risk Screening Levels?		Recommendation	Rationale
	GW	SO		
BAAF AOPIs (5 AOPIs; FFTA [SWMU 24], Former Nozzle Testing Area, Former Sewage Treatment Lagoons [SWMU 23], Building 9608 Temporary AFFF Storage Area, and Hangar 9633)	Yes	No	Further study in a remedial investigation	Detections in groundwater above the OSD risk screening level.
Landfill 1 (FTC-005, SWMU 1)	Yes	NS	Further study in a remedial investigation	Detections in groundwater above the OSD risk screening level.
Grit/Oil Pit (FTC-020, SWMU 13)	Yes	NS	Further study in a remedial investigation	Detections in groundwater above the OSD risk screening level.
Fort Carson Sewage Treatment Plant (FTC-042, SWMU 22)	NS	No	No action at this time	No soil exceedances of OSD risk screening levels.

AOPI Name	PFOS, PFOA, and/or PFBS detected greater than OSD Risk Screening Levels?		Recommendation	Rationale
	GW	SO		
Fort Carson Golf Course (FTC-034 and FTC-036, SWMUs 32 and 33)	NS	No	No action at this time	No soil exceedances of OSD risk screening levels.
Building 8110 Foam Storage Area	Yes	No	Further study in a remedial investigation	Detections in groundwater above the OSD risk screening levels.
ARNG Building 1982 Foam Storage Area	No	NS	No action at this time	No groundwater exceedances of OSD risk screening levels
PCMS Hill Ranch AFFF Storage Area	NS	Yes	Further study in a remedial investigation	Detections in soil above the OSD risk screening levels.

Notes:

* Groundwater was not encountered during the sampling event and was therefore unable to be collected.

GW – groundwater

NS – not sampled

1 INTRODUCTION

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

1.1 Project Background

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

Though there are many types of PFAS-containing materials, two have been used most commonly by the Army as part of operational history; aqueous film-forming foam (AFFF), and PFAS-containing mist suppressants used in metal plating.

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

Potential PFAS use associated with metal plating activities may also be relevant to Army installations. During metal plating operations, a metal surface may be treated with a layer of electrochemically deposited metals in an acid bath. PFAS, specifically PFOS, have been used in metal plating operations as surface tension-reducing wetting agents to mitigate the release of aerosolized chemicals into a working environment. Hard chromium plating is one type of metal plating operation where PFAS-containing mist suppressants were commonly used. Historically, it was common for spent plating baths from metal plating operations to be disposed of in a lined or unlined pit or into a sanitary or storm sewer. Therefore, PFAS present in mist suppressants during the metal plating process could be released to the environment.

Many of the PFAS found in AFFF and metal plating operations are surfactants (which do not volatilize) and are found in a charged or ionic state at environmentally-relevant pH (i.e., pH 5 to 9 standard units). PFOS, PFOA, and PFBS are each negatively charged at environmentally-relevant pH. The media potentially affected by PFAS releases at Army installations are soil, groundwater, surface water, and sediment. Once released to the environment, a primary factor that inhibits the movement of PFAS is the presence of organic matter and organic co-constituents in soils and sediments. Generally, PFAS are mobile in the potentially affected media, and they are not known to be fully broken down by natural processes.

In 2016, the United States Environmental Protection Agency (USEPA) established a lifetime health advisory of 70 nanograms per liter (ng/L) in drinking water for PFOS or PFOA and for the sum of PFOS and PFOA when both are present (USEPA 2016).

On 15 October 2019, the OSD provided guidance on the investigation of PFOS, PFOA, and PFBS at DoD restoration sites (OSD 2019). The 15 October 2019 Memorandum: Investigating Per- and Polyfluoroalkyl Substances within the Department of Defense Cleanup Program is provided for reference as **Appendix A**. The DoD guidance provides risk screening levels for PFOS, PFOA, and PFBS in groundwater (tap water) or soil, calculated using the USEPA's Regional Screening Level (RSL) calculator for residential and industrial/commercial worker receptor scenarios. Following the issuance of the 2019 OSD memo, on 08 April 2021, USEPA published an updated toxicity assessment for PFBS (USEPA 2021). Based on the updated toxicity assessment for PFBS, the OSD issued a memorandum on 15 September 2021 to include updated PFBS risk screening levels. The September 2021 Memorandum: Investigating Per- and Polyfluoroalkyl Substances within the Department of Defense Cleanup Program is provided for reference as **Appendix A**. The OSD risk screening levels for tap water (and also used to evaluate groundwater or surface water used as drinking water sources) are 40 ng/L for PFOS and PFOA, and 600 ng/L for PFBS. The PFOS and PFOA soil screening levels for the residential and industrial/commercial scenarios are 0.13 milligrams per kilogram (mg/kg) (residential) and 1.6 mg/kg (industrial/commercial). The soil screening levels for PFBS are 1.9 mg/kg (residential) and 25 mg/kg (industrial/commercial). These screening criteria are discussed further in **Section 6.6**.

1.2 PA/SI Objectives

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

1.2.1 PA Objectives

During the PA, investigators collect readily available information and conduct site reconnaissance and identifies sites requiring further assessment (USEPA 1991). This PA will evaluate and document areas where PFAS-containing materials were used, stored, and/or disposed, so the Army can distinguish between sites that pose little or no threat to human health and the environment and sites that require further investigation.

1.2.2 SI Objectives

When the PA identifies that such use, storage and/or disposal has occurred and the area is determined to be an AOPI, the SI evaluates whether there is a release to the environment and, if so, whether further investigation under CERCLA is warranted.

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

1.3 PA/SI Process Description

For FTC, PA/SI development followed a similar process as described in **Sections 1.3.1** through **1.3.5** below. **Section 3** provides a summary of the PA activities completed, and **Section 6** provides a summary of the SI activities completed for FTC. The PA and SI processes are documented in the PA/SI Quality Control Checklist included as **Appendix B**.

1.3.1 Pre-Site Visit

First, an installation kickoff teleconference was held between applicable points of contact (POCs) from United States Army Environmental Command (USAEC), United States Army Corps of Engineers (USACE), FTC, and Arcadis U.S., Inc. (Arcadis). The kickoff call occurred on 01 May 2018, three weeks before the site visit to discuss the goals and scope of the PA, project scheduling, installation access, timeline for the site visit, access to installation-specific databases, and to request available records.

Records review was conducted before the site visit to obtain electronically available documents from the installation and external sources for review. The purpose of the records research was to identify any area on the installation that may have been a location where AFFF and/or PFAS-containing materials were used, stored, and/or disposed, as well as to gather information on the physical setting and site history at FTC.

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

- The Installation Management Command (IMCOM) operation order
- The Army PA Operations Security requirements package, which includes the antiterrorism/operations security review cover sheet (**Appendix C**)
- The PFAS PA kickoff call minutes

- An information paper on the PA portion of the Army's PFAS PA/SI
- Contact information for key POCs
- A list of the data sources requested and reviewed
- A list of preliminary locations identified during the kickoff call and pre-site visit records review, that may be evaluated as potential AOPIs, where additional information on those areas will be collected through personnel interviews, additional document review, and site reconnaissance.
- A list of roles for the installation POC to consider when recommending potential interviewees.

1.3.2 Preliminary Assessment Site Visit

The site visit was conducted on 22-24 May 2018. An in brief meeting was held in order to provide installation staff with the objectives of the site visit and team introductions. **Section 3** includes information regarding personnel interviewed and areas where site reconnaissance was performed during the site visit.

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

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

An exit briefing was offered to installation personnel at the conclusion of the site visit to raise any items identified during the site visit, discuss any follow-up items, and review the schedule for submitting deliverables. The exit briefing was conducted on 24 May 2018 with FTC, the USAEC, and the USACE to discuss preliminary findings of the PA site visit.

1.3.3 Post-Site Visit

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

1.3.4 Phase I SI Sampling Planning and Field Work

Following the PA site visit, it was determined that Phase I SI sampling was appropriate at FTC due to the potential threat to human receptors on and off post. A Programmatic Uniform Federal Policy-Quality Assurance Project Plan (PQAPP) was developed and finalized in October 2018 for the USAEC PFAS PA/SI program (Arcadis 2018b). The PQAPP details general planning processes for collecting data and describes the implementation of quality assurance (QA) and quality control (QC) activities for the Phase I SI sampling (and/or Phase II SI sampling) portion of the program for Army installations nationwide. An installation-specific Sampling Work Plan and Site Safety and Health Plan (SSHP) was developed and finalized in January 2019 for the scope of work completed under the PA (Arcadis 2019a, 2019b).

In February 2019, following submittal to the installation and finalization of the Sampling Work Plan, Arcadis teams completed field planning and coordination with the installation and subcontractors. Once the schedule was determined, field teams mobilized to the installation to complete the scope of work defined in the Sampling Work Plan.

Upon receiving the Phase I SI sampling results, it was determined by FTC, USACE, and USAEC that additional immediate Phase I SI sampling was required in some off-installation private water wells located southeast of Butts Army Airfield (BAAF). This sampling occurred in July 2019. Results are summarized in **Section 7.1**.

The DQOs, sampling design and rationale, and field methods employed for the Phase I SI sampling at FTC are summarized from the Sampling Work Plan developed for FTC (Arcadis 2019a) in **Sections 6.1** through **6.3**.

1.3.5 Site Inspection Planning and Field Work

The SI process was initiated at the installation to evaluate PFAS presence or absence at each AOPI and determine whether further investigation is warranted. First, an SI kickoff teleconference was held between the applicable POCs from the USAEC, USACE, the installation, and Arcadis.

The objectives of the SI kickoff teleconference were to:

- discuss the AOPIs selected for sampling and the proposed sampling plan for each AOPI
- gauge regulatory involvement, Colorado Department of Public Health and Environment (CDPHE) requirements, or preferences
- identify overlapping unexploded ordinance or cultural resource areas
- confirm the plan for investigation derived waste (IDW) handling and disposal
- identify specific installation access requirements and potential schedule conflicts
- discuss general SI deliverable and field work schedule information and logistics

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

- gauge regulatory involvement, CDPHE requirements or preferences
- confirm the plan for investigation derived waste (IDW) handling and disposal
- identify specific installation access requirements and potential schedule conflicts
- provide an updated SI deliverable and field work schedule

A Programmatic Uniform Federal Policy-Quality Assurance Project Plan (PQAPP) was developed and finalized in October 2019 for the USAEC PFAS PA/SI (Arcadis 2019c). The PQAPP details general planning processes for collecting data and describes the implementation of quality assurance (QA) and quality control (QC) activities for the SI portion for Army installations nationwide. Additionally, an installation-specific QAPP Addendum was developed to define the DQOs, present the sampling design and rationale, and provide qualifications for project personnel. The SI field work was completed in accordance with the PQAPP (Arcadis 2019c) and the approved installation-specific QAPP Addendum. A SSHP was also developed as an attachment to the QAPP Addendum to identify specific health and safety hazards that may be encountered at the installation during sampling. The SSHP was designed to supplement the Accident Prevention Plan (Arcadis 2018a), which was developed for Army installations nationwide. The QAPP Addendum and SSHP were submitted to the installation and finalized before commencement of field work.

The DQOs, sampling design and rationale, and field methods employed for the SI are summarized from the QAPP Addendum developed for FTC (Arcadis 2019d) in **Sections 6.1** through **6.3**.

After finalization of the QAPP Addendum and SSHP, field planning and coordination with the installation and subcontractors was completed. Once the schedule was determined, field teams mobilized to the installation to complete the scope of work defined in the QAPP Addendum in December 2019.

Following the Phase II SI sampling event and programmatic changes, three new AOPIs were identified and required sampling due to current and/or historical AFFF storage. A field change report was prepared to outline the sampling plan. The additional AOPIs include Building 8110 Foam Storage, Army National Guard (ARNG) Building 1982 Foam Storage, and the Piñon Canyon Maneuver Site (PCMS) Hill Ranch AFFF Storage location. Shallow soil samples and/or groundwater samples from existing monitoring wells were collected in November 2020 to determine presence or absence at these AOPIs.

1.3.6 Data Analysis, Validation, and Reporting

Environmental samples collected during the SI were submitted to a laboratory which is DoD Environmental Laboratory Accreditation Program (ELAP)-accredited for PFAS analysis in accordance with the DoD Quality Systems Manual (QSM) 5.1.1 (DoD 2018. Laboratory analytical results were then validated and verified by a project chemist to assess the usability of the data collected. Validated analytical results were summarized in the context of project screening levels (defined in **Section 6.5**). Both PA findings (**Sections 3** through **5**) as well as SI findings (**Sections 6** and **7**) are included in this PA/SI report.

2 INSTALLATION OVERVIEW

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

2.1 Site Location

The information contained in this section is excerpted from the Installation Action Plan for FTC (FTC 2017). FTC occupies approximately 220 square miles (approximately 142,000 acres). The installation is adjacent to the eastern flank of the Rocky Mountain front range and the Pike National Forest in central Colorado. The northern edge of the post is located in El Paso County, south of Colorado Springs, and the southern boundary is approximately 10 miles north of and parallel to US Highway 50 in Pueblo County. A small area in the southwestern portion of the post is located in Fremont County (**Figures 2-1** and **2-2**). The PCMS is located near Trinidad, approximately 150 miles by road southeast of FTC and encompasses 235,000 acres for training (FTC 2015). The PCMS provides critical maneuver land for larger units stationed at FTC (FTC 2015; FTC 2017).

2.2 Mission and Brief Site History

The information contained in this section is excerpted from the Installation Action Plan for FTC (FTC 2017). Construction of Camp Carson began in 1942, shortly after the bombing of Pearl Harbor. It was originally known as Camp Carson and served primarily as a training facility for more than 100,000 soldiers during World War II. The camp was also the site of the Mountain Training Center, the Army Nurse Corps Training Center, and an internment camp for prisoners of war. In 1954, the name of the installation was officially changed from Camp Carson to Fort Carson (FTC 2017).

In 1961, FTC was selected as the site for a new Army training center, but the center was phased out after one year. In 1965, approximately 78,500 acres were acquired, increasing the size of the installation to 142,000 acres. Throughout the 1970s, the mission of FTC continued to be the maintenance and training of combat-ready troops. As of 1995, operations at FTC were carried out by about 20,000 personnel (FTC 2017).

FTC underwent a construction boom in 2007 and 2008 in preparation for the arrival of and take-over of the installation by the 4th Infantry Division from Fort Hood, Texas, which occurred in 2009 (FTC 2017).

The current primary mission of FTC is the training and readiness of all assigned and attached troops to ensure combat-ready forces. Activities that support training include vehicle maintenance, aviation maintenance, weapons maintenance, and range qualifications. Major tenants include the U.S. Navy and Marine Corps Reserve, Colorado Army National Guard, Army Reserve, Medical Command, and Defense Reutilization. FTC also serves several off-post satellite units and activities in its geographical area of responsibility. The U.S. Air Force Academy, Cheyenne Mountain Air Station, Peterson Air Force Base, and 58 reserve components in nine states also use FTC's administrative, training, logistical, and other services (FTC 2017).

2.3 Current and Projected Land Use

The information contained in this section is excerpted from the Final Environmental Impact Statement for Implementation of Fort Carson (U.S. Army 2009). Land use at FTC falls generally into one of two broad categories: the cantonment area and the downrange area. The cantonment area consists of developed land and a high density of urban uses. The downrange area consists of open land used for training purposes and land specified for non-training uses (which are designated in various areas and are accessible by the public; U.S. Army 2009).

The cantonment area comprises approximately 6,000 acres and contains most of the infrastructure, such as soldier and family housing; administrative, maintenance, community support, recreation, supply, and storage facilities; utilities; and classroom and simulation training facilities. Principal industrial operations include the repair and maintenance of vehicles. These operations mostly occur within the north and east sides of the cantonment area (U.S. Army 2009).

The downrange area consists of approximately 131,000 acres of unimproved or open lands that are used for large caliber and small-arms live-fire individual and collective training; aircraft, wheeled and tracked vehicle maneuver operations, and mission readiness exercises. Additionally, BAAF is located in the northeast quadrant of the downrange area and is used for command and control of flight operations as well as maintenance and repair of aircraft. Remaining land is used for recreation and other purposes. The primary training activities that occur within the downrange area include live-fire and maneuver training. Other areas within the downrange area are restricted from training to protect natural and cultural resources (U.S. Army 2009).

PCMS is currently a military training site for FTC and authorized for brigade-level training (FTC 2015). PCMS supports the capacity for FTC's brigade combat team to maintain readiness and training.

2.4 Climate

The information contained in this section is excerpted from the Draft Final RCRA Facility Investigation for Sewage Treatment Lagoons (Solid Waste Management Unit [SWMU] 23/FTC-039; Rust Environment and Infrastructure 1999). FTC's climate is characterized as mid-latitude semi-arid with hot summers, cold winters, and low annual rainfall. Climatological data for Colorado Springs reports average daily temperatures ranging from 29 degrees Fahrenheit (°F) in January to 71°F in July. The area receives an average precipitation of 15 inches per year, with approximately 80 percent occurring between April and September. Annual snowfall averages 43 inches per year, with the heaviest snowfall occurring during March (Rust Environment and Infrastructure 1999).

2.5 Topography

The information in this section is excerpted from the Draft Final RCRA Facility Investigation for Sewage Treatment Lagoons (SWMU 23/FTC-039; Rust Environment and Infrastructure 1999). FTC is situated within two physiographic provinces. The eastern part of FTC is located in the Colorado Piedmont section of the Great Plains Province. This area is characterized by eastward-sloping plains dissected by tributaries to Fountain Creek. These dissecting tributaries, including intermittent streams such as Rock

Creek, Sand Creek, and Young Hollow, flow from northwest to southeast (Rust Environment and Infrastructure 1999).

The western part of FTC is located in the Rampart Range foothills section of the Southern Rocky Mountains Province. The west-central part of FTC is semi-mountainous with steep hills, shallow steep-walled canyons, and gently rolling uplands. The southwest section of the post consists of rolling high plains. Elevations range from 5,400 feet above mean sea level in the eastern part to 6,800 feet above mean sea level in the western part of FTC (Environmental Science and Engineering 1983, as cited in Rust Environment and Infrastructure 1999). **Figure 2-3** shows the topographic contours of the installation.

2.6 Geology

The geology at Fort Carson differs slightly between the eastern and western regions roughly divided by Turkey Creek. The eastern region is underlain by east dipping Upper Cretaceous sedimentary strata and Quaternary alluvium.

The western region of Fort Carson is underlain by gentle dipping anticlines and synclines of folded Pennsylvanian-age Fountain Formation. The Fountain Formation is composed of fine to coarse grained arkosic sandstone and conglomerate (U.S. Army Center for Health Promotion and Preventive Medicine [USACHPPM] 1995). The Permian-age Lyons Formation overlies the Fountain Formation. The Lyons Formation is composed of well sorted and well cemented sandstone. Overlying the Lyons Formation is Triassic- to Jurassic-age rocks that include the Lykins and Morrison Formations. The Lykins is composed mainly of reddish-brown siltstone, fine-grained sandstone, and interbedded limestone. The Morrison Formation is composed of interbedded green, red, yellow, and white claystone, and siltstone (Malcolm Pirnie, Inc. 2009).

Overlying the Dakota Group in the southernmost and eastern half of Fort Carson are Cretaceous rocks that include the Graneros Shale, Greenhorn Limestone, Carlisle Shale, Niobrara Formation, and the Pierre Shale. These younger formations, with the exception of the Pierre Shale, have undergone slight deformation, and are exposed in a synclinal structure between Red Creek and Booth Gulch in the southwest corner of the installation (USACHPPM 1995). The Pierre Shale underlies most of the eastern part of the installation as the shallowest bedrock unit (Malcolm Pirnie, Inc. 2009).

2.7 Hydrogeology

The information in this section is excerpted from the Draft Final Operational Range Assessment Program Phase I Qualitative Assessment Report (Malcolm Pirnie 2009). The aquifer systems at FTC include two bedrock aquifers (the Dakota-Purgatoire aquifer and the Fountain aquifer) and various Quaternary alluvial aquifers. The principal aquifer in the FTC area is the Dakota-Purgatoire aquifer, which is composed of the sandstones, shale, and conglomerates of the Dakota and Purgatoire Formations (United States Geological Survey [USGS] 1994). The base of the aquifer is the Cheyenne Sandstone Member of the Purgatoire Formation, which is composed of a lower unit of gray to black shale and massive fine grained sandstone. The Dakota-Purgatoire Formation outcrops/sub-crops west of Turkey Creek and dips to the east, where it is confined beneath the Graneros Shale.

At the eastern boundary of FTC, the top of the unit may occur as deep as 1,800 feet below ground surface (bgs) (USGS 1994). The Dakota-Purgatoire aquifer has an average saturated thickness ranging

from 20 to 300 feet. Yields from this aquifer at the installation generally vary from 5 to10 gallons per minute (gpm), but locally may range as high as 150 to 200 gpm if fractures are encountered (USACHPPM 1995). The upper part of the aquifer is the Dakota Sandstone Member which is composed of fine grained thin to massive sandstone with average saturated thickness greater than 50 feet. Average hydraulic conductivity values for the Dakota-Purgatoire aquifer range from 0.001 feet per day (ft/day) to 20.0 ft/day (Colorado Geological Survey 1946).

Secondary aquifers present at FTC are the Quaternary alluvial deposits. These include Pleistocene alluvial deposits and the Holocene Piney Creek Alluvium. The Pleistocene aquifers are generally thin, of limited areal extent, and only saturated part of the year. The Piney Creek Alluvium is an important aquifer at the installation because it possesses sufficient permeability to transmit groundwater to the surface streams. The Piney Creek alluvial deposits are found in the stream valleys located in the northern potions of FTC, the most active and developed parts of the installation. The most important of these deposits are those that occur along Rock Creek and Little Fountain Creek. Both are part of the Fountain Creek aquifer, located just east of the installation. Wells installed in the Piney Creek Alluvium are capable of yielding 45 gpm. Average hydraulic conductivity values for the alluvial aquifers range from 0.0002 ft/day to 7.5 ft/day, the seepage velocity of groundwater through the alluvium range from 0.75 to 150 feet per year (USACHPPM 1995).

A third aquifer, the Fountain aquifer, has a recharge area located on southwestern FTC where the Fountain Formation outcrops. As the sedimentary strata dip eastward, this aquifer's depths increase to greater than 2,000 feet in the eastern portion of FTC, where this aquifer is confined beneath the Lyons Formation. Thicknesses of the Fountain Formation range between 2,100 and 2,900 feet thick beneath FTC (USGS 1994). Yields from this aquifer are generally low and range from one to ten gpm. Groundwater uses from this aquifer are primarily for agricultural and stock watering (Malcolm Pirnie 2009).

Groundwater flow direction is illustrated on **Figure 2-2.**

2.8 Surface Water Hydrology

The information in this section is excerpted from the Draft Final RCRA Facility Investigation for Sewage Treatment Lagoons (Rust Environment and Infrastructure 1999). FTC is located within the Upper Arkansas Watershed in the southwestern portion of the installation, and Fountain Watershed in the northeastern portion of the installation (**Figure 2-2**). FTC encompasses several drainages and watersheds that are tributaries to the Arkansas River (many via Fountain Creek, which is east of the installation). The drainages are referred to by the names of the predominant rivers, creeks, or irrigation ditches within each watershed. Northern and eastern drainages include B Ditch, Clover Ditch, Central Unnamed Ditch, Rock Creek, Little Fountain Creek, and Southeast Drainages; these flow predominantly from northwest to southeast in broad valleys where unconsolidated alluvial deposits overlie the Pierre Shale and Niobrara Formation. Streams in the southwestern portion of the installation flow south, mostly across more resistant formations. These southern watersheds, which include Red Creek, Turkey Creek, and Wild Horse Creek, tend to be narrow with less extensive alluvial fill deposits (Rust Environment and Infrastructure 1999).

The northeastern portion of the installation (i.e., near BAAF) is located on a pediment. This area is located within the Rock Creek drainage basin. Rock Creek flows off-post toward the east and joins Little Fountain Creek approximately two miles south and east of the installation. Little Fountain Creek eventually flows into Fountain Creek. Surface water bodies and their ephemeral tributaries are shown on **Figure 2-2.**

2.9 Relevant Utility Infrastructure

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

2.9.1 Stormwater Management System Description

FTC discharges stormwater runoff from their Municipal Separate Storm Sewer System under USEPA National Pollutant Discharge Elimination System Permit COR042001. This permit does not authorize stormwater discharges associated with industrial activities. Additionally, the PCMS, a military training site located approximately 150 miles southeast of FTC, is not covered under this permit. This permit contains requirements specific to FTC that provide practical and achievable controls to municipal stormwater pollution. The permitted area includes all areas within the installation boundaries of FTC. FTC is located in the Fountain Watershed and Upper Arkansas Watershed (**Figure 2-2**, HDR, Inc. 2016). The cantonment area at FTC drains to one of four drainages on-installation including B Ditch, Clover Ditch, Infantry Creek and Rock Creek. All four drainages discharge into Fountain Creek off-installation. Fountain Creek discharges into the Arkansas River south of FTC within the city of Pueblo (HDR, Inc. 2016). Other programs that support this municipal stormwater permit include the Multi-Sector General Permit for industrial stormwater discharges and the associated Stormwater Pollution Prevention Plan, the construction stormwater program, and the Spill Prevention, Control and Countermeasures Plan (HDR, Inc. 2016).

2.9.2 Sewer System Description

The Sewage Treatment Plant (STP, SWMU 22) and the Industrial Wastewater Treatment Plant (IWTP, SWMU 21) treat sanitary and industrial wastewater generated at FTC. The STP and IWTP operate under USEPA National Pollutant Discharge Elimination System Permit CO-0021181. The STP is in the southeast corner of the cantonment area north of Clover Ditch, immediately downstream of the IWTP, west of the eastern border of FTC (near Gate No. 20). The facility has been in operation since the 1940s. It receives sanitary wastewater from the cantonment area and since 1981 also receives IWTP effluent via a sewer pipeline located along Magrath Avenue that intersects the sanitary sewer line just before entering the STP (Bay West 2008a). The STP was updated from December 1998 through March 1999 and currently uses several processes for wastewater treatment including grit and grease removal, aeration in an equalization basin followed by secondary aeration and discharge to oxidation channels, separation of solids and treatment in aerobic digestors, clarification of the aqueous phase followed by continuous backwash filtration and ultraviolet treatment. Treated wastewater exits through a modified single-channel contact chamber (Bay West 2008a).

Treated effluent from the STP is discharged to two permitted outfalls. In the summer, most of the effluent is discharged to the Fort Carson Golf Course Holding Pond (GCHP; FTC-036/SWMU 32) where the pond water is used for irrigation of the golf course and as a reserve for firefighting at the clubhouse. The GCHP has received treated STP effluent via an approximately 3-mile long, 12-inch diameter permanent line since 1972. The remainder of the year treated effluent is discharged to Clover Ditch, a tributary to Fountain Creek, located on the south side of the STP (Bay West 2008a). Processed sludge from the STP was applied as a soil conditioner/fertilizer to the golf course grounds (Sludge Spreading Area [FTC-034/SWMU 33]) from approximately 1972 to 1984 (Earth Tech 2008, Bay West 2008a). Sludge from the STP is currently disposed off-installation at the Midway Landfill in Fountain, Colorado.

The IWTP receives industrial wastewater from the cantonment area and is located immediately west of the STP. The facility has been in operation since 1981. The IWTP treats oily wastewater and recycles used oil from the vehicle maintenance facilities. Three main areas are connected to the IWTP by the industrial sewer line: the motor pool near Building 749 along North Specker Avenue, the vehicle maintenance facilities near Building 8000 along O'Connell Boulevard and the motor pools along Minick Avenue. Of the 40 motor pools at FTC, 22 have outdoor wash racks connected to the IWTP via the industrial sewer line. Both wastewater and stormwater from the wash racks and maintenance areas drain to the IWTP. The industrial sewer line is buried in trenches that range from 3 to 19 feet bgs and access is provided by manholes. Much of the water flows entirely by gravity; however, wastewater from some of the facilities is pumped via lift stations to main industrial sewer lines before it continues by gravity to the IWTP (Bay West 2008b). From 1981 to 1992, industrial wastewater flowed directly into sedimentation basins at the IWTP. In 1992, a free oil separator building was added to collect oil in a 250-gallon tank. The effluent from the free oil separator is discharged to one of the sedimentation basins. Oil skimmers remove oil from the surface of the sedimentation basin. The aqueous phase flows from the sedimentation basins to aeration basins for further treatment. Oil and sludge from these processes are removed every few years and disposed by the FTC Directorate of Public Works (DPW; Bay West 2008b). Effluent from the aeration basins may be pumped to the STP.

2.10 Potable Water Supply and Drinking Water Receptors

The one on-installation drinking water supply well (Strobel Well) is located on Turkey Creek in the Upper Arkansas Watershed and provides the pre-treatment/source water for the Turkey Creek Recreation Area Water System. The drinking water for the remainder of the installation is supplied by Colorado Springs municipal water (Colorado Springs Utilities, public water system identification CO0221445). The information provided in this section regarding Colorado Springs Utilities water is excerpted from the 2019 Drinking Water Quality Report for Calendar Year 2018 (U.S. Army 2019). Much of the municipality's raw water originates from nearly 200 miles away near Aspen and Breckenridge, with about 75% of the water originating from mountain streams. Water from these streams is collected and stored in numerous reservoirs along the Continental Divide. Collection systems in this area consist of the Homestake, Fryingpan-Arkansas, Twin Lakes, and Blue River. Colorado Springs Utilities is also able to divert water from local surface and groundwater resources. These include Catamount, Crystal, and South Slope Reservoirs, North and South Cheyenne Creek, Fountain and Monument Creek, Pueblo Reservoir, and the Northfield Watershed. In addition, local ground water sources which include wells drilled into two different aquifers, two 500 to 700 feet deep wells on the Denver aquifer and two 900 to 1,000 feet deep wells on the Arapahoe aquifer (U.S. Army 2019). Specifically, for FTC, drinking water is supplied from the

Pueblo Reservoir greater than 5 miles south of the installation; water is pumped from the Juniper Pump Station to a water treatment plant to the east of the installation.

Side gradient (i.e., east of the installation and Fountain Creek) several residences and public utilities draw water from the Widefield Aquifer (CDPHE 2017). The Widefield Aquifer has estimated hydraulic-conductivity values range from 1 to about 1,300 ft/day; the larger values occur in the buried channel of the alluvial aquifer and the lower values occur near the boundaries of the saturated alluvium (USGS 1994). The Widefield Aquifer is hydraulically connected to Fountain Creek (USGS 1994) and has known PFAS impacts. FTC groundwater and surface water likely discharge into Fountain Creek downgradient of the town of Fountain (CDPHE 2017). Potable supply wells within a 5-mile radius of the installation are shown on **Figure 2-4** as provided in the Environmental Data Resources, Inc. (EDR) well search report (**Appendix E**).

2.11 Ecological Receptors

Due to the availability of adequate toxicity data, the Army focused the PA/SI on human receptors. The PA team collected information regarding ecological receptors that was available in the installation documents reviewed during the PA process. The following information is provided for future reference should the Army decide to evaluate exposure pathways relevant to the ecological receptors. The information in this section is excerpted from the Final Environmental Impact Statement for Implementation of Fort Carson Grow the Army Stationing Decisions (U.S. Army 2009).

FTC is located at the western edge of the Central Shortgrass Prairie Ecoregion, which includes all the plains of Colorado east of the Rocky Mountains as well as parts of Wyoming, Nebraska, Kansas, Oklahoma, Texas, and New Mexico. The Central Shortgrass Prairie is characterized by rolling-to undulating plains and tablelands of low relief that are traversed by streams and contain canyons, buttes, badlands, and isolated mountains. Shortgrass prairie, mixed-grass prairie, and sand-sage prairie community types dominate the Central Shortgrass Prairie Ecoregion. FTC is within upper regions of the Prairie Grasslands Plant Zone, an area characterized by generally treeless terrain dominated by plants belonging to the grass family (U.S. Army 2009).

Forest and woodlands constitute about 37% of FTC. Ponderosa pine, Pinyon pine, and one-seed juniper are dominant species and are found in mountainous and high relief sites, primarily on coarse or rocky soils. Ponderosa pine occurs in pure stands or mixed with pinyon, gambel oak, and Rocky Mountain juniper, depending upon relative seral stage of the site. One-seed juniper dominates low relief hills and mesas primarily in the southern half of FTC, occasionally invading adjacent grasslands (U.S. Army 2009).

There are 22 noxious weeds known to occur on FTC. Only one, myrtle spurge (Euphorbia myrsinites) is considered a List A species in Colorado. List A species are those considered so potentially damaging (and not yet widespread throughout the state) that they are designated for eradication. List B weed species are species for which state management plans are developed to stop their continued spread. There are 14 known List B weed species on FTC (U.S. Army 2009).

Wildlife on FTC include large mammals, birds, fish, reptiles, and amphibians. Common large mammals include mule, white-tailed deer, elk, pronghorn, mountain lion, coyote, and black bear. Twenty-seven species of hawks and owls are known to use FTC, including eight species classified as federally- or state-listed or as species of special concern. Native and non-native fish can be found in reservoirs on FTC.

Wetlands support several reptile and amphibian species, including the plains leopard frog, northern leopard frog, and painted turtle. Other typical reptile species on FTC include western rattlesnake, triploid checkered whiptail, and coachwhip (U.S. Army 2009).

2.12 Previous PFAS Investigations

In response to the third Unregulated Contaminant Monitoring Rule and IMCOM Operations Order 16-088, FTC conducted sampling at their one on-post drinking water well and existing groundwater monitoring wells. The on-post drinking water well (Strobel Well; see **Section 2.9**) was sampled in July 2016 and no PFAS compounds were detected above the laboratory method detection limit. Additionally, existing groundwater monitoring wells located on-post, at and downgradient from BAAF, were sampled in July / October 2016 and PFOS/PFOA were detected above the lifetime health advisory at all locations except well AHA. The maximum detected PFOS/PFOA concentrations at these BAAF monitoring wells are as follows:

- PFOS: 41,000 ng/L at BECSMW28R
- PFOA: 94,000 ng/L at BECSMW13
- PFBS: 4,300 ng/L at BECSMW13 (duplicate sample identification BECSMW100, run at dilution)

All historical analytical PFAS results are provided in **Table 2-1** and shown on **Figure 2-5.** The laboratory reports and associated data validations reports for the historical PFAS sampling events are provided as **Appendix F**.

3 SUMMARY OF PA ACTIVITIES

The following three principal sources of information were used to develop this PA:

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

These sources of data, along with their relative application to this PA, are discussed below. The specific findings of records review, personnel interviews, and site reconnaissance relevant to PFAS at FTC are described in **Section 4**.

3.1 Records Review

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

3.2 Personnel Interviews

Interviews were conducted during the site visit. If a previously identified interviewee was not available during the site visit, attempts were made to complete the interview via telephone before or following the site visit or by contacting an alternate interviewee identified by the installation POC.

The list of roles for the installation personnel interviewed during the PA process for FTC is presented below (affiliation is with FTC unless otherwise noted).

- Environmental Compliance Branch Chief
- Environmental Protection Specialist
- Interim Environmental Chief
- IRP Contractor
- Operations Manager
- Deputy Fire Chief
- Retired Fire Chief
- Current Fire Chief
- Invasive Species and Pest Program Manager
- Safety and Occupational Health Specialist
- Fort Carson Golf Course Maintenance

- Pesticide Shop Manager
- Installation GIS Manager
- DPW GIS Manager

The compiled interview logs provided in **Appendix H**.

3.3 Site Reconnaissance

Site reconnaissance and visual surveys were conducted at all 9 of the preliminary AOPIs identified during the records review process, the installation in-brief meeting, and during the installation personnel interviews (**Table 3-1**). An area may have been classified as an area not retained for further investigation or an AOPI based on a combination of other information collected (e.g., records reviewed, personnel interviews, internet searches) as described in **Sections 5.1** and **5.2**, respectively. A photo log from the site reconnaissance is provided in **Appendix I**; photos were used to assist in verification of qualitative data collected in the field. The site reconnaissance logs are provided in **Appendix J**.

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

Table 3-1. Site Reconnaissance Areas

Site Identifier	Description and Relevance
Fire Related Areas	
Former Fire Training Area (FFTA); SWMUs 23/24*	The FFTA is located at BAAF. PFAS have been historically detected in groundwater here, with the greatest concentrations observed in wells BECSMW-13 and -28R. Wells in the area, including at SWMU 23 and SWMU 24, are accessible with a key.
Former Nozzle Testing Area*	The area north of SWMU 89 and the Former Fire Station at BAAF was used for nozzle testing weekly or bi-weekly over numerous decades. This area is just north of the current fire station and has been significantly regraded during recent construction activities. PFAS were detected in groundwater here during sampling in 2016.
Aviation Areas	
BAAF	Mass casualty trainings performed here every 3 to 4 years. During this time, AFFF was used. Additionally, miscellaneous fire training tasks were performed here.
Buildings and Facilities	
Building 8000	This facility reportedly conducted plating operations. It was confirmed that operations here involved armor plating and not chromium plating.
Pesticide Shops	
Pesticide Maintenance Shop	PFAS-containing pesticides and herbicides are not used on post.

Site Identifier	Description and Relevance
Fort Carson Golf Course*	PFAS-containing pesticides and herbicides are used on post. Also, potentially PFAS-containing effluent water from the STP was retained in holding ponds on the golf course and applied to the fairways for irrigation.
Waste Management Facilities	
Landfill 1*	Soil from FFTA at BAAF was moved here during decommissioning.
Grit/Oil Pit*	Oil from the oil/water separator at the FFTA at BAAF was periodically disposed of at the Grit/Oil Pit. Unknown substances potentially containing PFAS may have also been placed here.
Other	
North Side Reservoir	Spring-fed reservoir downgradient of SWMU 23/24 and nozzle testing area. Stocked with fish for recreational fishing and subsequent consumption.

* indicates the area has been further identified as an AOPI.

4 SUMMARY OF PFAS USE, STORAGE, AND/OR DISPOSAL AREAS RESEARCHED

A summary of the observations made, and data collected through records reviews (**Appendix G**), installation personnel interviews (**Appendix H**), and site reconnaissance (**Appendix J**) during the PA process for FTC is presented below.

4.1 AFFF Use, Storage, and Disposal at FTC

AFFF was historically used at BAAF for firefighter training activities. At BAAF, historical fire training activities were conducted at the FFTA (FTC-021, SWMU 24). The FFTA was located approximately 80 feet east of the BAAF Sewage Treatment Lagoons (FTC-039, SWMU 23) and 400 feet southeast of the Former Used Waste Oil Tank at Building 9620 (FTC-023, SWMU 90). The FFTA consisted of a concrete basin, a flammable storage area, and an oil/water separator. Fire training activities were conducted in the concrete basin, which was approximately 50 by 50 feet in area and 1.5 feet deep. The concrete basin was constructed in 1972 and was demolished in July 1996. Historical observations reported that the concrete walls of the basin were disintegrating, and numerous cracks were present in the concrete floor. Prior to construction of the concrete basin in 1972, the fire training exercises were conducted in an unlined earthen pit located at the site (Earth Tech 2005). The former oil/water separator was located adjacent to and west of the concrete basin at the FFTA. It received the water, AFFF, and residual fuel mixture after the fire was extinguished during firefighter training exercises. The former oil/water separator was 3 feet wide, 5 feet long and 6 feet deep and was constructed of concrete.

The FFTA was used by fire fighters at FTC for training activities (potentially every two weeks) from the 1960s (exact date unknown) through December 1993. Training activities consisted of filling a basin with flammable liquids, igniting the liquids, and using water and AFFF to extinguish the fire. Approximately 800 to 1,000 gallons of flammable liquids were used during each exercise. The amount of AFFF used during each exercise is not known (Earth Tech 2005).

In addition to AFFF use at the FFTA, AFFF was historically stored and/or released at several locations at FTC, as follows:

- Nozzle testing was conducted once per week from approximately the 1970s to 1991 with AFFF equipment near the Former Fire Station (Building 9600) located adjacent to the airfield.
- Building 9608 is a former temporary storage facility at BAAF where an unknown quantity of an unknown type of AFFF contained in blue 55-gallon barrels was stored. In 2018 the barrels were turned in to the FTC DPW for disposal. Building 9608 has been demolished, and currently Hangar 9680 exists at this location, which does not contain AFFF in its fire suppression system. There are no known releases of AFFF from former Building 9608 while it was in storage.
- Hangar 9633 at BAAF contained 2,000 gallons of AFFF in the fire suppression system, which was removed in July/August 2018 under contract W9128F-15-D-0034. There are no known releases of AFFF from Hangar 9633 prior to removal.
- Hangar 9660 at BAAF is the unmanned aerial vehicle hangar at BAAF that contained an unknown quantity of high-expansion foam (ANSUL Jet-X 2% High Expansion Foam Concentrate) in the fire

suppression system. In 2017 the foam contained in the fire suppression system was released into the hangar and filled the hangar up to approximately 5 feet in height. The foam dissipated quickly and drained into a lined holding pond located at BAAF, which is connected to all the fire suppression systems on BAAF.

- Mass casualty training was completed periodically with a C130 aircraft at BAAF. The exact location of this training is not known.
- AFFF was reportedly used at the refueling site in the northwestern corner of BAAF in response to a helicopter fire in December 1991. The type and quantity of AFFF used is unknown.
- Building 8110 Foam Storage location historically housed fire trucks with AFFF storage until 2018.
- ARNG Building 1982 Foam Storage location historically housed fire trucks with AFFF storage until 2018.

At the time of the post site visit AOPI teleconference, BAAF was identified as a single AOPI containing multiple potential AFFF release sites. However, by the time the installation specific QAPP was written, the Army decided to break the sites out to individual AOPIs.

Additionally, 5 gallons of 3M Light Water AFFF is stored at the PCMS, as reported in a 2017 IMCOM AFFF Inventory Report provided by the Army. PCMS is a military training site for FTC that began operation in the mid-1980s. It is located approximately 150 miles southeast of FTC near Trinidad, Colorado (U.S. Army 2015). The PCMS fire department reported that firefighting foam has not been used at PCMS in over 20 years and had no knowledge of firefighting foam use prior to that time period. After the initial Phase II SI sampling occurred, the Army identified the need to evaluate all storage areas and the AFFF storage area at PCMS was included as an AOPI.

4.2 Metal Plating Operations

There is no record of chromium plating operations at FTC. Historical armor plating was completed at FTC at Building 8000 but is not a known source of PFAS at this time.

4.3 Other Potential PFAS Sources at FTC

The September 2018 Army guidance indicates the mechanisms for potential use, storage, and disposal of PFAS (Army 2018). It was noted during a discussion with a USAEC Pest Management Consultant that the larger group of pesticides are generally not of PFAS concern. Specifically, products containing Sulfluramid (i.e., associated with insecticides) may have contained PFAS and were phased out in 1996. The USAEC Pest Management Consultant has records of pesticides used and stored at IMCOM installations, including FTC, and did not identify FTC as an installation ever containing PFAS-containing pesticides/insecticides. Following document research, personnel interviews, and site reconnaissance at FTC, the following other potential PFAS source areas were identified in the sections below.

4.3.1 Waste Disposal/Treatment Facilities Associated with AFFF Use at the FFTA

Two former Sewage Treatment Lagoons (FTC-039, SWMU 23) received wastewater (sanitary) from the BAAF facilities and effluent from the former oil/water separator adjacent to the FFTA. The effluent water

from the oil/water separator at the former FTA flowed into the former Sewage Treatment Lagoons via a sump and a subsurface pipeline. The two lagoons were constructed in the 1960s and consisted of two clay-lined evaporation lagoons, each approximately two acres in area. Two overflow outfall pipes, one at each lagoon, allowed diversion of wastewater to the ground surface and runoff into the surface drainage south of the lagoons in the event of overflow conditions. During 1995 field reconnaissance activities, the area below the outfall pipe of the westernmost lagoon showed signs of erosion from a historical release or releases. Flow to the lagoons was discontinued in April 1997 when construction of a pipeline to the STP in the cantonment area was completed. The remaining liquid in the lagoons was pumped out in May and June 1997, and the sludge was allowed to air dry. The sludge was removed from the basins in September 1999 and transported off-site (Earth Tech 2005).

The accumulated oil was periodically pumped out of the oil/water separator at the FFTA for disposal at the Grit/Oil Pit (FTC-020, SWMU 13) (Earth Tech 2005). In June 2001, the oil/water separator was demolished and removed in accordance with the Final Oil/Water Separator Removal Work Plan (Earth Tech 2001a) and Work Plan Addendum (Earth Tech 2001b). As part of the removal activities, impacted soil was observed and subsequently excavated from a 600-square-foot area surrounding the former oil/water separator. The oil/water separator components, contents, soil within piping, and rinse water were disposed at an off-site hazardous waste treatment, storage, and disposal facility. The excavated soil was treated on site to reduce volatile organic compound (VOC) concentrations prior to being shipped off site for disposal at a Subtitle D landfill (Earth Tech 2001a and 2001b).

In addition, demolition debris from the concrete basin at the former FTA (FTC-021, SWMU 24) was disposed as non-hazardous waste at Landfill 1 (FTC-005, SWMU 1) following demolition and analysis of debris samples in July 1996 (Earth Tech 2005).

4.3.2 Facilities Associated with Off-Installation Cheyenne Mountain Air Force Station AFFF Release

The Fort Carson Sewage Treatment Plant (FTC-042, SWMU 22) received wastewater potentially containing PFAS from a release of AFFF at the Cheyenne Mountain Air Force Station into the FTC sanitary sewer system in June 2004 (**Section 4.4**). In addition to this wastewater, the STP received sanitary wastewater from throughout the Fort Carson cantonment area since 1981 as well as treated effluent from the IWTP at Fort Carson.

Treated effluent from the STP is discharged to two permitted outfalls. In the summer, most of the effluent is discharged to the GCHP (FTC-036/SWMU 32) where the pond water is used for irrigation of the golf course and as a reserve for firefighting at the clubhouse. The remainder of the year treated effluent is discharged to Clover Ditch, a tributary to Fountain Creek, located on the south side of the STP (Bay West 2008a). The GCHP has received treated STP effluent via an approximately 3-mile long, 12-inch diameter permanent line since 1972. In 2004 the GCHP received approximately 800,000 to 850,000 gallons of STP effluent per day. The GCHP overflows through a small ditch to a Water Hazard Pond located between the second fairway and the southern edge of a prominent hill. Drainage from the Water Hazard Pond continues eastward via a ditch that passes beneath Harr Avenue and terminates on the eastern edge of the golf course. The GCHP was dredged and reconfigured in 2013; associated sediments were disposed of at an off-site facility.

In 2004 water was pumped from the GCHP and applied to the greens, fairways, and improved roughs by a sprinkler system during the irrigation season. Approximately 65 acres of the 200-acre golf course were irrigated nightly using this water. Supplemental irrigation with STP effluent was performed during the day as needed. Approximately 38 inches of treated wastewater from the STP was applied by sprinkler irrigation between April and November 2004 (Earth Tech 2008).

In addition, processed sludge from the STP was applied as a soil conditioner/fertilizer to the golf course grounds (Sludge Spreading Area [FTC-034/SWMU 33]) from approximately 1972 to 1984 (Earth Tech 2008, Bay West 2008a); however, in 2004 all sludge generated at the STP was transported off-installation and disposed of at the Twin EnviroServices Landfill in Penrose, Colorado (Earth Tech 2008). Sludge from the STP is currently disposed off-installation at the Midway Landfill in Fountain, Colorado.

Other potential PFAS source types were either not identified at the installation or did not prompt further research or constitute categorization as AOPIs. Further discussion regarding areas not retained as AOPIs is presented in **Section 5.1**.

4.4 Readily Identifiable Off-Post PFAS Sources

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

Unassociated with operations at FTC, on 15 June 2004 the Fire Department at Cheyenne Mountain Air Force Station (located northwest of the installation) notified the FTC STP Supervisor that approximately 15 gallons of 3% AFFF was released to the sanitary sewer system. The release occurred at the Inductor Test Area which drains to an oil/water separator located at Aradcom Road and NORAD Road at Cheyenne Mountain Air Force Station. Water from the oil/water separator is conveyed via underground piping to the FTC STP (Ayuda 2017, see **Section 4.3**).

Several municipal fire departments exist within 5 miles of FTC, including those operated by Broadmoor, Stratmoor Hills, Colorado Springs to the north; Security-Widefield, Fountain, and Hanover to the east; and Penrose to the south of the installation. Several water and wastewater treatment plants, laundry facilities, automobile maintenance shops, and car washes are present in these municipalities as well.

In addition, the Colorado Springs Airport is located to the northeast of the installation, and Peterson Air Force Base is located just north of this airport. Peterson Air Force Base has known PFAS impacts to groundwater. Peterson Air Force Base is located on the other side of the Fountain Creek, directly cross gradient from FTC. Groundwater from Peterson Air Force Base does not flow towards FTC.

5 SUMMARY AND DISCUSSION OF PA RESULTS

The areas evaluated for potential PFAS use, storage and/or disposal at FTC were further refined during the PA process and identified either as an area not retained for further investigation or as an AOPI. In accordance with the established process for the PA/SI, 16 have been identified as areas not retained for further investigation and ten have been identified as AOPIs. The process used for refining these areas is presented on **Figure 5-1**, below.

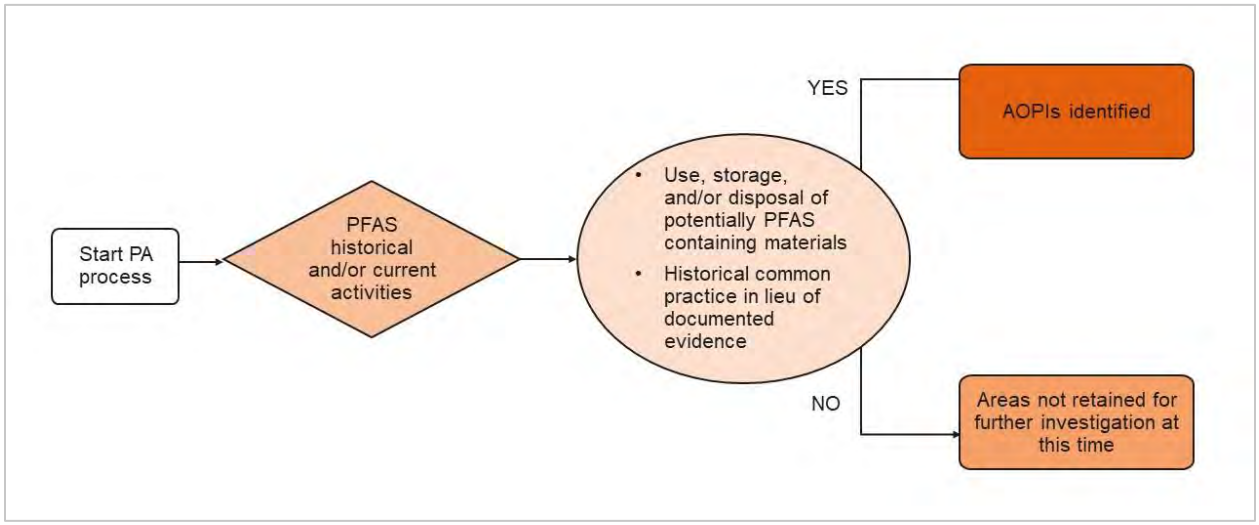

Figure 5-1: AOPI Decision Flowchart

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

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

5.1 Areas Not Retained for Further Investigation

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

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

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

Area Description	Dates of Operation	Relevant Site History	Rationale
SWMU 45 (FTC-017)	1963 to 1996	Range 1 – open burn area used to thermally treat waste explosive propellant from 1963 to 1996.	Fires were intended to burn to completion, no documented use of AFFF on grass fires. No evidence of any additional PFAS

Area Description	Dates of Operation	Relevant Site History	Rationale
		Personnel interviews during the SI indicated fires were not extinguished during the burn process.	containing materials used, stored, and/or disposed of at this location.
SWMU 46 (FTC-018)	1963 to 1987	Range 1A - units training near this area burned excess propellant in the trenches from 1963 until 1987. Personnel interviews during the SI indicated fires were not extinguished during the burn process.	Fires were intended to burn to completion, no documented use of AFFF on grass fires. No evidence of any additional PFAS containing materials used, stored, and/or disposed of at this location.
Building 8000 (FTC-033)	1973 to 1984	Vehicle maintenance, vapor degreaser, underground storage tanks, and potential metal plating.	No evidence of any PFAS containing materials used, stored, and/or disposed of at this location.
SWMUs 55-88, 90-111 (FTC-023)	Not available	Former used/waste oil storage tanks – used to store waste oil, possibly received undocumented hazardous wastes.	No evidence of any PFAS containing materials used, stored, and/or disposed of at this location.
SWMU 16 (FTC-058)	1970s to 1992	Former vapor degreaser – used to clean parts with TCE or 1,1,1-TCA solvents.	No evidence of any PFAS containing materials used, stored, and/or disposed of at this location.
FTC-008	1957	Landfill 4 - Received construction debris, sanitary wastes and possibly small amounts of sludge and waste petroleum, oil, and lubricants for six months in 1957.	No evidence of any PFAS containing materials used, stored, and/or disposed of at this location.
SWMU 14 (FTC-026)	1976 to early 1990s	Pete's Hill Dump - location of herbicides and chlorinated alkanes; received construction debris, municipal waste, and wash rack residuals.	No evidence of any PFAS containing materials used, stored, and/or disposed of at this location.
SWMU 59	1978	Oil waste tank installed in 1978.	No evidence of any PFAS containing materials used, stored, and/or disposed of at this location.
SWMU 21 (FTC-031, FTC-059)	1981, 1990, 1995	IWTP Area	No evidence of any PFAS containing materials used, stored, and/or disposed of at this location.
Pesticide Storage Shop	Currently Used	All pesticides used on site, other than at the golf course, are stored in the pesticide storage shop and must be on the approved pesticide list. Some of the approved	There is no evidence the subset of PFAS containing pesticides on the approved pesticide list were used, stored, or disposed of. No evidence of any additional PFAS

Area Description	Dates of Operation	Relevant Site History	Rationale
		pesticides contain PFAS, however no documented use.	containing materials used, stored, and/or disposed of at this location.
Pesticide Storage at Fort Carson Golf Course	Currently Used	The golf course uses a variety of pesticides during their landscaping activities and maintenance all of which are on the approved pesticide list. Some of the approved pesticides contain PFAS, however no documented use.	There is no evidence the subset of PFAS containing pesticides on the approved pesticide list were used, stored, or disposed of. No evidence of any additional PFAS containing materials used, stored, and/or disposed of at this location.
SWMU 34 (FTC-032)	Before 1981	Drainage ditch basin for vehicle wash rack.	No evidence of any PFAS containing materials used, stored, and/or disposed of at this location.
Hazardous Waste Storage Facility (Building 9246)	2016 to present	Temporary storage of 5-gallons of an unknown foam for approximately 24 hours. Facility stores purge water from SWMUs at BAAF with secondary containment in the northern most building for less than 90 days at a time. Site workers indicated temporary storage is well maintained and no indication of potential release.	No evidence of any PFAS containing materials used, stored, and/or disposed of at this location.
Training Area on McGrath Avenue (Building 3669)	Unknown	ARNG staff recalled training exercises in this area.	No corroborating evidence could be found to confirm fire training at this location. Additionally, the location of the supposed training could not be identified. No documentation of PFAS containing materials use, storage, or disposal.
Helicopter Crash at BAAF	1991	AFFF was reportedly used at the refueling site in the northwestern corner of BAAF in response to a helicopter fire in December 1991. The type and quantity of AFFF used is unknown.	No confirmatory documentation or interviews were identified. No documentation of PFAS containing materials use, storage, or disposal.

5.2 AOPIs

Overviews for each AOPI identified during the PA process are presented in this section. Six of the AOPIs overlap with FTC IRP sites and/or Headquarters Army Environmental System (HQAES) sites (**Figure 5-2**). The AOPI, overlapping IRP site identifier, HQAES number, and current site status are discussed within each AOPI subsection presented below. Other than activities associated with this PA/SI, none of the FTC IRP sites have historically been investigated or are currently being investigated for the possible presence of PFAS.

The AOPI locations are shown on **Figure 5-2**. Aerial photographs of each AOPI that also show the approximate extent of extent of PFAS containing material use, storage, and/or disposal (if applicable) are presented on **Figures 5-3** through **5-9** and include active monitoring wells in the vicinity of each AOPI.

5.2.1 Former Nozzle Testing Area (Former Fire Station, Building 9600)

The Former Nozzle Testing Area at the Former Fire Station (Building 9600) is identified as an AOPI following records research, personnel interviews, and site reconnaissance. Nozzle testing was performed weekly at the Old Fire Station at BAAF from the 1970s to 1991. The exact location of the nozzle testing was regraded significantly in 2008 as the installation shifted focus to mission readiness. Due to the regrading native topsoil is not likely present. The area is currently paved and likely drains into a nearby creek. The current and expected future land use of the area is industrial.

5.2.2 Former Fire Training Area (FTA; FTC-021, SWMU 24, 08005.1016)

The FFTA (FTC-021, SWMU 24, 08005.1016) is identified as an AOPI following records research, personnel interviews, and site reconnaissance due to historical fire training activities that occurred approximately every other week from the 1960s to 1993. Training activities consisted of filling a basin with flammable liquids, igniting the liquids, and using water and AFFF to extinguish the fire. Approximately 800 to 1,000 gallons of flammable liquids were used during each exercise. The amount of AFFF used during each exercise is not known.

FTC-021 was a 60 foot by 60 foot by 3 feet deep concrete basin (which was removed in 1996) located at the east end of BAAF. The water and fire-retardant chemicals used in the exercises were discharged to an oil/water separator. Effluent from the oil/water separator discharged to the adjacent Sewage Treatment Lagoons (FTC-039). Historical samples collected from the oil/ water separator detected metals, chlorinated VOCs (solvents), and total petroleum hydrocarbons. In 2001, the oil/water separator was excavated and disposed of off-post as non-hazardous waste. The site underwent groundwater treatment and monitoring through 2019. Land use controls are currently in place at the overlapping IRP sites. The current and expected future land use of the area is industrial.

5.2.3 Former Sewage Treatment Lagoons (FTC-039, SWMU 23, 08005.1086)

The Former Sewage Treatment Lagoons (FTC-039, SWMU 23, 08005.1086) are identified as an AOPI following records research, personnel interviews, and site reconnaissance. The former lagoons received wastewater (sanitary) from the BAAF facilities and effluent from the former oil/water separator adjacent to the FFTA. The two lagoons were constructed in the 1960s and consisted of two clay-lined evaporation lagoons, each approximately two acres in area. Two overflow outfall pipes, one at each lagoon, allowed diversion of wastewater to the ground surface and runoff into the surface drainage south of the lagoons in the event of overflow conditions. During 1995 field reconnaissance activities, the area below the outfall pipe of the westernmost lagoon showed signs of erosion from a historical release or releases. Flow to the lagoons was discontinued in April 1997 when construction of a pipeline to the STP in the cantonment area was completed. The remaining liquid in the lagoons was pumped out in May and June 1997, and the sludge was allowed to air dry. The sludge was removed from the basins in September 1999 and transported off-site. The lagoons were then excavated to approximately 10 feet bgs to remove underlying soil that contained an unidentified odor. Soil vapor screening and confirmatory soil sampling were not

performed after excavation. The former lagoons were then regraded in December 1999 (Earth Tech 2005). The site underwent groundwater treatment and monitoring through 2019. The current and expected future land use of the area is industrial.

5.2.4 Building 9608 Temporary Storage Location at BAAF

Building 9608 stored an unknown quantity and type of AFFF contained in blue 55-gallon barrels. In 2018 the barrels were turned in to the FTC DPW for disposal. Building 9608 has been demolished. While there are no documented releases of AFFF at this location, minor leaks may have occurred. At the time of the Phase I SI sampling event, temporary AFFF storage areas were not included as AOPIs. However, as the SI evolved it was determined that this area would be included as an AOPI. This AOPI is located at BAAF (**Figure 5-3**).

5.2.5 Hangar 9633 at BAAF

Hangar 9633 historically contained 2,000 gallons of AFFF in the fire suppression system, which was removed in July/August 2018 under contract W9128F-15-D-0034. While there are no documented releases of AFFF at this location, minor leaks may have occurred. At the time of the Phase I SI sampling event, temporary AFFF storage areas were not included as AOPIs. However, as the SI evolved it was determined that this area would be included as an AOPI. This AOPI is located at BAAF (**Figure 5-3**).

5.2.6 Landfill 1 (FTC-005, SWMU 1, 08005.1087)

The Landfill 1 (FTC-005, SWMU 1, 08005.1087) was identified as an AOPI following records research, personnel interviews, and site reconnaissance. Landfill 1 received potentially PFAS-impacted soil and concrete pad material from SMWU 24, the FFTA, in the 1990s and has since been capped. In 2014, construction of the landfill cap was completed. It is currently an open field with vegetation sloping towards the northeast with paved storm drainages on the eastern side. Long term monitoring will continue for a minimum of 30 years. Land use controls are currently in place at Landfill 1. The current and expected future land use of the area is industrial.

5.2.7 Grit/Oil Pit (FTC-020, SWMU 13, 08005.1015)

The Grit/Oil Pit (FTC-020, SWMU 13, 08005.1015) was identified as an AOPI following records research, personnel interviews, and site reconnaissance. The area was used as an open pit for disposal of materials from the vehicle wash facilities and sludge from the industrial and sanitary wastewater treatment plant. The operations were conducted from the 1960s to 1992 when materials were placed in a trench approximately 240 feet by 60 feet by 30 feet. Additionally, the Grit/Oil Pit would periodically receive accumulated oil from the oil/water separator adjacent to the FFTA.

In 1998, a temporary cap was placed over the pit to reduce surface water infiltration. In 1999 and between November 2004 and January 2005, oily product and the contents of the Grit/Oil Pit were removed. It is currently an open field with vegetation sloping towards the northeast with paved storm drainages on the eastern side. The Grit/Oil Pit is undergoing remedial operations monitoring, cover maintenance, and groundwater treatment to continue through at least 2030. Land use controls are

currently in place at the Grit/Oil Pit, and it is currently capped. The current and expected future land use of the area is industrial.

5.2.8 Fort Carson Sewage Treatment Plant (STP; FTC-042, SWMU 22, 08005.1036)

The STP is a tertiary treatment facility that has operated since the 1940s. The STP receives sanitary wastewater from throughout the cantonment area of FTC and beginning in 1981, also receives treated water from the IWTP effluent. In 1988, the digesters and trickling filters at the STP ceased normal operation due to a toxics load entering the plant. A 4,000-gallon oil spill into a manhole resulted in operational issues at the STP. Low levels of VOCs, semi-VOCs, and metals were detected in a few sample locations beneath the foundations and floors of the STP, collected during a 1999 facility upgrade. The STP received a No Further Action notice in 2013.

On June 15, 2004, the Fire Department at Cheyenne Mountain Air Force Station (AFS) notified the Fort Carson STP Supervisor that approximately 15 gallons of 3% AFFF was released to the sanitary sewer system. The release occurred at the Inductor Test Area which drains to an oil/water separator located at Aradcom Road and NORAD Rd at Cheyenne Mountain AFS. Water from the oil/water separator is conveyed via underground piping to the Fort Carson STP (Ayuda 2017). It is unlikely that any PFAS -containing material was released to the environment from this event as the STP is a self-contained system with the only release points being the very end where effluent discharges or gets pumped up to the golf course. During this particular time a very large majority of the effluent would have been pumped up to the golf course and not discharged. The Cheyenne Mountain AFS PA/SI concluded the oil water separator overflow area, the location of the initial release, would not be moving forward to a remedial investigation based on the data collected (Ayuda 2017). In addition, the STP is going through its NPDES renewal, and it is a foregone conclusion that PFAS testing will be required.

5.2.9 Fort Carson Golf Course (FTC-034 and FTC-036, SWMUs 32 and 33, 08005.1028 and 08005.1030)

The Fort Carson Golf Course (FTC-034 and FTC-036, SWMUs 32 and 33, 08005.1028 and 08005.1030) is identified as an AOPI following records research, personnel interviews, and site reconnaissance. Treated effluent from the STP is discharged to two permitted outfalls. In the summer, most of the effluent is discharged to the GCHP (FTC-036/SWMU 32), a permitted outfall that receives and reserves treated effluent from the STP. The pond water is used for irrigation of the golf course and as a reserve for firefighting at the clubhouse. The GCHP has received treated STP effluent via an approximately 3-mile long, 12-inch diameter permanent line since 1972.

In 2004, the same year the STP received approximately 15 gallons of 3% AFFF, the GCHP received approximately 800,000 to 850,000 gallons of STP effluent per day. During the time of year that the GCHP would have received the effluent presumably containing some AFFF residual, the golf course would be irrigating the total area heavily once per day. Therefore, any AFFF still remaining in the water would be extremely dilute and spread over 80 acres. The GCHP overflows through a small ditch to a Water Hazard Pond located between the second fairway and the southern edge of a prominent hill. Drainage from the Water Hazard Pond continues eastward via a ditch that passes beneath Harr Avenue and terminates on the eastern edge of the golf course. Similar to the STP, it is unlikely that any PFAS -containing material was released to the environment from this event.

Previous environmental investigations were performed to evaluate the impact of treated effluent from the STP on the GHCP. Sediment, groundwater, and surface water samples collected during these investigations identified chemicals of potential concern in groundwater and sediment; however, their significance was determined suspect due to upgradient detections and poor correlation with available STP data, respectively. No further restoration action was deemed necessary at the GCHP in 2009. The GCHP was dredged and reconfigured in 2013; associated sediments were disposed of at an off-site facility. The current and expected future land use of the area is commercial and is accessed by recreational users.

5.2.10 Building 8110 Foam Storage Area

Building 8110 Foam Storage is identified as an AOPI following records research, personnel interviews, and site reconnaissance. Building 8110 was previously owned by the ARNG, which operated the building from an unknown time until 2018. ARNG operations that involved potential release of PFAS include the storage of two fire trucks, 13 55-gallon drums of AFFF, and 33 5-gallon buckets of AFFF. The Fort Carson DPW now owns Building 8110.

5.2.11 ARNG Building 1982 Foam Storage Area

ARNG Building 1982 Foam Storage is identified as an AOPI following records research, personnel interviews, and site reconnaissance. Building 1982 is being investigated for potential release of PFAS due to operations between 2018 and 2019. ARNG trucks, 13 55-gallon drums and 33 5-gallon buckets of AFFF were transferred to Building 1982 in mid-2018 and housed there until they were moved offsite in late 2019.

5.2.12 Piñon Canyon Maneuver Site (PCMS) Hill Ranch AFFF Storage Area

Piñon Canyon Maneuver Site (PCMS) Hill Ranch AFFF Storage is identified as an AOPI following records research, personnel interviews, and site reconnaissance. This AOPI has been in operation from the mid-1980s to present. Current operations that involve potential release of PFAS include the storage of a crash truck that uses AFFF for training purposes as well as storage of AFFF.

6 SUMMARY OF PHASE I AND PHASE II SI SAMPLING ACTIVITIES

Data collected during the PA phase, as well as historical analytical data from PFOS, PFOA, and PFBS sampling events at BAAF, indicate all AOPIs as likely primary source areas in which PFAS releases are documented or are likely to have occurred. These AOPIs are potentially impacting drinking water off-installation; therefore, the Army directed Arcadis to conduct Phase I and Phase II SI sampling at FTC in order to identify potential drinking water impacts and presence or absence of PFOS, PFOA, and PFBS at the AOPIs. As such, an installation-specific Sampling Work Plan (Arcadis 2019a) was developed to support the Phase I SI sampling event and a comprehensive installation-specific QAPP Addendum (Arcadis 2019d) was developed to support the Phase II SI sampling event. Both site-specific documents supplement the general programmatic information provided in the PQAPP (Arcadis 2018b and 2019c) and detail the site-specific proposed scopes of work. The Phase I and Phase II SI sampling scopes of work were completed through the collection of field data and analytical samples. The Phase I SI scope of work was completed in February 2019 with subsequent off-installation supply well sampling completed in July 2019. The Phase II SI scope of work was completed in December 2019.

The PA and SI field work was completed in accordance with the standard operating procedures (SOPs), technical guidance instructions (TGIs), sampling design, and QA/QC requirements as detailed in the Sampling Work Plan (Arcadis 2019a), QAPP Addendum (Arcadis 2019d) and PQAPP (Arcadis 2018b, 2019c). The subsections below summarize the DQOs, sampling design and rationale, sampling activities and methods, and data analyses procedures for the SI phase at FTC. Non-conformances to the prescribed procedures in the PQAPP and QAPP Addendum are described in **Section 6.3.3**. Analytical results obtained through SI field activities are summarized in **Section 7**.

6.1 Data Quality Objectives

As identified during the DQO process and outlined in the site-specific QAPP Addendum (Arcadis 2019d), the objective of the SI is to identify whether there has been a release to the environment at the AOPIs identified in the PA and determine whether further investigation is warranted. This PA and SI evaluated groundwater and soil for PFOS, PFOA, or PFBS presence or absence at each of the sampled AOPIs.

6.2 Sampling Design and Rationale

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

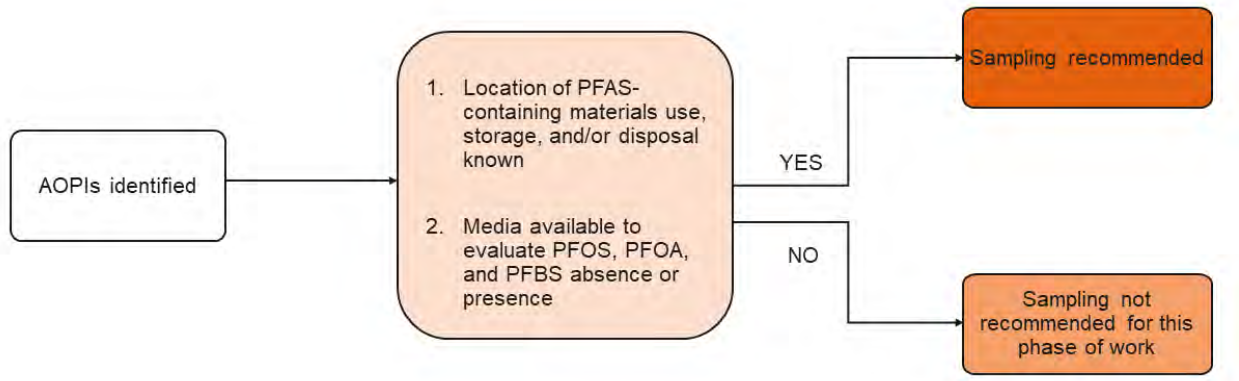

Figure 6-1: AOPI Sampling Decision Tree

6.2.1 Phase I SI and Off-Installation Supply Well Sampling Design and Rationale

The sampling design for Phase I SI sampling activities at FTC is detailed in Worksheet #17 of the Sampling Work Plan (Arcadis 2019a). Briefly, groundwater samples were collected from Strobel Well (on-installation drinking water supply well) and existing monitoring wells at and downgradient from BAAF AOPIs in areas with known or suspected PFAS release. Groundwater was sampled to identify PFOS, PFOA, and/or PFBS presence and concentrations. The targeted sampling areas were believed to have the potential for the greatest PFAS concentrations closest to known or suspected releases of AFFF. PFOS, PFOA, and PFBS had been detected in monitoring wells in the BAAF AOPI during previous 2016 investigation activities. Select monitoring wells with significant PFOS, PFOA, and/or PFBS detections were chosen for resampling. The existing monitoring wells sampled at BAAF were chosen based on existing site information (e.g., known AFFF releases and local groundwater gradient) and typically included one or more source area (or near source area) wells and one or more downgradient wells. Additional downgradient and boundary wells were sampled to identify if any off-installation sampling of drinking water receptors was warranted.

Upon receiving the Phase I SI sampling results it was determined by FTC, USACE, and USAEC that additional immediate sampling was required in two off-installation water wells located southeast of BAAF. The private water wells, Well 1 and Well 2, are not currently used for potable water supply or any other use. This sampling event followed the design outlined in the Sampling Work Plan (Arcadis 2019a). Groundwater was sampled to identify PFOS, PFOA, and/or PFBS presence and concentration. Note that the well name was inadvertently switched in the sample IDs for these two supply wells (e.g., Well 1 has a sample ID of FTC-SCHMIDT2-070219).

Approximate sampling depths, sampling methods, and constituents analyzed for each sampling location and medium collected during Phase I SI sampling are included in **Table 6-1**. Sampling depths noted for existing monitoring wells represent approximately the center of the saturated screened interval. Available construction details for existing monitoring wells included in the Phase I SI sampling scope of work are included in **Table 6-2**.

6.2.2 Phase II SI Sampling Design and Rationale

The sampling design for Phase II SI sampling activities at FTC is detailed in Worksheet #17 of the QAPP Addendum (Arcadis 2019d). Briefly, groundwater and/or soil samples were collected at or downgradient of all twelve AOPIs with known or suspected PFAS release. Groundwater and soil were sampled to identify PFOS, PFOA, and/or PFBS presence and concentrations, as well as total organic carbon, pH, and grain size for soil samples. The targeted sampling areas are believed to have the potential for the greatest PFOS, PFOA, and PFBS concentrations closest to known or suspected releases of potential PFOS, PFOA, and/or PFBS containing materials. The existing monitoring wells sampled at each AOPI typically included one or more source area (or near source area) wells and one or more downgradient wells. Phase II SI sampling at BAAF, however, included resampling existing downgradient monitoring wells near or along the installation boundary as well as groundwater upgradient of the BAAF AOPIs and groundwater near potential source areas. Soil samples were taken at locations that did not have existing monitoring wells at or near the potential source area, including the Former Nozzle Testing Area (Former Fire Station, Building 9600), Fort Carson Sewage Treatment Plant (FTC-042, SWMU 22), and the Fort Carson Golf Course (FTC-034 and FTC-036, SWMUs 32 and 33), in order to evaluate source strength.

Approximate sampling depths, sampling methods, and constituents analyzed for each sampling location and medium collected during Phase II SI sampling are included in **Table 6-1**. Sampling depths noted for existing monitoring wells represent approximately the center of the saturated screened interval. Available construction details for existing monitoring wells included in the Phase II SI sampling scope of work are included in **Table 6-2**.

6.3 Sampling Methods and Procedures

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

The sampling methods employed during the SI are detailed in the PQAPP (Arcadis 2018b, 2019c), Sampling Work Plan (Arcadis 2019a), and QAPP Addendum (Arcadis 2019d). The subsections below provide a summary of the field methods and procedures utilized to complete the SI scope of work. Field notes and field forms (i.e., soil boring logs and groundwater purging logs) documenting the Phase I and Phase II SI sampling activities are included in **Appendices K** and **L**, respectively. Photographs of the Phase II SI sampling activities are included in **Appendix M**.

6.3.1 Field Methods

Groundwater samples were collected using low-flow purging methods from approximately the center of the saturated screened interval at existing monitoring wells. Groundwater samples were collected depending on field conditions, either a peristaltic pump or portable bladder pump with PFAS-free disposable high-density polyethylene tubing or a PFAS-free disposable bailer was used to collect groundwater samples through a screen-point sampler. In the event a monitoring well was not able to be sampled by low-flow sampling (low-yield wells with low or no recovery), conventional sampling techniques using a polyvinyl chloride or high-density polyethylene (HDPE) bailer were followed as outlined in the Fort Carson Final Field and Laboratory Procedures Manual (Kemron Environmental Services, Inc. [Kemron] 2018) while following PFAS-specific protocols outlined in the PQAPP (Arcadis 2019d). The groundwater sample taken at SEEP1 was collected using the direct-fill method at the location that appeared to have the highest flow.

Soil samples were collected via direct-push technology (DPT) drilling method in accordance with the TGI P-12 in Appendix A to the PQAPP [Arcadis 2019c]) at the Former Nozzle Testing Area, Sewage Treatment Plant, and the Fort Carson Golf Course. DPT borings were completed using a single-tube drilling method. If possible, boring locations were positioned within the suspected release area. Soil samples were collected from the top two feet of native soil.

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

6.3.2 Quality Assurance/Quality Control

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

QA/QC samples were collected at the frequencies specified in the Sampling Work Plan (Arcadis 2019a) and QAPP Addendum (Arcadis 2019d). Typically, QA/QC samples were collected at a rate of 1 per 20 parent samples; however, field duplicates were collected at a rate of two per 20 parent samples during Phase II SI sampling activities in accordance with the Fort Carson Final Field and Laboratory Procedures Manual (Kemron 2018). Field duplicates and matrix spike/matrix spike duplicate samples were collected for media sampled for PFAS, including PFOS, PFOA, and PFBS, only. EBs were collected for media sampled for PFAS, including PFOS, PFOA, and PFBS, at a frequency of one per piece of relevant equipment for each sampling event, as specified in the Sampling Work Plan (Arcadis 2019a) and QAPP Addendum (Arcadis 2019d). The decontaminated equipment from which EBs were collected include tubing, drill casing and cutting shoes, hand auger, water-level meters, HDPE bladders, bladder pump screen, and HDPE bailer, as applicable to the sampled media. Source blanks were collected from the water used to pressure-wash drill tooling. Analytical results for QA/QC samples are discussed in **Sections 7.1.3** and **7.2.9.**

6.3.3 Dedicated Equipment Background

One dedicated equipment background (DEB) sample was collected at one AOPI where groundwater sampling was conducted at an existing monitoring well that contained dedicated, down-hole equipment. When collecting samples from the monitoring well with dedicated, down-hole equipment, two water samples were taken from the monitoring well. One DEB sample was collected from the first water produced through the pump and tubing and was used to evaluate whether the dedicated equipment may be impacting the PFOS, PFOA, and/or PFBS results, as it is unknown if the dedicated equipment was comprised of PFOS, PFOA, and/or PFBS-containing components; PFAS concentrations in the DEBs reflect concentrations of stagnant groundwater, and they may be biased high by contributions from equipment that contains PFOS, PFOA, and/or PFBS components. The parent sample was collected after the well was purged until the field parameters stabilized. Further DEB analysis is included in **Section 7.2.10**.

6.3.4 Field Change Reports

Non-conformances to the approved sampling scope and/or procedures may occur during the sampling events. In some cases, clarifications to the established scope of work were needed but do not necessarily constitute a non-conformance from the sampling plans described in the QAPP Addendum (or Sampling Work Plan). Minor modifications from and clarifications for the procedures and scope of work detailed in the Sampling Work Plan, QAPP Addendum, and PQAPP that did not affect DQOs are summarized below.

<u>February 2019</u>

[Field Change Report: FCR-FTC-01]

- Wells BECSMW200 and BECSMW201 were found with minimal water and very low recharge. The wells were purged dry and allowed 72 hours to recharge but did not recharge enough to collect a sample during that time. Proximal wells that were included in the sampling plan were successfully sampled and presence or absence of PFOS, PFOA, and PFBS in the associated AOPIs was still possible.

<u>December 2019</u>

[Field Change Report: FCR-FTC-02]

- Monitoring well CLAMW30 was unable to be located, monitoring well GPMW07A was unable to be sampled due to dedicated equipment that was not removable, and SEEP8 was dry at the time of the sampling event. These locations were not sampled but after discussing with FTC, USAEC, and USACE, it was determined that replacement sample locations were not necessary as determination of presence or absence of PFOS, PFOA, and PFBS was still possible based on data from other wells.

<u>November 2020</u>

[Field Change Report: FCR-FTC-03]

- Three soil samples via hand auger were not able to be collected from the ARNG Building 1982 AOPI due to the area being covered by concrete, and as a result, the field duplicate was not collected at this AOPI as proposed. Presence or absence of PFOS, PFOA, and PFBS at this AOPI was still

possible based on PFOS, PFOA, and PFBS data from side gradient and downgradient groundwater samples.

Additionally, following the determination of additional AOPIs due to AFFF storage, a field change report was prepared to document the sampling scope and reason for inclusion. The field change report is included as FCR-FTC-04 in **Appendix N**.

Non-conformances were reviewed and approved in accordance with the following chain of communication: 1) minor modifications or clarifications were communicated within the Arcadis field team; and 2) major modifications were communicated to USACE in the daily/periodic field status email updates submitted by the regional lead during the sampling event. Non-conformances to the approved sampling plan which affect the DQOs are documented in Non-Conformance Reports included as **Appendix O** and are summarized below.

December 2019

[Non-Conformance Report: NCR-FTC-01]

- Soil borings at the Former Nozzle Testing Area, Fort Carson STP (FTC-042, SWMU 22), and Fort Carson Golf Course (FTC-034 and FTC-036, SWMUs 32 and 33) AOPIs hit refusal prior to reaching groundwater, and well W89MW12, slightly downgradient from the Former Nozzle Testing Area, had not been reinstalled at the time of the Phase II SI sampling. Groundwater was not able to be sampled at these locations, but soil was collected as planned and groundwater samples were taken from existing monitoring wells downgradient from the Former Nozzle Testing Area.

6.3.5 Decontamination

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

6.3.6 Investigation-Derived Waste

Investigation-derived waste (IDW), including soil cuttings, groundwater, decontamination fluids, and disposable equipment were collected and placed in Department of Transportation-approved 55-gallon drums, labeled for pending analysis, segregated by medium: waters, soil/sediment, and equipment IDW, and held at the hazardous waste facility at FTC. Equipment IDW includes personal protective equipment and other disposable materials (e.g., gloves, plastic sheeting, Lexan tubes, and HDPE and silicon tubing) that may come in contact with sampling media. All IDW drums produced during the Phase I and Phase II SI have been removed of and disposed of by FTC DPW.

6.4 Data Analysis

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

6.4.1 Laboratory Analytical Methods

Analytical samples collected during the PA were submitted to Gulf Coast Analytical Laboratories, Inc. and samples collected during the SI were submitted to Eurofins Lancaster Laboratories Environmental, both of which are ELAP-accredited laboratory for PFAS analysis, including PFOS, PFOA, and PFBS. Laboratory analyses associated with the SI were completed in accordance with Worksheets #12.1 through #12.5 in the PQAPP (Arcadis 2019c). Eighteen PFAS-related compounds, including PFOS, PFOA, and PFBS, were analyzed for in groundwater and soil samples using a PFAS analytical method that is ELAP-accredited and compliant with QSM 5.1.1, Table B-15 (**Appendix Q**; DoD 2018). Copies of laboratory analytical reports generated during the SI are included as attachments to the Data Usability Summary Report (DUSR) in **Appendix P**.

Additionally, the following general chemistry and physical characteristic analyses were completed for select soil and sediment samples in accordance with Worksheet #18 of the QAPP Addendum (Arcadis 2019d) by the analytical method noted:

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

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

6.4.2 Data Validation

All analytical data generated during the SI, except grain size, were verified and validated in accordance with the data verification procedures described in Worksheets #34 through #36 of the PQAPP (Arcadis 2019c). Each laboratory data package/sample delivery group underwent Stage 3 data validation in accordance with DoD QSM 5.1.1 (DoD 2018). Additionally, 10% of the data underwent Stage 4 data validation. Copies of the data validation reports for each sample delivery group are included as attachments to the DUSR in **Appendix P**.

6.4.3 Data Usability Assessment and Summary

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

Based on the final data usability assessment, the environmental data collected at FTC during the Phase I and Phase II SI sampling were found to be valid and usable except for the 11 results that were rejected. The 11 results were rejected due to Extracted Internal Standard recoveries less than 10% affecting four sample locations: FTC-CUD7-021219, FTC-FD-021219, FTC-AHA-021219, and FTC-LFC4-021219. No

PFOS, PFOA, or PFBS results were rejected during data validation. The completeness for this data set does meet the criteria of 90%.

The results that are qualified as estimated are usable with caution. Additional qualifications are documented in the DUSR and its associated data validation reports (**Appendix P**), and as indicated in the full analytical tables (**Appendix Q**) provided for the Phase I and Phase II SI results. These data are of sufficient quality to meet the objectives and requirements of the PQAPP (Arcadis 2018b, 2019c), FTC Sampling Work Plan (Arcadis 2019a) and QAPP Addendum (Arcadis 2019d). Data qualifiers applied to laboratory analytical results for samples collected during the SI at FTC are provided in the data tables, data validation reports, and the Data Usability Summary Table located at the end of DUSR. Qualifiers for data shown on figures are defined in the notes of figures.

6.5 Project Screening Levels

The laboratory LOD is defined as "the lowest concentration for reliable reporting of a non-detect of a specific analyte in a specific matrix with a specific method at 99 percent confidence" (DoD 2017). The laboratory analyte-, sample-, and batch-specific LODs are used as the project screening levels (PSLs) to evaluate the presence or absence of the PFOS, PFOA, and PFBS constituents analyzed for during this SI. Since the PSLs are equivalent to the LODs, PSLs vary slightly depending on the sample- and batch-specific LODs reported by the laboratory for each analyte. For this SI, the presence/absence of PFAS constituents was evaluated as follows:

- If PFAS, including PFOS, PFOA, and PFBS, are not detected at concentrations greater than the PSLs, PFAS are not present.
- If PFAS, including PFOS, PFOA, and PFBS, are detected at concentrations greater than or equal to the PSLs, PFAS are present.

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

While PSLs (i.e., the LODs) are used to identify presence or absence of PFOS, PFOA, and PFBS at the AOPIs sampled during the SI, the analytical data are compared to OSD risk screening levels (**Appendix A**) to make recommendations for further study in remedial investigations as described in **Section 6.6**.

6.6 Office of the Secretary of Defense Risk Screening Levels

The OSD risk screening levels for PFOS, PFOA, and PFBS in groundwater (tap water) and soil were calculated using the USEPA's RSL calculator for residential and industrial/commercial worker receptor scenarios and current toxicity values. These risk screening levels are shown in **Table 6-3**.

Table 6-3 OSD Risk Screening Levels Calculated for PFOS, PFOA, PFBS in Tap Water and Soil Using USEPA's Regional Screening Level Calculator

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

Notes:

1. Risk screening levels for tap water and soil provided by the OSD. 2021. Memorandum: Investigating Per- and Polyfluoroalkyl Substances within the Department of Defense Cleanup Program. September 15 (**Appendix A**).
2. All soil data will be screened against both the Residential Scenario and Industrial/Commercial risk screening levels (if collected from less than 2 feet below ground surface), regardless of the current and projected land use of the AOPI.
mg/kg = milligram per kilogram
ng/L = nanograms per liter
ppm = parts per million
ppt = parts per trillion

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

7 SUMMARY AND DISCUSSION OF ANALYTICAL RESULTS

This section summarizes the analytical results obtained from samples collected during the SI at FTC (field duplicate results are provided in the associated tables). Sampled media and QA/QC samples were analyzed for the constituents prescribed per Worksheet #18 of the QAPP Addendum (Arcadis 2019d). The sample results discussion below focuses on the PFOS, PFOA, and PFBS analytical results due to these constituents' relevance to the OSD risk screening levels. The Army will make subsequent investigation decisions based on these constituents' concentrations relative to the screening criteria described above.

Tables 7-1 and **7-2** provide a summary of the groundwater and soil analytical results for PFOS, PFOA, and PFBS only. **Appendix Q** includes the full suite of analytical results for these media, as well as for the QA/QC samples. An overview of AOPIs at FTC with OSD risk screening level exceedances is depicted on **Figure 7-1**. **Figures 7-2** through **7-9** show the PFOS, PFOA, and PFBS analytical results in groundwater and soil for each AOPI. Non-detected results are reported as less than the LOQ. PFOS, PFOA, and/or PFBS concentrations detected between the LOD and LOQ are estimated, as indicated with a J laboratory qualifier, and will be interpreted as presence. Detected concentrations of PFAS greater than the LODs (i.e., PFOS, PFOA, and/or PFBS are present) are bolded in summary tables and on figures for the sampled media in accordance with the methodology described in **Section 6.5**. Detections of PFOS, PFOA, and/or PFBS greater than the applicable OSD risk screening levels are highlighted in summary tables and on figures. Final qualifiers applied to the data by the laboratory and the project chemist are presented on the analytical tables. Groundwater and surface water data collected during the SI are reported in ng/L, or parts per trillion, and soil and sediment data are reported in mg/kg, or parts per million.

Field parameters measured for groundwater during low-flow purging and sample collection are provided on the field forms in **Appendix L**. Soil lithological descriptions are provided on the field forms in **Appendix L**. The results of the SI are grouped by AOPI and discussed for each medium as applicable. Groundwater was encountered at 20 to 35 feet bgs at the BAAF AOPIs and Landfill 1 and the Grit/Oil Pit. Groundwater was not encountered between 25 to 30 feet at the STP and the golf course and therefore was unable to be collected.

7.1 Summary of Phase I SI Sampling Results

The following sections discuss the findings of the Phase I SI sampling, including sampling of the off-installation water wells**.**

7.1.1 Phase I SI sampling

Groundwater sampling was conducted at nine monitoring wells at and/or downgradient of the BAAF AOPIs (Former Nozzle Testing Area [Former Fire Station, Building 9600], Former Fire Training and Storage Area [FTC-021, SWMU 24, 08005.1016], Sewage Treatment Lagoons [FTC-039, SWMU 23, 08005.1086], Building 9608 Temporary Storage Area, and Hangar 9633) in order to identify the potential threat to off post human receptors downgradient in February 2019 (**Table 7-1** and **Figure 7-3**).

PFOS, PFOA, and PFBS were detected at concentrations greater than the LOD and the OSD risk screening levels at the groundwater samples collected at the FFTA and the Former Sewage Treatment Lagoons in monitoring wells BECSMW13 (5,600 D ng/L PFOS, 151,000 EDJ ng/L PFOA, and 3,710 D ng/L) and BECSMW28R (16,500 D ng/L PFOS, 4,450 D ng/L PFOA, and 694 ng/L PFBS).

PFOS and PFOA were also detected greater than the LOD and the OSD risk screening level in downgradient wells RC2 (1,800 D ng/L PFOS and 221 ng/L PFOA) and TH5 (169 [163] ng/L PFOS and 49.2 [47.3] ng/L PFOA). PFBS was detected above the LOD but below the OSD risk screening level in RC2 (89.1 ng/L) and in TH5 (32.5 [32.0] ng/L).

PFOS and PFOA were not detected above the LOD or the OSD risk screening level in the furthest south monitoring well that was sampled, LFC4, however, PFBS was detected above the LOD with a concentration of 3.83 J ng/L.

Slightly northeast of BAAF, at monitoring well CUD7, PFOS and PFOA were detected above the LOD but below the OSD risk screening level with concentrations of 7.10 J ng/L PFOS and 4.89 J ng/L PFOA. PFBS was also detected above the LOD but below the OSD risk screening level with a concentration of 13.2 ng/L.

At monitoring well AHA, located directly south of BAAF, PFOA was detected above the LOD but below the OSD risk screening level with a concentration of 11.7 ng/L. PFOS and PFBS were not detected above the LOD or the OSD risk screening level.

Monitoring wells BECSMW200 and BECSMW201 were included in the sampling scope and were purged dry quickly when using the low flow technique. The wells were given 72 hours of recharge time and then an additional attempt to sample was made. The wells did not recharge enough for a groundwater sample to be collected. Therefore, there is no PFAS groundwater data for these wells.

7.1.2 Off-Installation Water Well Sampling

Sampling was completed in July 2019 at two water wells, Well 1 and Well 2, located off-installation and downgradient from the BAAF AOPIs. PFOS and PFOA were detected above the LOD and the OSD risk screening level at both wells. Well 1 had concentrations of 140 J ng/L PFOS and 81 ng/L PFOA, and Well 2 had concentrations of 280 DJ [260 DJ] ng/L PFOS and 330 D [270D] ng/L PFOA. PFBS was detected in both wells above the LOD but below the OSD risk screening levels with a concentration of 57 ng/L in Well 1 and 200 D [180 D] ng/L in Well 2 (**Figure 7-3** and **Table 7-1**).

7.1.3 Phase I Blank Samples

PFOS, PFOA, and PFBS were not detected at concentrations greater than the LODs in any of the equipment blanks that were collected. The full analytical results for QA/QC samples collected during the SI are included in **Appendix Q**.

7.2 Summary of Phase II SI Results

The subsections below discuss the findings of the Phase II SI sampling results from the twelve AOPIs collected during December 2019 and November 2020.

7.2.1 BAAF AOPIs (Former Nozzle Testing Area, FFTA, and Sewage Treatment Lagoons, Building 9608 Temporary AFFF Storage Area, and Hangar 9633)

The subsections below describe the PFOS, PFOA, and PFBS analytical results from soil and groundwater samples collected at BAAF AOPIs.

7.2.1.1 Soil

PFOS and PFOA concentrations were greater than the LOD but less than the OSD risk screening level in shallow soil (0-2 feet bgs) at borings FNTA-01-SO (0.074 mg/kg PFOS and 0.0044 mg/kg PFOA) and FNTA-02-SO (0.11 DJ [0.072] mg/kg PFOS and 0.0010 [0.00073] mg/kg PFOA, **Figure 7-3** and **Table 7-2**). PFBS was not detected above the LOD or OSD risk screening level at either shallow soil sample.

7.2.1.2 Groundwater

Groundwater sampling was conducted at six monitoring wells and one SEEP location at and/or downgradient of the BAAF AOPIs (Former Nozzle Testing Area [Former Fire Station, Building 9600], Former Fire Training and Storage Area [FTC-021, SWMU 24, 08005.1016], and Sewage Treatment Lagoons [FTC-039, SWMU 23, 08005.1086], Building 9608 Temporary AFFF Storage Area, and Hangar 9633), and at one monitoring well located upgradient of the BAAF AOPIs (**Figure 7-3** and **Table 7-1**).

PFOS and PFOA were detected in monitoring well CUD6, located upgradient of BAAF, above the LOD and the OSD risk screening level with concentrations of 1,300 D ng/L PFOS, and 98 ng/L PFOA. PFBS was detected above the LOD but below the OSD risk screening level with a concentration of 250 D ng/L.

PFOS and PFOA were detected above the LOD and the OSD risk screening level in downgradient wells RC2 (1,300 D [1,300 D] ng/L PFOS and 190 D [180 D] ng/L PFOA) and TH5 (170 ng/L PFOS and 63 J ng/L PFOA). PFBS was detected above the LOD but below the OSD risk screening level in RC2 (93 [93] ng/L) and in TH5 (49 ng/L).

PFOS and PFOA were not detected above the LOD or the OSD risk screening level in the furthest south monitoring well, LFC4, however, PFBS was detected above the LOD with a concentration of 4.7 ng/L.

Slightly northeast of BAAF, at monitoring well CUD7, PFOS and PFOA were detected above the LOD but below the OSD risk screening level with concentrations of 6.0 ng/L PFOS and 5.8 J ng/L PFOA. PFBS was also detected above the LOD but below the OSD risk screening level with a concentration of 15 ng/L.

At monitoring well AHA, located directly south of BAAF, PFOA was detected above the LOD but below the OSD risk screening level with a concentration of 7.0 J ng/L. PFOS and PFBS were not detected above the LOD or the OSD risk screening level.

Two seeps, which are representative of groundwater, were proposed for sampling during the SI (SEEP1 and SEEP8), however, SEEP8 was found to be dry at the time of sampling as discussed in **Section 6.3**. PFOS and PFOA were detected above the LOD and the OSD risk screening level in the groundwater sample collected from SEEP1 with concentrations of 910 D ng/L PFOS and 520 D ng/L PFOA. PFBS was detected above the LOD but below the OSD risk screening level with a concentration of 140 ng/L.

Monitoring wells BECSMW200 and BECSMW201 were again included in the sampling scope and were purged dry quickly when using the low flow technique. The wells were given 72 hours of recharge time

and then an additional attempt to sample was made. The wells did not recharge enough for a groundwater sample to be collected. Therefore, there is no groundwater PFAS data for these wells.

7.2.2 Landfill 1 (FTC-005, SWMU 1, 08005.1087)

Groundwater sampling was conducted at four existing monitoring wells at Landfill 1 (**Figure 7-4** and **Table 7-1**). Two monitoring wells, CLAMW12 and MW95-01, are located in the northeastern border of the landfill and two monitoring wells, OP03 and CLAMW41, are located on the southeastern perimeter of the landfill. At CLAMW12 and MW95-01, PFOS and PFOA were detected above the LOD but below the OSD risk screening level with concentrations of 3.4 ng/L PFOS and 9.3 J ng/L PFOA at CLAMW12 and 1.4 J ng/L PFOS and 1.7 J ng/L PFOA at MW95-01. At CLAMW41 PFOS was not detected above the LOD or the OSD risk screening level and PFOA was detected above the LOD but below the OSD risk screening level with a concentration of 1.1 J ng/L. PFOS, PFOA, and PFBS were detected above the LOD and the OSD risk screening levels at OP03 with concentrations of 90 ng/L PFOS, 160 J ng/L PFOA, and 770 D ng/L PFBS.

PFBS was detected in groundwater above the LOD but below the OSD risk screening level in three monitoring wells sampled at the landfill with concentrations of 15 ng/L at CLAMW12 and 1.5 J ng/L at CLAMW41. PFBS was not detected above the LOD or the OSD risk screening level at monitoring well MW95-01.

7.2.3 Grit/Oil Pit (FTC-020, SWMU 13, 08005.1015)

Groundwater sampling was conducted at three existing monitoring wells at the Grit/Oil Pit located at the southern perimeter of the pit (**Figure 7-4** and **Table 7-1**).

At all three existing monitoring wells, GPMW02, GPMW08, and GPPZ21, PFOS, PFOA, and PFBS were detected above the LOD and the OSD risk screening level with concentrations of 9,300 D ng/L PFOS, 6,600 DJ ng/L PFOA, and 6,600 D ng/L PFBS at GPMW02, 460 [550] ng/L PFOS, 4,100 DJ [4,200 DJ] ng/L PFOA, and 9,800 D [9,400 D] ng/L PFBS at GPMW08, and 55,000 DJ ng/L PFOS, 9,700 D ng/L PFOA and 7,500 D ng/L PFBS at GPPZ21.

7.2.4 Fort Carson Sewage Treatment Plant (FTC-042, SWMU 22, 08005.1036)

Soil sampling was conducted at one location downstream of the STP outfall (**Figure 7-5**). PFOS, PFOA, and PFBS were not detected above the LOD or the OSD risk screening level in this soil sample (**Table 7-2**). Attempts to sample groundwater were made at the DPT boring, however refusal was encountered prior to groundwater. When refusal was met at approximately 25 feet bgs, the soil was dry and crumbly indicating groundwater would not be encountered at that depth.

7.2.5 Fort Carson Golf Course (FTC-034 and FTC-036, SWMUs 32 and 33, 08005.1028 and 08005.1030)

Soil sampling was conducted at one location at the Fort Carson Golf Course, located downgradient from the Fort Carson Golf Course Holding Pond. PFOS and PFOA were detected above the LOD but below the OSD risk screening level with concentrations of 0.0060 mg/kg PFOS and 0.00062 J mg/kg PFOA. PFBS was not detected above the LOD or the OSD risk screening level (**Figure 7-6** and **Table 7-2**).

Attempts to sample groundwater were made at the DPT boring, however refusal was encountered prior to groundwater. When refusal was met, at approximately 25 feet bgs, the soil was dry and crumbly indicating groundwater would not be encountered at that depth.

7.2.6 Building 8110 Foam Storage Area

Soil sampling was conducted at three locations (B8110-01 through B8110-03) and groundwater sampling was conducted at two existing monitoring wells (8200-MW-04 and 8200-MW-05) at the Building 8110 Foam Storage AOPI (**Figure 7-7**). The subsections below describe the PFOS, PFOA, and PFBS analytical results for soil and groundwater at this AOPI.

7.2.6.1 Soil

PFOS was detected above the LOD but less than the OSD risk screening level in shallow soil (0-2 feet bgs) at B8110-01 (0.00049 J mg/kg). PFOA and PFBS were not detected above the LOD at this location. PFOS and PFOA concentrations were greater than the LOD but less than the OSD risk screening level in shallow soil (0-2 feet bgs) at boring B8110-02 (0.00056 J mg/kg PFOS and 0.00052 J mg/kg PFOA) and PFBS was not detected. PFOS, PFOA, and PFBS were not detected above the LOD at B8110-03 (**Figure 7-7** and **Table 7-2**).

7.2.6.2 Groundwater

PFOS and PFBS were detected above the LOD but below the OSD risk screening level at 8200-MW-04 (20 M ng/L PFOS, 14 J- ng/L PFBS) and 8200-MW-05 (0.99 JM ng/L PFOS, 41 MJ- ng/L PFBS). PFOA was detected above the LOD but below the OSD risk screening level at 8200-MW-04 (29 ng/L) and above the LOD and above the OSD risk screening level at 8200-MW-05 ([77 ng/L] **Figure 7-7** and **Table 7-1**).

7.2.7 ARNG Building 1982 Foam Storage Area

Groundwater sampling was conducted at two existing monitoring wells (1982-MW-07 and FCMW-100) at the ARNG Building 1982 Foam Storage AOPIs (**Figure 7-8** and **Table 7-1**). PFOS and PFOA were not detected above the LOD or the OSD risk screening levels in either groundwater sample. PFBS was detected above the LOD but below the OSD risk screening levels with detections of 1.2 JM ng/L at 1982-MW-07 and 5.4 MJ- [3.6 MJ-] ng/L at FCMW-100.

7.2.8 Piñon Canyon Maneuver Site (PCMS) Hill Ranch AFFF Storage Area

Shallow soil sampling (0-2 ft bgs) was completed at three locations (PCMS-01 through PCMS-03) at the PCMS Hill Ranch AFFF Storage AOPI (**Figure 7-9**). PFOS was detected above the LOD but below the OSD risk screening level at PCMS-03 (0.022 mg/kg) and above the LOD and OSD risk screening level at PCMS-01 (0.28 D mg/kg) and PCMS-02 (0.14 D mg/kg). PFOA and PFBS were detected above the LOD and below the OSD risk screening level at PCMS-01 (0.0019 M mg/kg PFOA and 0.0043 mg/kg PFBS) and PCMS-02 (0.0012 mg/kg PFOA and 0.0074 mg/kg PFBS) only (**Table 7-2**).

7.2.9 Phase II Blank Samples

PFOS, PFOA, and/or PFBS were not detected greater than LOD in any of the QA/QC samples collected during the SI work (**Appendix Q**).

7.2.10 Phase II DEB Analysis

A DEB was collected from one monitoring well (FCMW100) sampled in association with the ARNG Building 1982 Foam Storage Area, which contained dedicated down-hole equipment. PFOS, PFOA, and/or PFBS results between the paired DEB and parent sample was within 50% or less of one another for each analyte, suggesting minor equipment influence, if any. PFOS and PFOA were not detected above the LOD in either the DEB sample or the parent sample. The DEB sample pair collected at FTC suggest that sampling using the dedicated downhole sampling equipment did not bias sample PFOS, PFOA, and/or PFBS results (**Table 7-3**).

7.3 TOC, pH, and Grain Size

In addition to sampling soil for PFOS, PFOA, and PFBS, one soil sample per AOPI was analyzed for TOC, pH, moisture content, and grain size data as they may be useful in future fate and transport studies. The TOC in the soil at FTC samples ranged from 3,100 to 17,400 mg/kg. The TOC at this installation was within range typically observed in topsoil: 5,000 – 30,000 mg/kg. The combined percentage of fines (i.e., silt and clay) in soils at FTC ranged from 20.2-78.6% with an average of 50.52%. PFAS tend to be more mobile in soils with less than 20% fines (silt and clay) and lower TOC. The percent moisture of the soil was typical for Loam (0-12%) and clay (0-20%). The pH of the soil was slightly alkaline (7-9). Based on these geochemical and physical soil characteristics (i.e., high percentage of fines and TOC) observed underlying the installation during the SI, PFAS are expected to be relatively less mobile at FTC than in soils with lower percentages of fines and TOC.

The TOC in the soil at PCMS was 10,800 mg/kg which is typical of topsoil. The combined percentage of fines (i.e., silt and clay) in soils at PCMS was 28.9%. The percent moisture was typical for sandy soil (0-10%) and Loam (0-12%). The pH of the soil was neutral (approximately 7). While PFAS are relatively more mobile in soils with low percentages of fines, elevated TOC may retard transport of the constituents from soil to groundwater.

7.4 Conceptual Site Models

The preliminary CSMs presented in the QAPP Addendum (Arcadis 2019d) were re-evaluated and updated, if necessary, based on the Phase I and Phase II SI sampling results. The CSMs presented on **Figures 7-10** through **7-15** and in this section therefore represent the current understanding of the potential for human exposure. For some AOPIs, the CSM is the same and thus shown on the same figure.

Many of the PFAS constituents found in AFFF are surfactants (which do not volatilize) and are found in a charged or ionic state at environmentally-relevant pH (i.e., pH 5 to 9 standard units). PFOS, PFOA, and PFBS are each negatively charged at environmentally-relevant pH. The media potentially affected by PFOS, PFOA, PFBS releases at Army installations are soil, groundwater, surface water, and sediment. Once released to the environment, a primary factor that inhibits the movement of PFAS constituents is the presence of organic matter and organic co-constituents in soils and sediments. Generally, PFAS constituents are mobile in the potentially affected media, and they are not known to be fully broken down by natural processes.

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

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

CSMs were developed for each individual AOPI and were combined where source media, potential migration pathways and exposure media, and human exposure pathway determinations are congruent. The following exposure pathway determinations apply to all CSMs for AOPIs located at FTC (**Figures 7-10** through **7-14**). The CSM for PCMS Hill Ranch AFF Storage Area is described separately below (**Figure 7-15**).

- PFOS, PFOA, and/or PFBS were detected in groundwater at all the FTC AOPIs except the STP and Fort Carson Golf Course AOPIs, where groundwater samples were not collected. The AOPIs are downgradient of and not likely to affect the Strobel Well used as an additional source of potable water (i.e., other than that supplied from Colorado Springs Utilities) on-installation. However, the groundwater exposure pathways (via drinking water ingestion and dermal contact) for on-installation site workers and residents are potentially complete to account for potential future use of the on-post groundwater downgradient of the FTC AOPIs.
- Recreational users are not likely to contact groundwater during outdoor recreational activities. Therefore, the groundwater exposure pathway for on-installation recreational users is incomplete.
- Generally, groundwater originating at the AOPIs flows southeast and off-post. The groundwater exposure pathway for off-installation drinking water receptors was determined to be potentially complete due to the current use and potential future use of off-post groundwater as a potable water source.

- Recreational users could contact constituents in on-post surface water bodies, North Side Reservoir, and unnamed intermittent streams, through incidental ingestion and dermal contact. Therefore, the surface water and sediment exposure pathways for on-installation recreational users were determined to be potentially complete.
- Surface water bodies on-post are not used for drinking water. On-installation site workers and residents are not likely to otherwise contact surface water and sediment, except at the Fort Carson Golf Course, where site workers may access ponds during course maintenance. Therefore, the surface water and sediment exposure pathways are incomplete for on-installation site workers and residents at all AOPIs, except for the Fort Carson Golf Course, where these pathways are potentially complete for site workers.
- Surface water bodies (and runoff from AOPIs) flow off-post towards the southeast and discharge to Fountain Creek. Fountain Creek is not used for drinking water off-post; therefore, the surface water exposure pathway (via drinking water ingestion and dermal contact) for off-installation drinking water receptors is incomplete. However, recreational users off-post could contact constituents in surface water and sediment through incidental ingestion and dermal contact. Therefore, the surface water and sediment exposure pathways for off-installation receptors are potentially complete.

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

Figure 7-10 shows the CSM for the Former Fire Training Area (FTC-021, SWMU 24, 08005.1016), Former Sewage Treatment Lagoons (FTC-039, SWMU 23, 08005.1086), Building 9608 Temporary AFFF Storage Area, Hangar 9633, and ARNG Building 1982 Foam Storage Area. AFFF was historically released to soil and paved surfaces at the Former Fire Training Area during firefighter training exercises. AFFF was potentially released at the ARNG Building 1982 Foam Storage Area. The former sewage treatment lagoons received wastewater from the BAAF facilities and effluent from the former oil/water separator adjacent to the FFTA.

- Soil was not sampled at these AOPIs. However, due to known or potential AFFF releases at these AOPIs and PFOS, PFOA, and PFBS detections in groundwater, it is reasonable to conclude PFOS, PFOA, and/or PFBS may be present in soil. Site workers could contact constituents in soil via incidental ingestion, dermal contact, and inhalation of dust. Therefore, the soil exposure pathway for on-installation site workers is potentially complete.
- The AOPIs are not residential or recreational sites and are wholly located within the installation boundary. Therefore, the soil exposure pathways for on-installation residents and recreational users and for off-installation receptors are incomplete.

Figure 7-11 shows the CSM for the Former Nozzle Testing Area and Building 8110 Foam Storage Area. AFFF was historically released to soil and paved surfaces during firefighter training exercises and AFFF storage.

- PFOS, PFOA, and/or PFBS were detected in soil at these AOPIs. Site workers could contact constituents in soil via incidental ingestion, dermal contact, and inhalation of dust. Therefore, the soil exposure pathway for on-installation site workers is complete.
- The AOPIs are not residential or recreational sites and are wholly located within the installation boundary. Therefore, the soil exposure pathways for on-installation residents and recreational users and for off-installation receptors are incomplete.

Figure 7-12 shows the CSM for Landfill 1 (FTC-005, SWMU 1, 08005.1087) and Grit/Oil Pit (FTC-020, SWMU 13, 08005.1015). These AOPIs historically received potentially PFAS-impacted soil and material.

- The AOPIs are currently capped or vegetated areas; thus, the potential residual source of PFOS, PFOA, and/or PFBS is in the subsurface soil. While the soil exposure pathway is currently incomplete, there is a potential for future site workers (e.g., construction workers) to contact constituents in soil via incidental ingestion, dermal contact, and inhalation of dust. Therefore, the soil exposure pathway for on-installation site workers is potentially complete to account for a future exposure scenario.
- The AOPIs are not residential or recreational sites and are wholly located within the installation boundary. Therefore, the soil exposure pathways for on-installation residents and recreational users and for off-installation receptors are incomplete.

Figure 7-13 shows the CSM for the FTC STP (FTC-042, SWMU 22, 08005.1036). AFFF was released to the STP and therefore could have impacted effluent water and sludge. The STP effluent is discharged to Clover Ditch via an outfall.

- Site workers could contact constituents in soil near the outfall location via incidental ingestion, dermal contact, and inhalation of dust. PFOS, PFOA, and PFBS were not detected in a soil sample collected on the banks of Clover Ditch downstream of the outfall. However, the outfall location was inaccessible to the drill rig due to steep terrain. Therefore, the soil exposure pathway for on-installation site workers remains potentially complete.
- The AOPI is not a residential or recreational site and is wholly located within the installation boundary. Therefore, the soil exposure pathways for on-installation residents and recreational users and for off-installation receptors are incomplete.

Figure 7-14 shows the CSM for the Fort Carson Golf Course. The AOPI historically received potentially PFAS-impacted treated effluent from the STP.

- PFOS, PFOA, and/or PFBS were detected in soil at this AOPI. Site workers and recreational users (i.e., golfers) could contact constituents in soil via incidental ingestion, dermal contact, and inhalation of dust. Therefore, the soil exposure pathways for these receptors are complete.
- The AOPI is not a residential property and is wholly located within the installation boundary. Therefore, the soil exposure pathways for on-installation residents and off-installation receptors are incomplete.

Figure 7-15 shows the CSM for the PCMS Hill Ranch AFFF Storage location. AFFF was historically stored at this location.

- PFOS, PFOA, and/or PFBS were detected in soil at this AOPI, and site workers could contact constituents in soil via incidental ingestion, dermal contact, and inhalation of dust. Therefore, the soil exposure pathway for on-installation site workers is complete.
- The AOPI is not a residential property and is wholly located within the installation boundary. While recreational users (e.g., hunters) may be present in the immediate area, they are unlikely to access the AFFF storage location. Therefore, the soil exposure pathways for on-installation residents and recreational users and for off-installation receptors are incomplete.
- Groundwater was not sampled at this AOPI. There are no residences or drinking water wells at PCMS Hill Ranch. However, due to PFOS, PFOA, and/or PFBS detections in soil, the groundwater

exposure pathway (via drinking water ingestion and dermal contact) for on-installation site workers is potentially complete to account for potential future use of the on-post groundwater.

- Recreational users are not likely to contact groundwater during outdoor recreational activities. Therefore, the groundwater exposure pathway for on-installation recreational users is incomplete.
- Groundwater flow direction is unknown and there are no nearby surface water bodies to which shallow groundwater may discharge. Therefore, surface water and sediment are not potential exposure media at this AOPI.

8 DATA LIMITATIONS AT FTC

Data collected during the PA (**Section 3**, **Section 4**, **Section 5**) and SI (**Section 6 and Section 7**) were sufficient to draw the conclusions summarized in **Section 9**. The data limitations relevant to the development of this PA/SI for PFOS, PFOA, and PFBS at FTC are discussed below.

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

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

The searches for ecological receptors and off-post PFOS, PFOA, and PFBS sources were not exhaustive and were limited to easily identifiable and readily available information evaluated during the relevant documents research, installation personnel interviews, and site reconnaissance. Additionally, the CSMs do not include ecological receptors and exposure pathways. The potential for ecological exposures to PFOS, PFOA, and/or PFBS may be evaluated at a future date if those pathways warrant further consideration.

Finally, the available PFOS, PFOA, and PFBS analytical data is limited to on-installation drinking water, two off-installation water wells, groundwater from existing monitoring wells and/or SEEPs, and potential source area soil samples. Groundwater was not able to be collected in conjunction with the soil samples, as proposed; therefore, absence or presence of PFOS, PFOA, and/or PFBS in groundwater at those AOPIs is not known at this time. Attempts to sample groundwater were made at all DPT borings, however refusal was encountered prior to groundwater. When refusal was met, typically between 22 to 28 feet bgs, the soil was dry and crumbly indicating groundwater would not be encountered at that depth. Additionally, the available PFAS data, including PFOS, PFOA, and PFBS is limited to the eighteen PFAS-related compounds as listed in **Appendix P**, which were analyzed per the selected analytical method. The limited sampling scope of the SI focused on identifying presence or absence of PFOS, PFOA, and PFBS at the AOPIs. SI sampling at locations at or in close proximity of the AOPIs, as well as the one on installation drinking water well, did not delineate the extent of PFAS impacts or identify the primary migration pathways for the chemicals.

Based on the information included within this PA/SI report, a more comprehensive evaluation may be conducted for those AOPIs that warrant further study in a remedial investigation.

9 CONCLUSIONS AND RECOMMENDATIONS

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

Although there is currently no federal maximum contaminant level for drinking water defined for any PFAS, OSD provided residential risk screening levels for PFOS, PFOA, and PFBS in soil and groundwater (tap water) and industrial/commercial risk screening levels for PFOS, PFOA, and PFBS in soil (**Appendix A**). A combination of document review, internet searches, interviews with installation personnel, and an installation site visit were used to identify specific areas of suspected PFOS, PFOA, and/or PFBS use, storage, and disposal at FTC. Following the evaluation, twelve AOPIs were identified with source types comprised of AFFF use and/or storage areas and areas where potentially PFAS-containing material was disposed.

The only on-installation drinking water well (Strobel Well) is located on Turkey Creek in the Upper Arkansas Watershed and provides the pre-treatment/source water for the Turkey Creek Recreation Area Water System. The drinking water for the remainder of the installation is supplied by Colorado Springs municipal water (Colorado Springs Utilities, public water system identification CO0221445). PFAS compounds have not been detected in the Strobel Well, either during initial sampling in 2016 or during the Phase I SI sampling in 2019 (**Figures 2-2** and **7-2**).

Before the SI sampling, a preliminary CSM was developed for each AOPI based on an assessment of existing records, personnel interviews, and site reconnaissance. The preliminary CSMs identified potential human receptors and exposure pathways for groundwater and surface water that is known to be used, or could realistically be used in the future, as a source of drinking water and identified potential soil and sediment exposure pathways.

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

The maximum PFOS, PFOA, and PFBS concentrations observed in groundwater samples collected at and/or downgradient of the applicable AOPIs are summarized below.

- **BAAF AOPIs**: 16,500 D ng/L PFOS at monitoring well BECSM28R (located immediately downgradient of the FFTA); 151,000 EDJ ng/L PFOA at monitoring well BECSMW13 (located adjacent to the Former Sewage Treatment Lagoons); and 3,710 D ng/L PFBS also at monitoring well BECSMW13.
- **Landfill 1 (FTC-005, SWMU 1)**: 90 ng/L PFOS; 160 J ng/L PFOA; and 770 D ng/L PFBS at monitoring well OP03 (located on the southeast boundary of the landfill).
- **Grit/Oil Pit (FTC-020, SWMU 13)**: 55,000 DJ ng/L PFOS and 9,700 D ng/L PFOA at monitoring well GPPZ21; and 9,800 D ng/L PFBS at monitoring well GPMW08.

- **Building 8110 Foam Storage Area**: 20 M ng/L PFOS at monitoring well 8200MW04; 77 ng/L PFOA and 41 MJ- ng/L PFBS at monitoring well 8200MW05.
- **ARNG Building 1982 Foam Storage Area**: No detections above the LOD for PFOS or PFOA; 5.4 MJ- ng/L PFBS at monitoring well FCMW100.

The maximum PFOS, PFOA, and PFBS concentrations observed in shallow soil samples (i.e., collected from 0 to 2 feet bgs) at the applicable FTC AOPIs are summarized below.

- **Former Nozzle Testing Area at BAAF**: 0.11 DJ mg/kg PFOS at soil sampling location FNTA-01-SO, and 0.0044 mg/kg PFOA at soil sampling location FNTA-02-SO. These concentrations are less than the OSD risk screening levels. PFBS was not detected at a concentration greater than the LOD or OSD risk screening level in either shallow soil sample.
- **Fort Carson Sewage Treatment Plant (FTC-042, SWMU 22)**: PFOS, PFOA, and PFBS were not detected at concentrations greater than the LOD or OSD risk screening levels in the shallow soil sample collected at this AOPI.
- **Fort Carson Golf Course (FTC-034 and FTC-036, SWMUs 32 and 33)**: 0.0060 mg/kg PFOS and 0.00062 J mg/kg PFOA. These concentrations are less than the OSD risk screening levels. PFBS was not detected at a concentration greater than the LOD or OSD risk screening level.
- **Building 8110 Foam Storage Area**: 0.00056 J mg/kg PFOS and 0.00052 J mg/kg PFOA. These concentrations are less than the OSD risk screening levels. PFBS was not detected at a concentration greater than the LOD or OSD risk screening level.

The maximum PFOS, PFOA, and PFBS concentrations observed in shallow soil samples (i.e., collected from 0 to 2 feet bgs) at PCMS are summarized below.

- 0.28 D mg/kg PFOS at soil sampling location PCMS-01, above the LOD and OSD risk screening levels.
- 0.0019 M mg/kg PFOA at soil sampling location PCMS-01, above the LOD and below the OSD risk screening levels.
- 0.0074 mg/kg PFBS at soil sampling locations PCMS-02, above the LOD and below the OSD risk screening levels.

The preliminary CSMs prepared for the PA were re-evaluated and updated, if necessary, as part of the SI. Following the SI sampling, all 12 AOPIs were considered to have complete or potentially complete exposure pathways. Soil exposure pathways are complete at four AOPIs where PFAS were detected in soil and on-installation site workers were identified as potential receptors. The soil exposure pathway is also complete for on-installation recreational users (e.g., golfers) at the Fort Carson Golf Course AOPI. Soil exposure pathways are potentially complete for on-installation site workers at the remaining six AOPIs. While the FTC AOPIs are downgradient of and not likely to affect the Strobel Well used as an additional source of potable water (i.e., other than that supplied from Colorado Springs Utilities) on-installation, and while there are no drinking water wells at PCMS Hill Ranch, the groundwater exposure pathways (via drinking water ingestion and dermal contact) are potentially complete to account for potential future use of the on-post groundwater downgradient of the AOPIs. Due to the potential for potable use of the off-post groundwater, the groundwater exposure pathway for off-installation drinking

water receptors is potentially complete. Site workers could also contact constituents in surface water and sediment during maintenance activities at the Fort Carson Golf Course; therefore, these exposure pathways are potentially complete. For all 12 AOPIs, the surface water and sediment exposure pathways are potentially complete for on-installation recreational users and for off-installation receptors who could contact constituents in surface water and sediment in creeks and streams that receive runoff/surface water from FTC (i.e., downgradient of AOPIs).

Results from this PA/SI indicate further study in a remedial investigation for PFAS is warranted at FTC in accordance with the October 2019 guidance provided by the OSD. **Table 9-1** below summarizes the sampling at FTC and rationale for recommendations for future study in a remedial investigation or no action at this time at each AOPI.

Table 9-1 Summary of PFOS, PFOA, and PFBS Sampling at FTC and Recommendations

AOPI Name	PFOS, PFOA, and/or PFBS detected greater than OSD Risk Screening Levels?		Recommendation	Rationale
	GW	SO		
BAAF AOPIs (5 AOPIs; FFTA [SWMU 24], Former Nozzle Testing Area, Former Sewage Treatment Lagoons [SWMU 23], Building 9608 Temporary AFFF Storage Area, and Hangar 9633)	Yes	No	Further study in a remedial investigation	Detections in groundwater above the OSD risk screening level.
Landfill 1 (FTC-005, SWMU 1)	Yes	NS	Further study in a remedial investigation	Detections in groundwater above the OSD risk screening level.
Grit/Oil Pit (FTC-020, SWMU 13)	Yes	NS	Further study in a remedial investigation	Detections in groundwater above the OSD risk screening level.
Fort Carson Sewage Treatment Plant (FTC-042, SWMU 22)	NS	No	No action at this time	No soil exceedances of the OSD risk screening level.
Fort Carson Golf Course (FTC-034 and FTC-036, SWMUs 32 and 33)	NS	No	No action at this time	No soil exceedances of the OSD risk screening level.
Building 8110 Foam Storage Area	Yes	No	Further study in a remedial investigation	Detections in groundwater above the OSD risk screening level.

AOPI Name	PFOS, PFOA, and/or PFBS detected greater than OSD Risk Screening Levels?		Recommendation	Rationale
	GW	SO		
ARNG Building 1982 Foam Storage Area	No	NS	No action at this time	No groundwater exceedances of OSD risk screening levels
PCMS Hill Ranch AFFF Storage Area	NS	Yes	Further study in a remedial investigation	Detections in soil above the OSD risk screening level.

Notes:
* Groundwater was not encountered during the sampling event and was therefore unable to be collected
GW – groundwater
NS – not sampled
SO – soil

Based on the data collected during the Phase I SI sampling event and the PFAS analytical data collected in February 2019, July 2019, and November 2020 during the Phase II SI sampling events, in accordance with the guidance provided by the OSD, further investigation is recommended at FTC at this time. In accordance with CERCLA, site-specific risk will be assessed during a future phase to evaluate whether remedial actions are required.

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ACRONYMS

°F	degrees Fahrenheit
%	percent
6:2 FTSA	6:2 fluorotelomer sulfonate
8:2 FTSA	8:2 fluorotelomer sulfonate
AFFF	aqueous film-forming foam
AOPI	area of potential interest
Arcadis	Arcadis U.S., Inc.
Army	United States Army
ARNG	Army National Guard
BAAF	Butts Army Airfield
bgs	below ground surface
CDPHE	Colorado Department of Public Health and Environment
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CSM	conceptual site model
DEB	dedicated equipment background
DoD	Department of Defense
DPT	direct-push technology
DPW	Directorate of Public Works
DQO	data quality objectives
DUSR	Data Usability Summary Report
EB	equipment blank
EDR	Environmental Data Resources, Inc.
ELAP	Environmental Laboratory Accreditation Program
FCR	Field Change Report
FFTA	former fire training area
FLPM	Filed and Laboratory Procedures Manual
FTC	Fort Carson
ft/day	feet per day
GCHP	Fort Carson Golf Course Holding Pond

GIS	geographic information system
gpm	gallons per minute
HDPE	high-density polyethylene
HQ	hazard quotient
HQAES	Headquarters Army Environmental System
IDW	investigation-derived waste
IMCOM	Installation Management Command
installation	United States Army or Reserve installation
IRP	Installation Restoration Program
IWTP	Industrial Wastewater Treatment Plant
LOD	limit of detection
LOQ	limit of quantitation
mg/kg	milligrams per kilogram (parts per million)
ng/L	nanograms per liter (parts per trillion)
OSD	Office of the Secretary of Defense
PA	preliminary assessment
PCMS	Piñon Canyon Maneuver Site
PFAS	per- and polyfluoroalkyl substances
PFBA	perfluorobutanoic acid
PFBS	perfluorobutanesulfonic acid
PFDA	perfluorodecanoic acid
PFDoA	perfluorododecanoic acid
PFHpA	perfluoroheptanoic acid
PFHxA	perfluorohexanoic acid
PFHxS	perfluorohexanesulfonic acid
PFNA	perfluorononanoic acid
PFOA	perfluorooctanoic acid
PFOS	perfluorooctane sulfonate
PFPA	perfluoropentanoic acid
PFTA	perfluorotetradecanoic acid
PFTrDA	perfluorotridecanoic acid

PFUnA	perfluoroundecanoic acid
POC	point of contact
ppm	parts per million
ppt	parts per trillion
PQAPP	Programmatic Uniform Federal Policy-Quality Assurance Project Plan
PSL	project screening level
QA	quality assurance
QAPP	Quality Assurance Project Plan
QC	quality control
QSM	Quality Systems Manual
RSL	Regional Screening Level
SI	site inspection
SOP	standard operating procedure
SSHP	Site Safety and Health Plan
STP	sewage treatment plant
TGI	technical guidance instruction
TOC	total organic carbon
U.S.	United States
USACE	United States Army Corps of Engineers
USAEC	United States Army Environmental Command
USEPA	United States Environmental Protection Agency
VOC	volatile organic compound

TABLES

Table 2-1 - Historical PFAS Analytical Results
USAEC PFAS Preliminary Assessment/Site Inspection
Fort Carson, Colorado

Well / Location ID			Strobel Well		AHA	TH5	FTAMW03	W89MW12	BECSMW07	
Sample ID			STROBELWELL USF	STROBELWELL DSF	AHI	TH5	FTAMW03	W89MW12	BECSMW07	BECSMW07FD
Sample Date			7/8/2016	7/8/2016	10/18/2016	10/24/2016	7/8/2016	10/20/2016	7/7/2016	7/7/2016
PFAS (Modified USEPA Method 537)	**OSD Tapwater RSL**	**Units**								
Perfluorobutane sulfonic acid (PFBS)	0.6	µg/L	0.0019 U	0.0019 U	0.0020 U	**0.074**	**0.53 J**	**0.15**	**0.043**	**0.045**
Perfluoroheptanoic acid (PFHpA)	--	µg/L	0.0047 U	0.0047 U	0.0020 U	**0.010**	0.27 U	**0.048**	**0.013 J**	**0.013 J**
Perfluorohexane sulfonic acid (PFHxS)	--	µg/L	0.0040 U	0.0040 U	**0.0010 JM**	**0.42 M**	**1.3**	**2.6 D**	**0.34**	**0.34**
Perfluorononanoic acid (PFNA)	--	µg/L	0.0046 U	0.0046 U	0.0020 U	**0.025**	**0.39 J**	**0.050**	0.0046 U	0.0046 U
Perfluorooctanesulfonic acid (PFOS)	0.040	µg/L	0.0033 U	0.0033 U	0.0030 U	**0.26**	**5.5**	**1.5 D**	**1.2**	**1.2**
Perfluorooctanoic acid (PFOA)	0.040	µg/L	0.0053 U	0.0053 U	**0.0043**	**0.11**	**2.0**	**0.61 M**	**0.075**	**0.073**

Table 2-1 - Historical PFAS Analytical Results
USAEC PFAS Preliminary Assessment/Site Inspection
Fort Carson, Colorado

Well / Location ID			BECSMW8	BECSMW13			BECSMW19A	BECSMW22	BECSMW28R	
Sample ID			BECSMW8	BECSMW13	BECSMW13	BECSMW100 (Blind FD)	BECSMW19A	BECSMW22	BECSMW28R	BECSMW28R
Sample Date			10/24/2016	7/8/2016	10/20/2016	10/20/2016	7/7/2016	7/7/2016	7/8/2016	10/18/2016
PFAS (Modified USEPA Method 537)	**OSD Tapwater RSL**	**Units**								
Perfluorobutane sulfonic acid (PFBS)	0.6	µg/L	**0.33**	**3.2**	**2.6 JSD**	**4.3 D**	**0.065**	**0.059**	**1.0**	**0.61 D**
Perfluoroheptanoic acid (PFHpA)	--	µg/L	**0.080**	**9.2**	**5.4 JD**	**8.3 D**	**0.045**	**0.027**	**0.59 J**	**0.32 D**
Perfluorohexane sulfonic acid (PFHxS)	--	µg/L	**1.7 DM**	**15**	**12 JSD**	**19 D**	**0.56**	**0.50**	**4.1**	**3.9 DM**
Perfluorononanoic acid (PFNA)	--	µg/L	**0.026**	**0.24 J**	**0.090 J**	**0.10**	**0.020**	0.0046 U	**1.3**	**0.74 D**
Perfluorooctanesulfonic acid (PFOS)	0.040	µg/L	**0.35**	**3.8**	**2.7 JD**	**4.3 D**	**1.9**	**1.4**	**41**	**33 DM**
Perfluorooctanoic acid (PFOA)	0.040	µg/L	**0.33**	**94**	**55 JD**	**91 JD**	**0.60**	**0.15**	**6.8**	**6.7 D**

Table 2-1 - Historical PFAS Analytical Results
USAEC PFAS Preliminary Assessment/Site Inspection
Fort Carson, Colorado

Well / Location ID				BECSMW34	BECSMW200		BECSMW201	
Sample ID			BECSMW28R (Split sample)	BECSMW34	NA (DRY)	NA (DRY)	NA (DRY)	NA (DRY)
Sample Date			10/18/2016	7/7/2016	11/21/2016	12/13/2016	11/22/2016	12/13/2016
PFAS (Modified USEPA Method 537)	**OSD Tapwater RSL**	**Units**						
Perfluorobutane sulfonic acid (PFBS)	0.6	µg/L	**0.57 JS**	**0.056**	BECSMW200 was installed on 21 November 2016. The well was dry on 21 November 2016 and 13 December 2016, and no PFAS samples were collected.		BECSMW201 was installed on 22 November 2016. The well was dry on 22 November 2016 and 13 December 2016, and no PFAS samples were collected.	
Perfluoroheptanoic acid (PFHpA)	--	µg/L	**0.32 JS**	**0.015 J**				
Perfluorohexane sulfonic acid (PFHxS)	--	µg/L	**3.2**	**0.45**				
Perfluorononanoic acid (PFNA)	--	µg/L	**0.69 JS**	**0.015 J**				
Perfluorooctanesulfonic acid (PFOS)	0.040	µg/L	**20**	**1.1**				
Perfluorooctanoic acid (PFOA)	0.040	µg/L	**5.4**	**0.092**				

Notes:
1. **Bolded** values indicate the result was detected greater than the limit of detection.
2. Grey shaded values indicate the result was detected greater than the 2021 Office of the Secretary of Defense (OSD) risk screening levels, (OSD. 2021. Memorandum: Investigating Per- and Polyfluoroalkyl Substances within the Department of Defense Cleanup Program. September.).

Acronyms/Abbreviations:
-- = not applicable
D = the reported value is from a dilution
FD = field duplicate
ID = identification
J = value is estimated
M = manually-integrated compound
NA = not analyzed
PFAS = per- and polyfluoroalkyl substances
RSL = risk screening level
S = surrogate recoveries not within control limits
U = analyte was not detected at or greater than the limit of detection
USEPA = United States Environmental Protection Agency
µg/L = micrograms per liter (parts per billion)

Sources:
Maxxam. 2016. Fort Carson FTC PFCs, Job Number: B6E4517. July 25.
Maxxam. 2016. Fort Carson PFC Assessment Phase II, Job Number: B6N1635. November 02.
Test America. 2016. Ft. Carson - Phase II PFCs. Job Number 320-22915-1. October 31.
Test America. 2016. Ft. Carson - Phase II PFCs. Job Number 320-23014-1. November 06.

Table 6-1 - PA and SI Sampling Location Details
USAEC PFAS Preliminary Assessment/Site Inspection
Fort Carson, Colorado

AOPI	Matrix	Location ID	Sample ID / Field Duplicate ID	Depth Interval (ft bmp)	Sample Method	Analytes
PA Sampling (February and July 2019)						
Not Applicable (Water Supply Well)	GW	Strobel Well	FTC-STROBEL-021319	13.83	Low-flow (peristaltic pump)	PFAS group, field parameters
General - BAAF AOPIs	GW	AHA	FTC-AHA-021219	19	Low-flow (peristaltic pump)	PFAS group, field parameters
		BECSMW13	FTC-BECSMW13-021319	37.50	Low-flow (bladder pump)	PFAS group, field parameters
		BECSMW28R	FTC-BECSMW28R-021319	43.48		
		CUD7	FTC-CUD7-021219	15.70	Low-flow (peristaltic pump)	PFAS group, field parameters
		LFC4	FTC-LFC4-021219	19		
		RC2	FTC-RC2-021219	14.37		
		TH5	FTC-TH5-021219 (FTC-FD-021219)	22.93		
SI Sampling (December 2019)						
Not Applicable (Water Supply Well)	GW	Well 1	FTC-SCHMIDT2-070219	42.0	Low-flow (bladder pump)	PFAS group, field parameters
		Well 2	FTC-SCHMIDT1-070219 (FTC-FD-070219)	30.0		
General - BAAF AOPIs	GW	AHA	FTC-AHA-12042019	19.9	Low-flow (peristaltic pump)	PFAS group, field parameters
		CUD6	FTC-CUD6-12032019	24.06		
		CUD7	FTC-CUD7-12032019	15.40		
		LFC4	FTC-LFC4-12032019	16.41		
		RC2	FTC-RC2-12032019 (FTC-01-FD-12032019)	14.42		
		TH5	FTC-TH5-12042019	25		
		SEEP1	FTC-SEEP1-12042019	NA	Grab (direct-fill)	
Former Nozzle Testing Area at BAAF	SO	FNTA-01	FTC-FNTA-01-SO-0-2-12202019	0-2	DPT/Hand Auger (composite)	PFAS group, TOC, grain size, pH
		FNTA-02	FTC-FNTA-02-SO-0-2-12202019 (FTC-DUP-SO-01-12202019)	0-2		
Landfill 1	GW	CLAMW12	FTC-CLAMW12-12042019	18.93	Low-flow (peristaltic pump)	PFAS group, field parameters
		CLAMW41	FTC-CLAMW41-12052019	22.27		
		MW95-1	FTC-MW95-01-12042019	73	Low-flow (bladder pump)	
		OP03	FTC-OP03-12052019	19.23	Low-flow (peristaltic pump)	
Grit/Oil Pit	GW	GPMW02	FTC-GPMW02-12052019	37.15	Grab (bailer)	PFAS group, field parameters
		GPMW08	FTC-GPMW08-12052019 (FTC-02-FD-12052019)	40.23	Low-flow (bladder pump)	
		GPPZ21	FTC-GPPZ21-12052019	33.14		
FTC Golf Course	SO	GC-01	FTC-GC-01-SO-0-2-12192019	0-2	DPT/Hand Auger (composite)	PFAS group, TOC, grain size, pH
FTC STP	SO	STP-01	FTC-STP-01-SO-0-2-2019	0-2	DPT/Hand Auger (composite)	PFAS group, TOC, grain size, pH
SI Sampling (October and November 2020)						
ARNG Building 1982	GW	1982MW07	FTC-1982MW07-MMDDYY	21.16	Low-flow (bladder pump)	PFAS group, field parameters
		FCMW100	FTC-FCMW100-MMDDYY	21.66		

Table 6-1 - PA and SI Sampling Location Details
USAEC PFAS Preliminary Assessment/Site Inspection
Fort Carson, Colorado

AOPI	Matrix	Location ID	Sample ID / Field Duplicate ID	Depth Interval (ft bmp)	Sample Method	Analytes
ARNG Building 8110	GW	8200MW04	FTC-8200MW04-MMDDYY	16.54	Low-flow (bladder pump)	PFAS group, field parameters
		8200MW05	FTC-8200MW05-MMDDYY	20.05		
	SO	B8110-01	FTC-B8110-01-SO-MMDDYY	0-2	DPT/Hand Auger (composite)	PFAS group, TOC, pH, Grain Size[1]
		B8110-02	FTC-B8110-02-SO-MMDDYY			PFAS group
		B8110-03	FTC-B8110-03-SO-MMDDYY			
PCMS Hill Ranch	SO	Hill-01	FTC-Hill-01-SO-MMDDYY	0-2	DPT/Hand Auger (composite)	PFAS group, TOC, pH, Grain Size[1]
		Hill-02	FTC-Hill-02-SO-MMDDYY			PFAS group
		Hill-03	FTC-Hill-03-SO-MMDDYY			

Notes:

1. Depth units are reported in ft bmp unless otherwise noted. The measuring point for monitoring/supply wells was typically the top of casing. The measuring point for soil locations was the ground surface. Sampling depth noted for existing monitoring wells indicates the depth at approximately the center of the saturated screened interval.
2. The first 5 feet of each DPT boring was hand auguered. Soil samples were collected from the top two feet of native soil at each DPT boring location.
3. In addition to laboratory analytes, field parameters were measured for groundwater samples and include temperature, pH, conductivity, dissolved oxygen, turbidity, and oxidation-reduction potential. Lithologic descriptions were logged continuously at soil boring locations. Field parameters and lithological descriptions are shown on field sampling forms included in **Appendix K**.
4. The PFAS analyte group includes PFOS, PFOA, PFBS and 15 other PFAS constituents.

AOPI = Area of Potential Interest
BAAF = Butts Army Airfield
DPT = Direct Push Technology
ft bmp = feet below measuring point
FTC = Fort Carson
GW = groundwater
ID = identification
PA = preliminary assessment
PFAS = per- and polyfluoroalkyl substances
PFBS = perfluorobutanesulfonic acid
PFOA = perfluorooctanoic acid
PFOS = perfluorooctane sulfonate
SI = site inspection
SO = soil
STP = Sewage Treatment Plant
TOC = total organic carbon

Table 6-2 - Well Construction Details
USAEC PFAS Preliminary Assessment/Site Inspection
Fort Carson, Colorado

Area of Potential Interest	Well ID	Water Level (ft btoc)	Well Depth (ft btoc)	Screened interval (ft bgs)	Well Diameter (inches)	Completion Date
Monitoring Wells						
General - BAAF AOPIs	AHA	8.92	21.81	NA	4	NA
	TH5	22.18	26.24	NA	4	NA
	RC2	7.52	21.36	NA	2	11/2/1994
	CUD7	9.10	21.69	-	2	NA
	LFC4	11.01	21.8	8.9 - 18.9	2	11/2/1994
	CUD6	22.62	25.49	NA	2	NA
	CUD7	9.10	21.69	NA	2	11/2/1994
	BECSMW13	36.00	38.99	26 - 36	2	6/12/2001
	BECSMW28R	38.65	47.3	NA	2	NA
	BECSMW200	31.89	34.14	20.5 - 30.5	2	11/21/2016
	BECSMW201	27.44	28.55	16 - 26.0	2	11/22/2016
Landfill 1	CLAMW12	18.09	19.76	NA	2	NA
	MW95-1	52.09	74.05	NA	2	NA
	OP03	13.44	25.01	NA	2	NA
	CLAMW41	12.24	32.3	NA	2	NA
Grit/Oil Pit	GPMW02	34.11	40.18	NA	2	NA
	GPMW08	28.68	51.78	NA	2	NA
	GPPZ21	30.05	36.22	NA	2	NA
Building 8110 Foam Storage Area	8200MW04	15.61	17.48	NA	2	NA
	8200MW05	19.56	22.75	NA	2	NA
ARNG Building 1982 Foam Storage Area	1982MW07	5.95	34.15	NA	4	NA
	FCMW100	10.46	32.86	NA	2	NA
Water Supply Wells						
Not Applicable	Strobel Well	11.34	16.32	NA	6	NA
	Well 1	16.02	47.10	NA	6	NA
	Well 2	24.91	34.72	NA	6	NA

Notes:
AOPI = Area of Potential Interest
BAAF = Butts Army Airfield
bgs = below ground surface
btoc = below top of casing
ft = feet
ID = identification
NA = not available

Table 7-1 - PA and SI Sampling Groundwater Analytical Results for PFOS, PFOA, and PFBS
USAEC PFAS Preliminary Assessment/Site Inspection
Fort Carson, Colorado

Associated AOPI	Location Type	Location ID	Sample ID	Sample Date	Sample Type	PFOS (ng/L)		PFOA (ng/L)		PFBS (ng/L)	
						Result	Qual	Result	Qual	Result	Qual
OSD Tapwater Risk Screening Level						40		40		600	
Not Applicable	Water Supply Well	Strobel Well	FTC-STROBEL-021319	02/13/2019	N	8.33	U	8.33	U	8.33	U
		Well 1	FTC-SCHMIDT2-070219	07/02/2019	N	**140**	J	**81**		**57**	
		Well 2	FTC-SCHMIDT1-070219	07/02/2019	N	**280**	DJ	**330**	D	**200**	D
			(FTC-FD-070219)		FD	**260**	DJ	**270**	D	**180**	D
General - BAAF AOPIs	Monitoring Well	AHA	FTC-AHA-021219	02/12/2019	N	8.33	U	**11.7**		8.33	U
			FTC-AHA-12042019	12/04/2019	N	1.8	U	**7.0**	J	1.8	U
		BECSMW13	FTC-BECSMW13-021319	02/13/2019	N	**5600**	D	**151000**	EDJ	**3710**	D
		BECSMW28R	FTC-BECSMW28R-021319	02/13/2019	N	**16500**	D	**4450**	D	**694**	
		CUD6	FTC-CUD6-12032019	12/03/2019	N	**1300**	D	**98**		**250**	D
		CUD7	FTC-CUD7-021219	02/12/2019	N	**7.10**	J	**4.89**	J	**13.2**	
			FTC-CUD7-12032019	12/03/2019	N	**6.0**		**5.8**	J	**15**	
		LFC4	FTC-LFC4-021219	02/12/2019	N	8.33	U	8.33	U	**3.83**	J
			FTC-LFC4-12032019	12/03/2019	N	1.7	U	1.7	U	**4.7**	
		RC2	FTC-RC2-021219	02/12/2019	N	**1800**	D	**221**		**89.1**	
			FTC-RC2-12032019	12/03/2019	N	**1300**	D	**190**	D	**93**	
			(FTC-01-FD-12032019)		FD	**1300**	D	**180**	D	**93**	
		TH5	FTC-TH5-021219	02/12/2019	N	**169**		**49.2**		**32.5**	
			(FTC-FD-021219)		FD	**163**		**47.3**		**32.0**	
			FTC-TH5-12042019	12/04/2019	N	**170**		**63**	J	**49**	
	Seep	SEEP1	FTC-SEEP1-12042019	12/04/2019	N	**910**	D	**520**	D	**140**	
Landfill 1	Monitoring Well	CLAMW12	FTC-CLAMW12-12042019	12/04/2019	N	**3.4**		**9.3**	J	**15**	
		CLAMW41	FTC-CLAMW41-12052019	12/05/2019	N	2.0	U	**1.1**	J	**1.5**	J
		MW95-01	FTC-MW95-01-12042019	12/04/2019	N	**1.4**	J	**1.7**	J	1.9	U
		OP03	FTC-OP03-12052019	12/05/2019	N	**90**		**160**	J	**770**	D
Grit/Oil Pit	Monitoring Well	GPMW02	FTC-GPMW02-12052019	12/05/2019	N	**9300**	D	**6600**	DJ	**6600**	D
		GPMW08	FTC-GPMW08-12052019	12/05/2019	N	**460**		**4100**	DJ	**9800**	D
			(FTC-02-FD-12052019)		FD	**550**		**4200**	DJ	**9400**	D
		GPPZ21	FTC-GPPZ21-12052019	12/05/2019	N	**55000**	DJ	**9700**	D	**7500**	D
Building 8110 Foam Storage Area	Monitoring Well	8200MW04	FTC-8200MW04-110220	11/02/2020	N	**20**	M	**29**		**14**	J-
		8200MW05	FTC-8200MW05-110220	11/02/2020	N	**0.99**	JM	**77**		**41**	MJ-
ARNG Building 1982 Foam Storage Area	Monitoring Well	FCMW100	FTC-FD-01-GW-110320 / FTC-FCMW100-110320	11/03/2020	FD	1.9	U	1.9	U	**3.6**	MJ-
			FTC-FCMW100-110320	11/03/2020	N	1.9	U	1.9	U	**5.4**	MJ-
		1982MW07	FTC-1982MW07-110320	11/03/2020	N	1.8	U	1.8	U	**1.2**	JM

Notes:
1. **Bolded** values indicate the result was detected greater than the limit of detection
2. Grey shaded values indicate the result was detected greater than the 2021 Office of the Secretary of Defense (OSD) risk screening levels, (OSD. 2021. Memorandum: Investigating Per- and Polyfluoroalkyl Substances within the Department of Defense Cleanup Program. September.).

3. Samples were analyzed by Modified USEPA Method 537 in accordance with QSM 5.1.1, Table B-15 (DoD. 2018. Quality Systems Manual, Version 5.1.1, 2018. February.)

Acronyms/Abbreviations:
-- = not applicable
AOPI = Area of Potential Interest
BAAF = Butts Army Airfield
D = The analyte was analyzed at dilution.
DJ = The analyte was analyzed at dilution and the result is an estimated quantity.
E = The reported result is above the limit of the calibration range.
FD = field duplicate sample
ID = identification
J = The analyte was positively identified; however the associated numerical value is an estimated concentration only.
J- = The result is an estimated quantity; the result may be biased low.
LHA = lifetime health advisory
M = Manually intergrated compound
N = primary sample
ng/L = nanograms per liter (parts per trillion)
PFAS = per- and polyfluoroalkyl substances
PFBS = perfluorobutanesulfonic acid
PFOA = perfluorooctanoic acid
PFOS = perfluorooctane sulfonate
Qual = qualifier
RSL = risk screening level
U = The analyte was analyzed for but the result was not detected above the limit of quantitation.
USEPA = United States Environmental Protection Agency

Table 7-2 - PA and SI Sampling Soil Analytical Results for PFOS, PFOA, and PFBS
USAEC PFAS Preliminary Assessment/Site Inspection
Fort Carson, Colorado

Associated AOPI	Location Type	Location ID	Sample ID	Sample Date	Sample Type	PFOS (mg/kg)		PFOA (mg/kg)		PFBS (mg/kg)	
						Result	Qual	Result	Qual	Result	Qual
OSD Industrial/Commercial Risk Screening Level						1.6		1.6		25	
OSD Residential Risk Screening Level						0.13		0.13		1.9	
Former Nozzle Testing Area	DPT Boring	FNTA-01	FTC-FNTA-01-SO-0-2-12202019	12/20/2019	N	**0.074**		**0.0044**		0.0022	U
		FNTA-02	FTC-FNTA-02-SO-0-2-12202019	12/20/2019	N	**0.11**	DJ	**0.0010**		0.0022	U
			FTC-DUP-SO-01-12202019		FD	**0.072**		**0.00073**		0.0023	U
FTC Golf Course	DPT Boring	GC-01	FTC-GC-01-SO-0-2-12192019	12/19/2019	N	**0.0060**		**0.00062**	J	0.0021	U
FTC STP	DPT Boring	STP-01	FTC-STP-01-SO-0-2-2019	12/19/2019	N	0.00067	U	0.00067	U	0.0022	U
Building 8110 Foam Storage Area	Hand Auger	B8110	FTC-B8110-01-SO-110320	11/03/2020	N	**0.00049**	J	0.00070	U	0.0023	U
			FTC-B8110-02-SO-110320	11/03/2020	N	**0.00056**	J	**0.00052**	J	0.0022	U
			FTC-B8110-03-SO-110320	11/03/2020	N	0.00072	U	0.00072	U	0.0024	U
PCMS Hill Ranch AFFF Storage Area	Hand Auger	PCMS	FTC-PCMS-01-SO-110520	11/05/2020	N	**0.28**	D	**0.0019**	M	**0.0043**	
			FTC-PCMS-02-SO-110520	11/05/2020	N	**0.14**	D	**0.0012**		**0.0074**	
			FTC-PCMS-03-SO-110520	11/05/2020	N	**0.022**		0.00067	U	0.0022	U

Notes:
1. **Bolded** values indicate the result was detected greater than the limit of detection
2. Data are compared to the 2021 Office of the Secretary of Defense (OSD) risk screening levels for the residential and commerical/industrial scenario (OSD. 2021), (Memorandum: Investigating Per- and Polyfluoroalkyl Substances within the Department of Defense Cleanup Program. September.).
3. Grey shaded values indicate the result was detected greater than or equal to the OSD risk screening level for the residential scenario. Italicized values indicate the result was detected greater than the OSD risk screening level for the industrial/commercial and residential scenario.
4. Units were converted from ng/g (dry weight), as reported by the laboratory, to mg/kg for agreement with the OSD risk screening levels.
5. Samples were analyzed by Modified USEPA Method 537 in accordance with QSM 5.1.1, Table B-15 (DoD. 2018. Quality Systems Manual, Version 5.1.1, 2018. February.)

Acronyms/Abbreviations:
AOPI = Area of Potential Interest
DJ = The analyte was analyzed at dilution and the result is an estimated quantity
DPT = Direct-Push Technology
FD = field duplicate sample
FTC = Fort Carson
ID = identification
HQ = hazard quotient
J = The analyte was positively identified; however the associated numerical value is an estimated concentration only
mg/kg = micrograms per kilogram (parts per million)
N = primary sample
ng/g = nanograms per kilogram (parts per billion)
PFAS = per- and polyfluoroalkyl substances
PFBS = perfluorobutanesulfonic acid
PFOA = perfluorooctanoic acid
PFOS = perfluorooctane sulfonate
Qual = qualifier
RSL = risk screening level
STP = Sewage Treatment Plant
U = The analyte was analyzed for but the result was not detected above the limit of quantitation.

Table 7-3 - Dedicated Equipment Background Sample Analysis
USAEC PFAS Preliminary Assessment/Site Inspection
Fort Carson, Colorado

			Sample/Parent ID	FTC-FCMW100-110320		FTC-FCMW100-DEB-110320	
			Locations	FTC-FCMW-100		FTC-FCMW-100	
			Sample Date	11/03/2020		11/03/2020	
			Sample Type	Original Sample		Dedicated Equipment Blank	
Analyte	**CAS**	**Units**	**Result**	**Qual**	**Result**	**Qual**
6:2 Fluorotelomer sulfonic acid (6:2 FTSA)	27619-97-2	ng/L	4.8	U	4.4	U
8:2 Fluorotelomer sulfonic acid (8:2 FTSA)	39108-34-4	ng/L	2.9	U	2.7	U
N-Ethyl perfluorooctane sulfonamidoacetic	2991-50-6	ng/L	2.9	U	2.7	U
N-Methylperfluoroocatane	2355-31-9	ng/L	1.9	U	1.8	U
Perfluorobutane sulfonic acid (PFBS)	375-73-5	ng/L	**5.4**	M	**3.4**	M
Perfluorobutanoic acid (PFBA)	375-22-4	ng/L	4.8	U	4.4	U
Perfluorodecanoic acid (PFDA)	335-76-2	ng/L	1.9	U	1.8	U
Perfluorododecanoic acid (PFDoA)	307-55-1	ng/L	1.9	U	1.8	U
Perfluoroheptanoic acid (PFHpA)	375-85-9	ng/L	1.9	UM	1.8	U
Perfluorohexane sulfonic acid (PFHxS)	355-46-4	ng/L	1.9	UM	1.8	U
Perfluorohexanoic acid (PFHxA)	307-24-4	ng/L	**3.2**	M	**3.1**	M
Perfluorononanoic acid (PFNA)	375-95-1	ng/L	1.9	U	1.8	U
Perfluorooctane sulfonic acid (PFOS)	1763-23-1	ng/L	1.9	U	1.8	U
Perfluorooctanoic acid (PFOA)	335-67-1	ng/L	1.9	UM	1.8	UM
Perfluoropentanoic acid (PFPeA)	2706-90-3	ng/L	**4.5**	M	**3.6**	M
Perfluorotetradecanoic acid (PFTeA)	376-06-7	ng/L	1.9	UM	1.8	U
Perfluorotridecanoic acid (PFTrDA)	72629-94-8	ng/L	1.9	U	1.8	U
Perfluoroundecanoic acid (PFUdA)	2058-94-8	ng/L	1.9	U	1.8	U

Notes:

1. **Bolded** values indicate the result was detected greater than the limit of detection.

Acronyms/Abbreviations:

M = manually-integrated compound

U = analyte was not detected at or greater than the limit of detection

FIGURES

USAEC PFAS Preliminary Assessment / Site Inspection
Fort Carson, Colorado

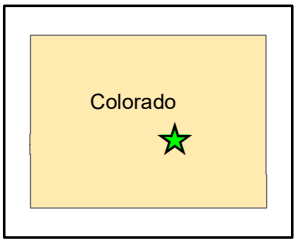
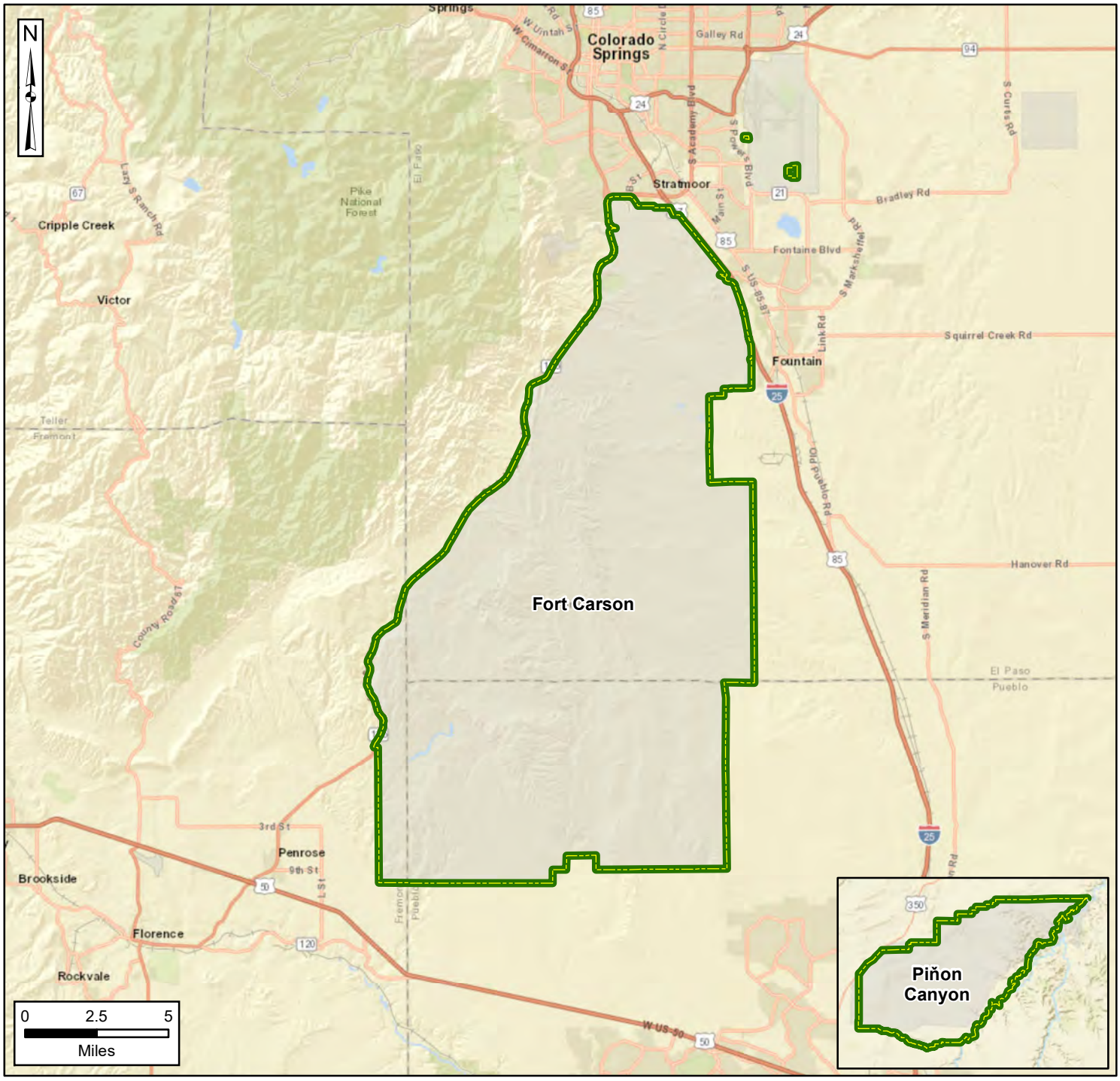


Figure 2-1
Site Location



Installation Boundary

Data Sources:
Fort Carson, GIS Data, 2018
ESRI ArcGIS Online, StreetMap Data

Coordinate System:
WGS 1984, UTM Zone 13 North

USAEC PFAS Preliminary Assessment / Site Inspection
Fort Carson, Colorado

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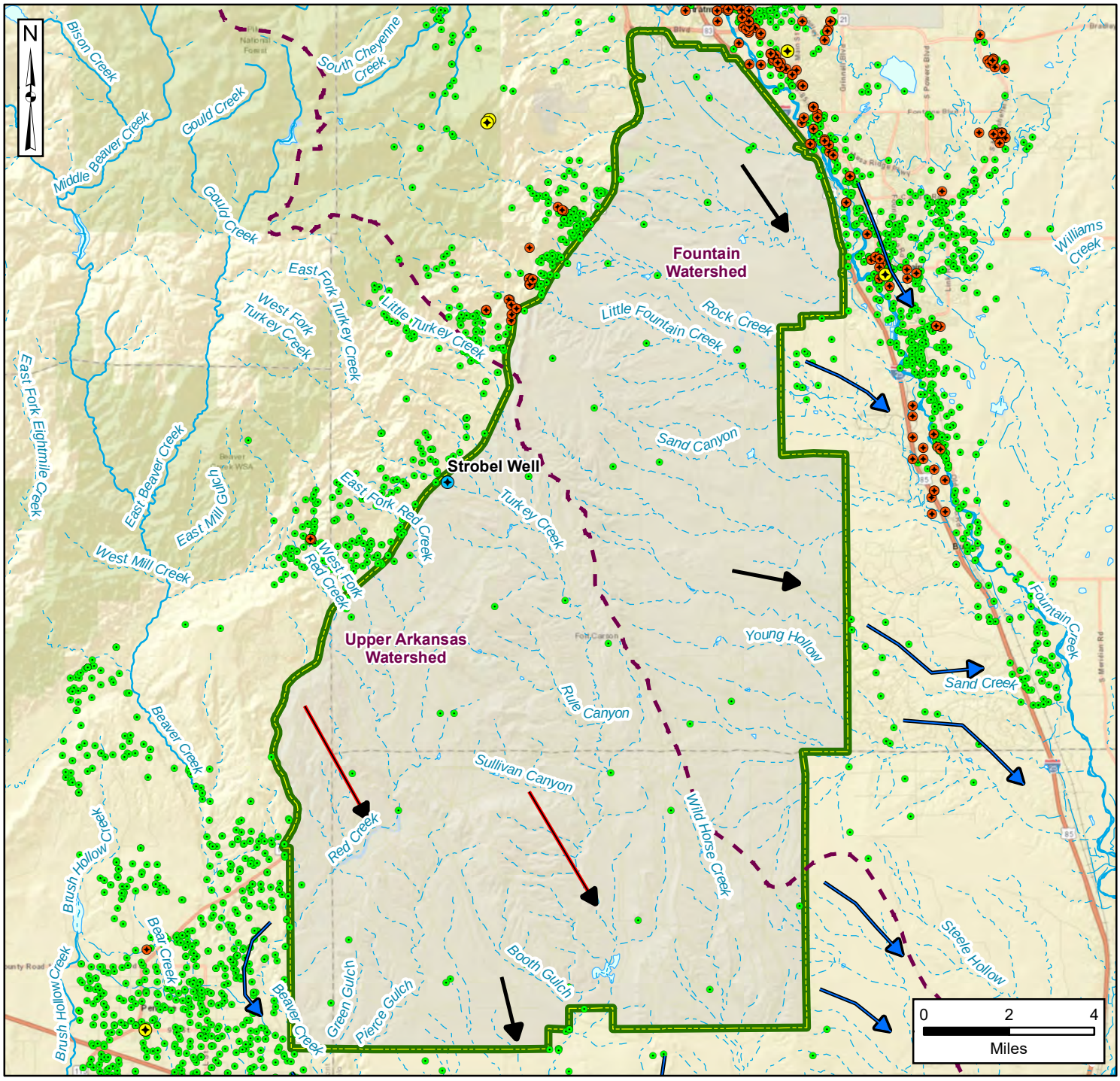
Figure 2-2
Site Layout



- Installation Boundary
- Watershed
- Surface Water Flow Direction
- Dakota-Purgatorie and Fountain Aquifer Groundwater Flow Direction
- Shallow Groundwater Flow Direction
- Water Body
- River/Stream (Perennial)
- Stream (Intermittent)
- Canal/Ditch
- Drinking Water Well
- Public Water Supply System Well
- State Water Well (Municipal)
- State Water Well (Other Potable / Potentially Potable)

Data Sources:
Fort Carson, GIS Data, 2018
EDR, Well Data, 2018
CO, DWR, Well Data, 2019
ESRI ArcGIS Online, StreetMap Data

Coordinate System:
WGS 1984, UTM Zone 13 North

USAEC PFAS Preliminary Assessment / Site Inspection
Fort Carson, Colorado

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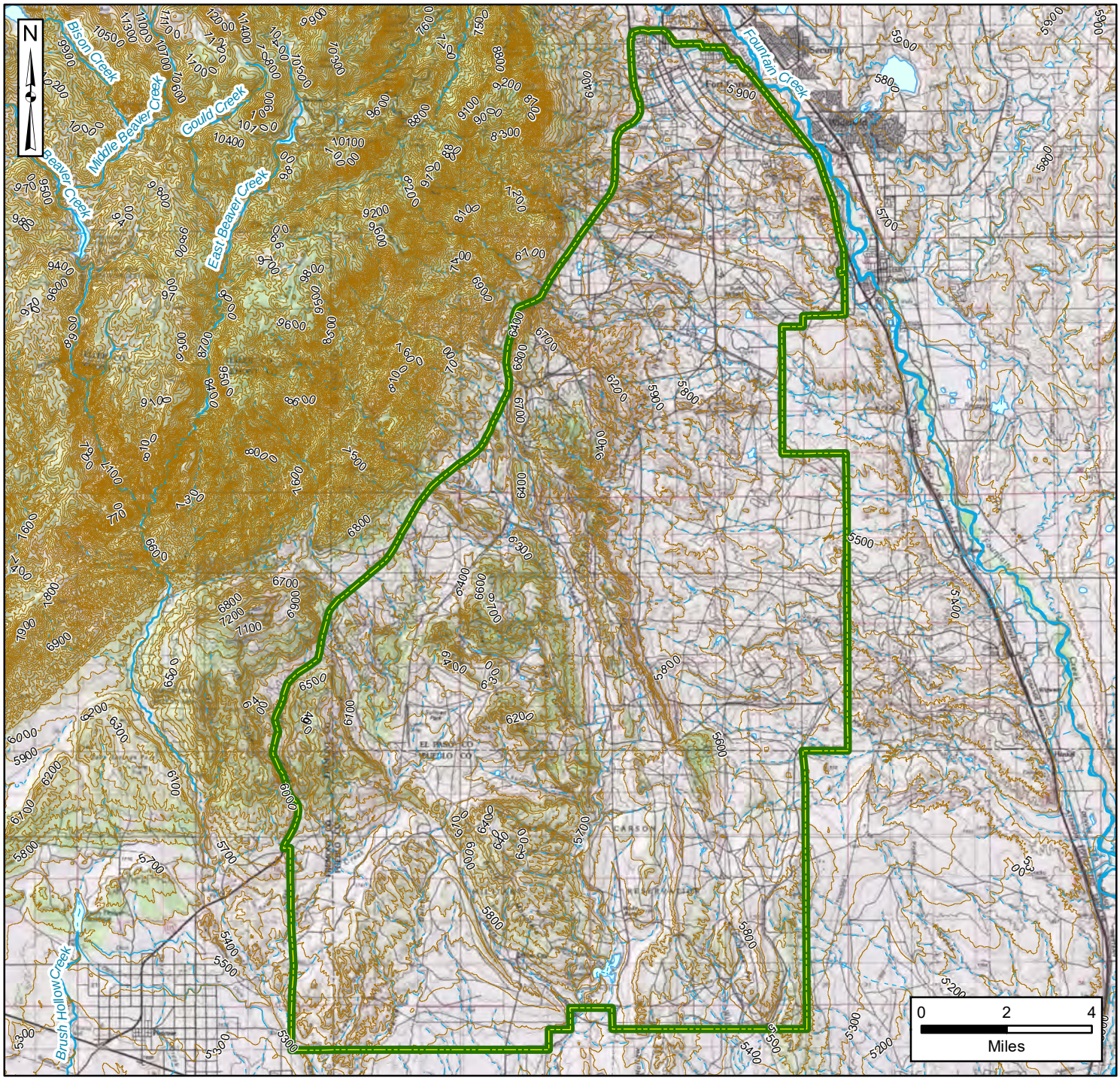
Figure 2-3
Topographic Map



Installation Boundary
Elevation Contour (ft)
River/Stream (Perennial)
Stream (Intermittent)
Canal/Ditch
Water Body

Data Sources:
Fort Carson, GIS Data, 2018
USGS, DEM, 2018
ESRI ArcGIS Online, Topo Map

Coordinate System:
WGS 1984, UTM Zone 13 North

USAEC PFAS Preliminary Assessment / Site Inspection
Fort Carson, Colorado

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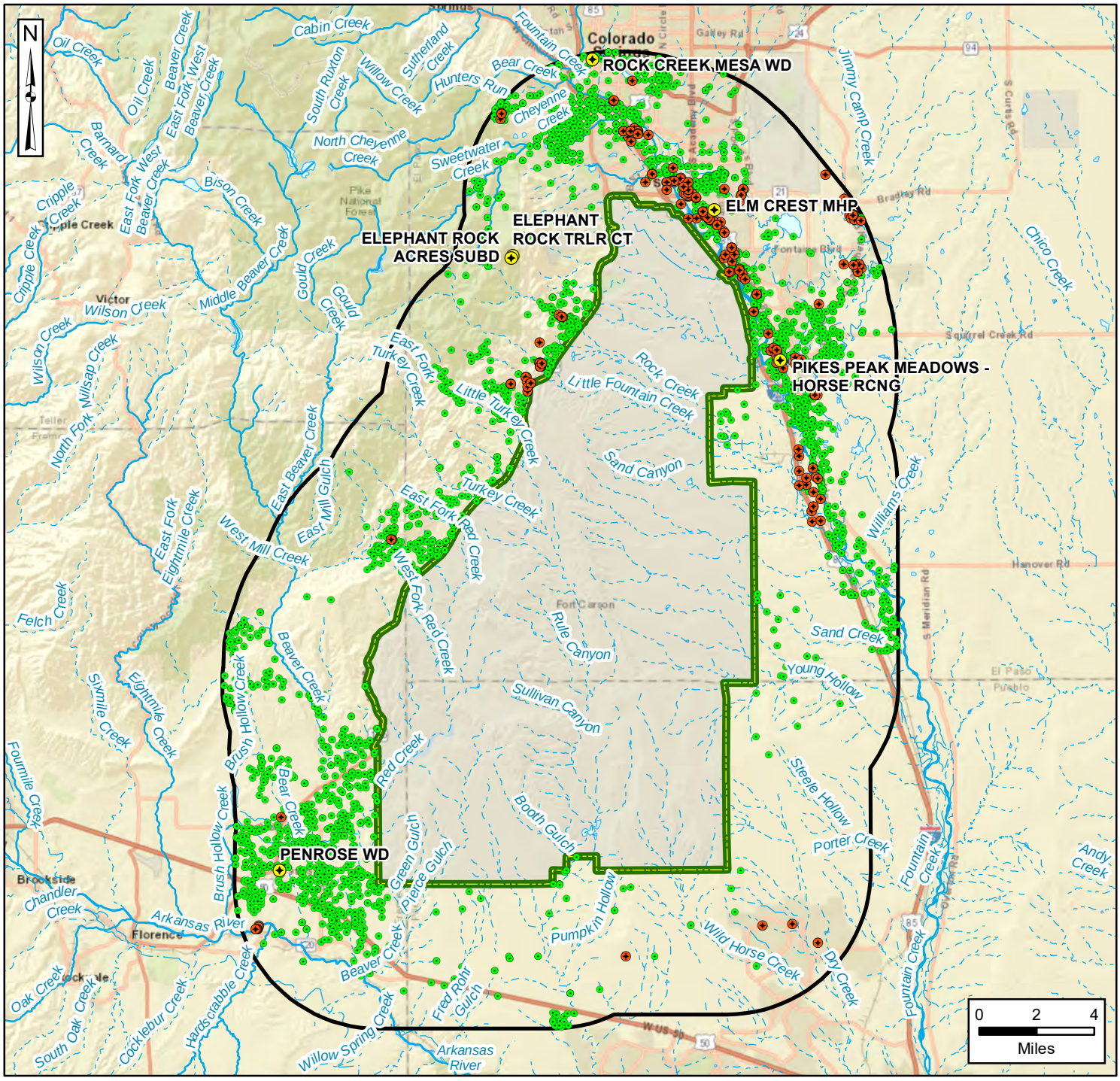
Figure 2-4
EDR Report Output and Colorado DWR Wells Within a Five Mile Radius



Installation Boundary
5-Mile Radius
River/Stream (Perennial)
Stream (Intermittent)
Canal/Ditch
Water Body

Public Water Supply System Well (EDR)
State Water Well (Municipal; DWR)
State Water Well (Other Potable / Potentially Potable; CO DWR)

CO DWR = Colorado Division of Water Resources
EDR = Environmental Data Resources

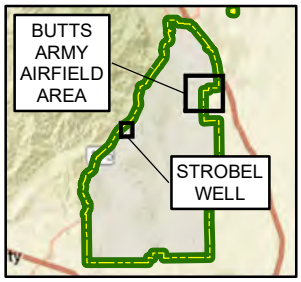
Note:
EDR output data and CO DWR wells have not been confirmed.

Data Sources:
Fort Carson, GIS Data, 2018
EDR, Well Data, 2018
CO DWR, Well Data, 2019
ESRI ArcGIS Online, StreetMap Data

Coordinate System:
WGS 1984, UTM Zone 13 North

USAEC PFAS Preliminary Assessment / Site Inspection
Fort Carson, Colorado

Figure 2-5
Historical PFAS Analytical Results



BUTTS ARMY AIRFIELD AREA

W89MW12	
Date	10/20/2016
PFBS	0.15
PFOS	1.5 D
PFOA	0.61 M

BECSMW34	
Date	7/7/2016
PFBS	0.056
PFOS	1.1
PFOA	0.092

BECSMW22	
Date	7/7/2016
PFBS	0.059
PFOS	1.4
PFOA	0.15

BECSMW07	
Date	7/7/2016
PFBS	0.043 [0.045]
PFOS	1.2 [1.2]
PFOA	0.075 [0.073]

BECSMW19A	
Date	7/7/2016
PFBS	0.065
PFOS	1.9
PFOA	0.60

BECSMW201
Drilled 11/22/16 (dry) Still Dry 12/13/16

BECSMW200
Drilled 11/21/16 (dry) Still Dry 12/13/16

BECSMW13		
Date	7/8/2016	10/20/2016
PFBS	3.2	2.6 JSD [4.3 D]
PFOS	3.8	2.7 JD [4.3 D]
PFOA	94	55 JD [91 JD]

FTAMW03	
Date	7/8/2016
PFBS	0.53 J
PFOS	5.5
PFOA	2.0

BECSMW8	
Date	10/24/2016
PFBS	0.33
PFOS	0.35
PFOA	0.33

BECSMW28R		
Date	7/8/2016	10/18/2016
PFBS	1.0	0.61 D [0.57 JS]
PFOS	41	33 DM [20]
PFOA	6.8	6.7 D [5.4]

AHA	
Date	10/18/2016
PFBS	0.0020 U
PFOS	0.0030 U
PFOA	0.0043

TH5	
Date	10/24/2016
PFBS	0.074
PFOS	0.26
PFOA	0.11

Strobel Well	
Date	7/8/2016
PFBS	0.0019 U [0.0019 U]
PFOS	0.0033 U [0.0033 U]
PFOA	0.0053 U [0.0053 U]

SWMU-89
SWMU-23/24
SWMU-23/24
Rock Creek
Little Fountain Creek
Turkey Creek
STROBEL WELL

0 0.1 0.2 Miles

0 0.1 0.2 Miles

Notes:
1. Historical data collected in July and October 2016 was provided by Fort Carson in various laboratory reports. Samples were analyzed by Maxxam and Test America laboratories.
2. Concentrations are in micrograms per liter (µg/L) or parts per billion.
3. Duplicate sample results are shown in brackets.
4. Bolded values indicate the result was greater than the limit of detection (LOD).
5. Concentrations of PFOS and PFOA that exceed the Office of the Secretary of Defense (OSD) residential tap water risk screening level of 0.040 µg/L (OSD 2019) are highlighted gray.
6. Concentrations of PFBS that exceed the OSD residential tap water risk screening level of 0.60 µg/L (updated in April 2021 based on the United States Environmental Protection Agency's updated PFBS toxicity assessment) are highlighted gray.
7. The Strobel Well is a potable well that provides pre-treatment/source water for the Turkey Creek Recreation Area Water System.

Qualifiers:
D = The reported value is from a dilution.
J = The analyte was positively identified; however the associated numerical value is an estimated concentration only.
M = Manually integrated compound.
S = Surrogate recoveries not within control limits.
U = The analyte was analyzed for, but was not detected above the limit of quantitation (LOQ).

Installation Boundary
Installation Restoration Program Site
Historical Sampling Location (Existing Monitoring Well)
Historical Sampling Location (Existing Drinking Water Well)
River/Stream (Perennial)
Stream (Intermittent)
Canal/Ditch
Water Body
Surface Water Flow Direction
Approximate Groundwater Flow Direction

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

Reference: Office of the Secretary of Defense (OSD). 2019. Memorandum: Investigating Per- and Polyfluoroalkyl Substances within the Department of Defense Cleanup Program. October.

Data Sources:
Fort Carson, GIS Data, 2018
ESRI ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 13 North

USAEC PFAS Preliminary Assessment / Site Inspection
Fort Carson, Colorado

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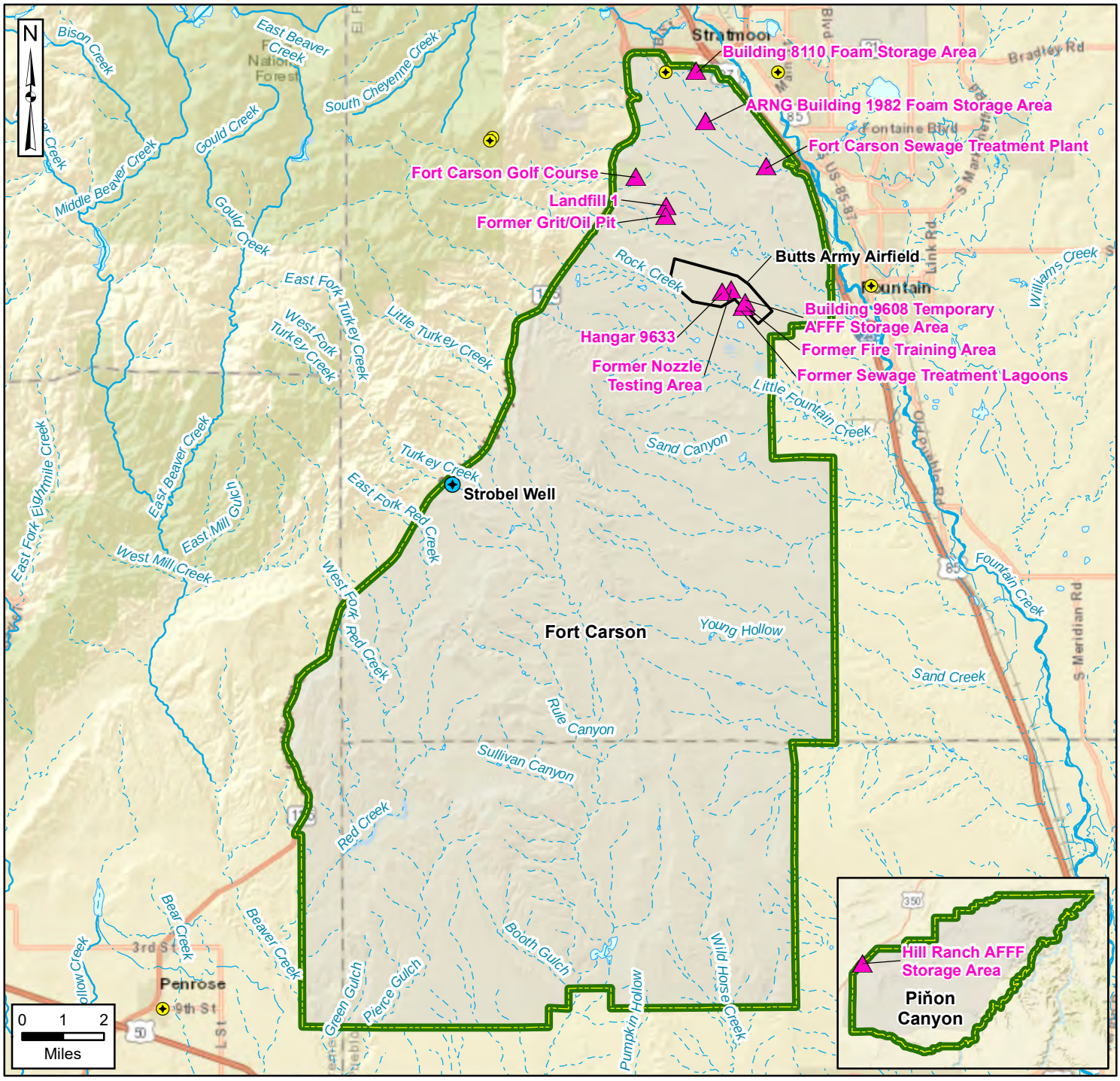
Figure 5-2
AOPI Locations



Installation Boundary
River/Stream (Perennial)
Stream (Intermittent)
Canal/Ditch
Water Body
AOPI
Public Water Supply System Well
Drinking Water Well

AFFF = aqueous film-forming foam
AOPI = area of potential interest

Data Sources:
Fort Carson, GIS Data, 2018
EDR Well Data, 2018
ESRI ArcGIS Online, StreetMap Data

Coordinate System:
WGS 1984, UTM Zone 13 North

USAEC PFAS Preliminary Assessment / Site Inspection
Fort Carson, Colorado

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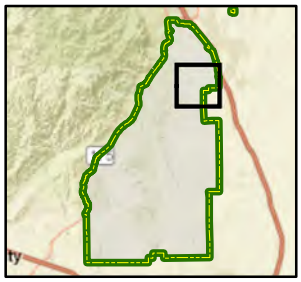
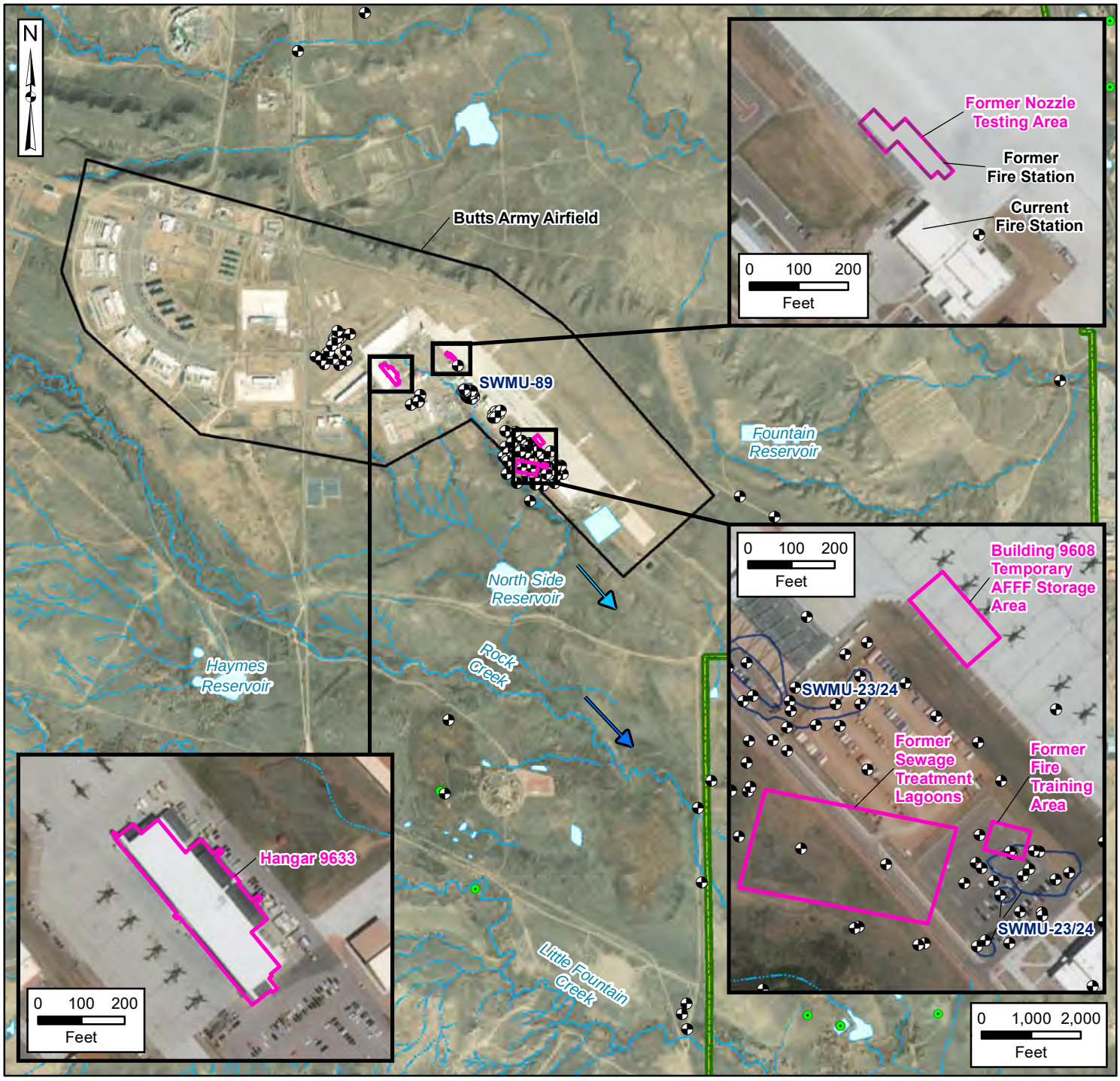
Figure 5-3
Aerial Photo of
Butts Army Airfield AOPIs





Installation Boundary
AOPI
Installation Restoration Program Site
Surface Water Flow Direction
Approximate Groundwater Flow Direction
River/Stream (Perennial)
Stream (Intermittent)
Water Body
State Water Well
(Other Potable / Potentially Potable)
Monitoring Well

AFFF = aqueous film-forming foam
AOPI = area of potential interest
SWMU = solid waste management unit

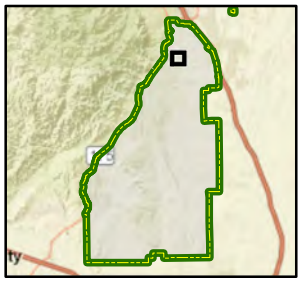
Data Sources:
Fort Carson, GIS Data, 2018
EDR Well Data, 2018
CO, DWR, Well Data, 2019
ESRI ArcGIS Online, Aerial Imagery

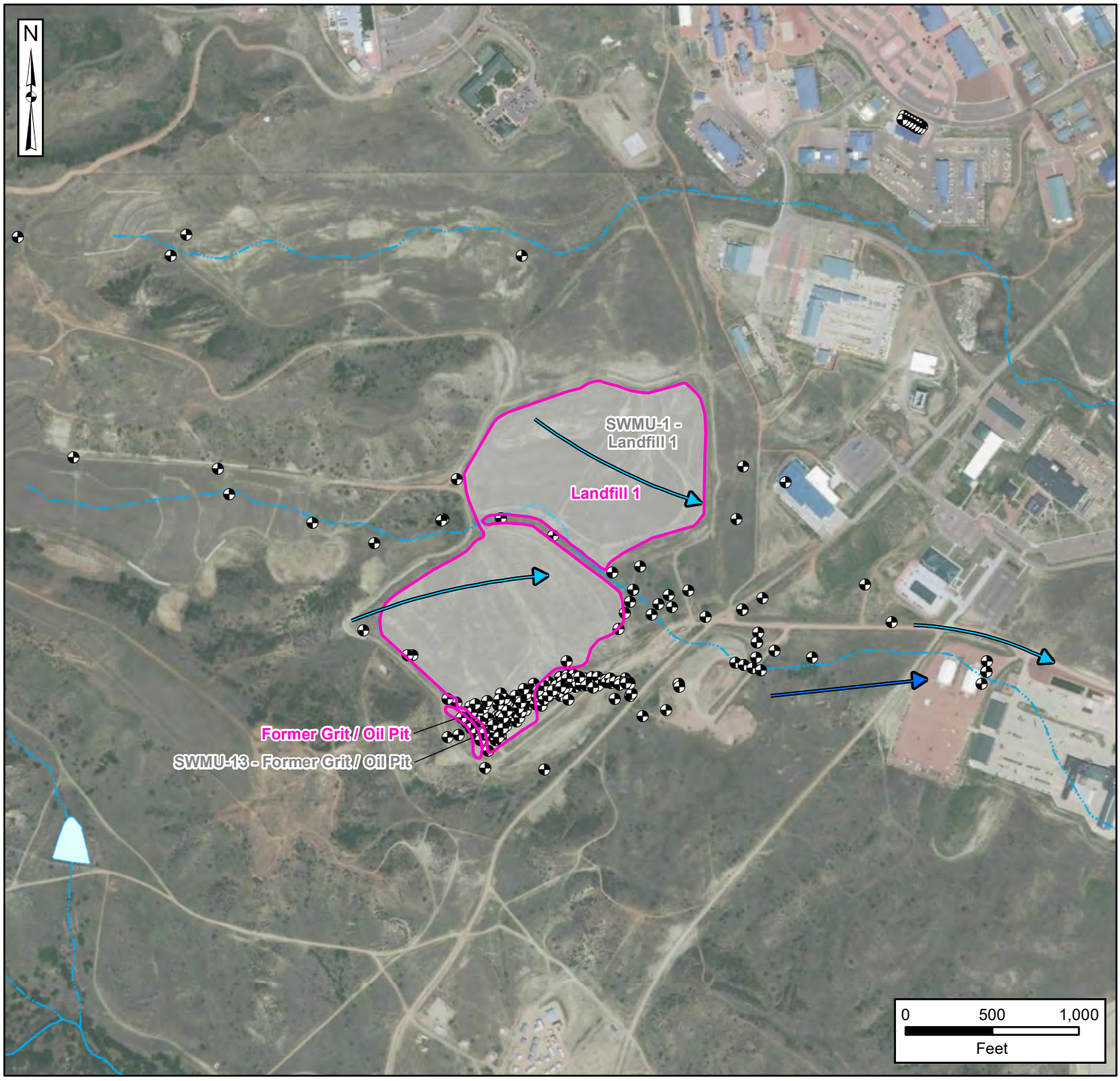
Coordinate System:
WGS 1984, UTM Zone 13 North

USAEC PFAS Preliminary Assessment / Site Inspection
Fort Carson, Colorado

ARCADIS

Figure 5-4
Aerial Photo of
Landfill 1 and Grit/Oil Pit AOPIs





Installation Boundary
AOPI
Installation Restoration Program Site
Groundwater Flow Direction
Surface Water Flow Direction
Stream (Intermittent)
Water Body
Monitoring Well

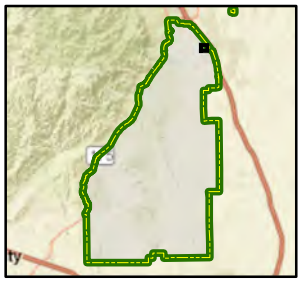
AOPI = area of potential interest
SWMU = solid waste management unit

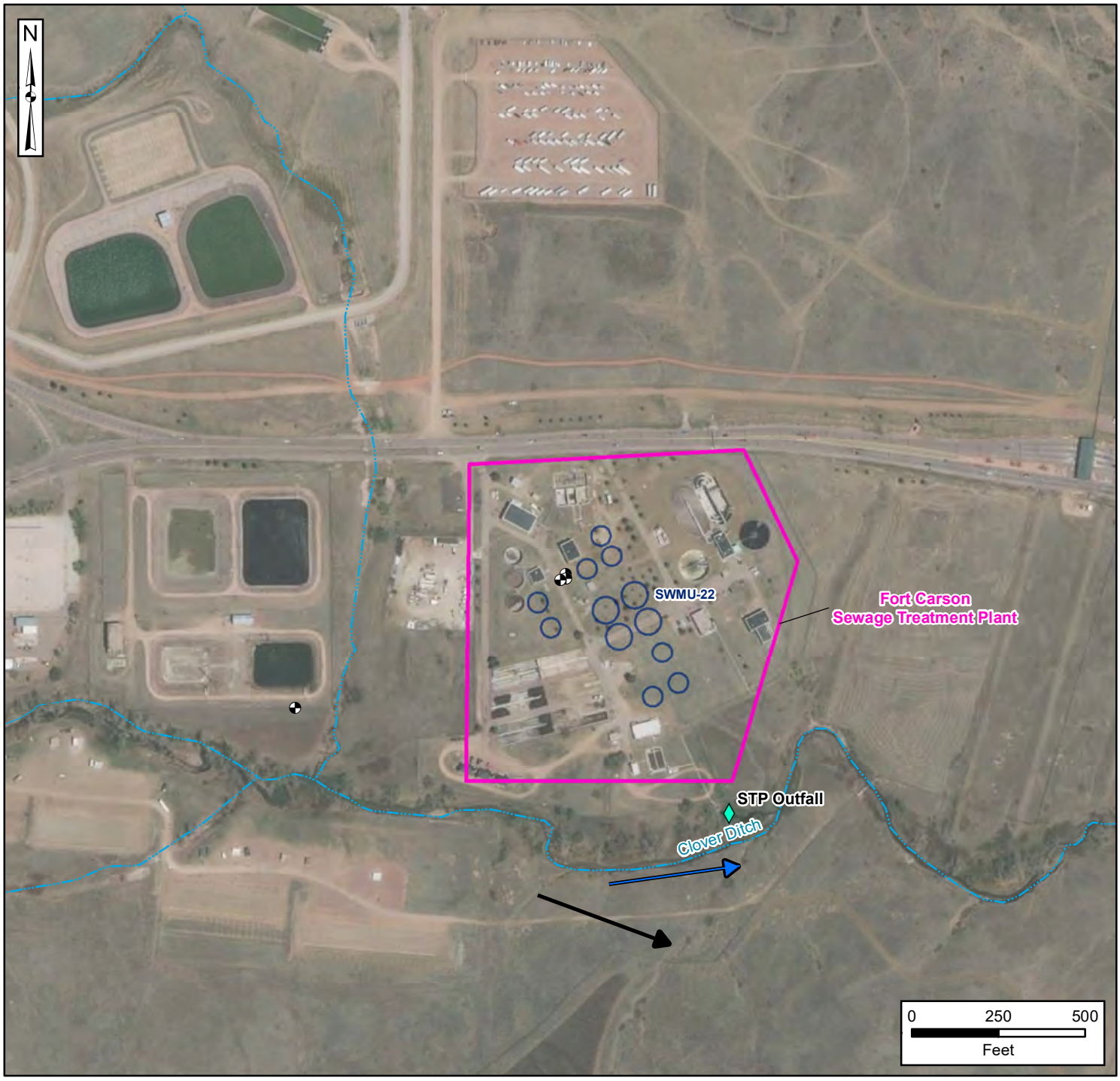
Data Sources:
Fort Carson, GIS Data, 2018
EDR Well Data, 2018
CO, DWR, Well Data, 2019
ECC, Groundwater Flow Direction, 2020/2021
ESRI ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 13 North

USAEC PFAS Preliminary Assessment / Site Inspection
Fort Carson, Colorado

Figure 5-5
Aerial Photo of Fort Carson
Sewage Treatment Plant





Installation Boundary
AOPI
Installation Restoration Program Site
Stream (Intermittent)
Canal/Ditch
Surface Water Flow Direction
Groundwater Flow Direction
STP Outfall
Monitoring Well

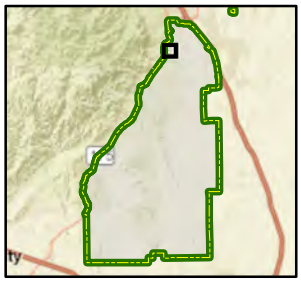
AOPI = area of potential interest
SWMU = solid waste management unit
STP = sewage treatment plant

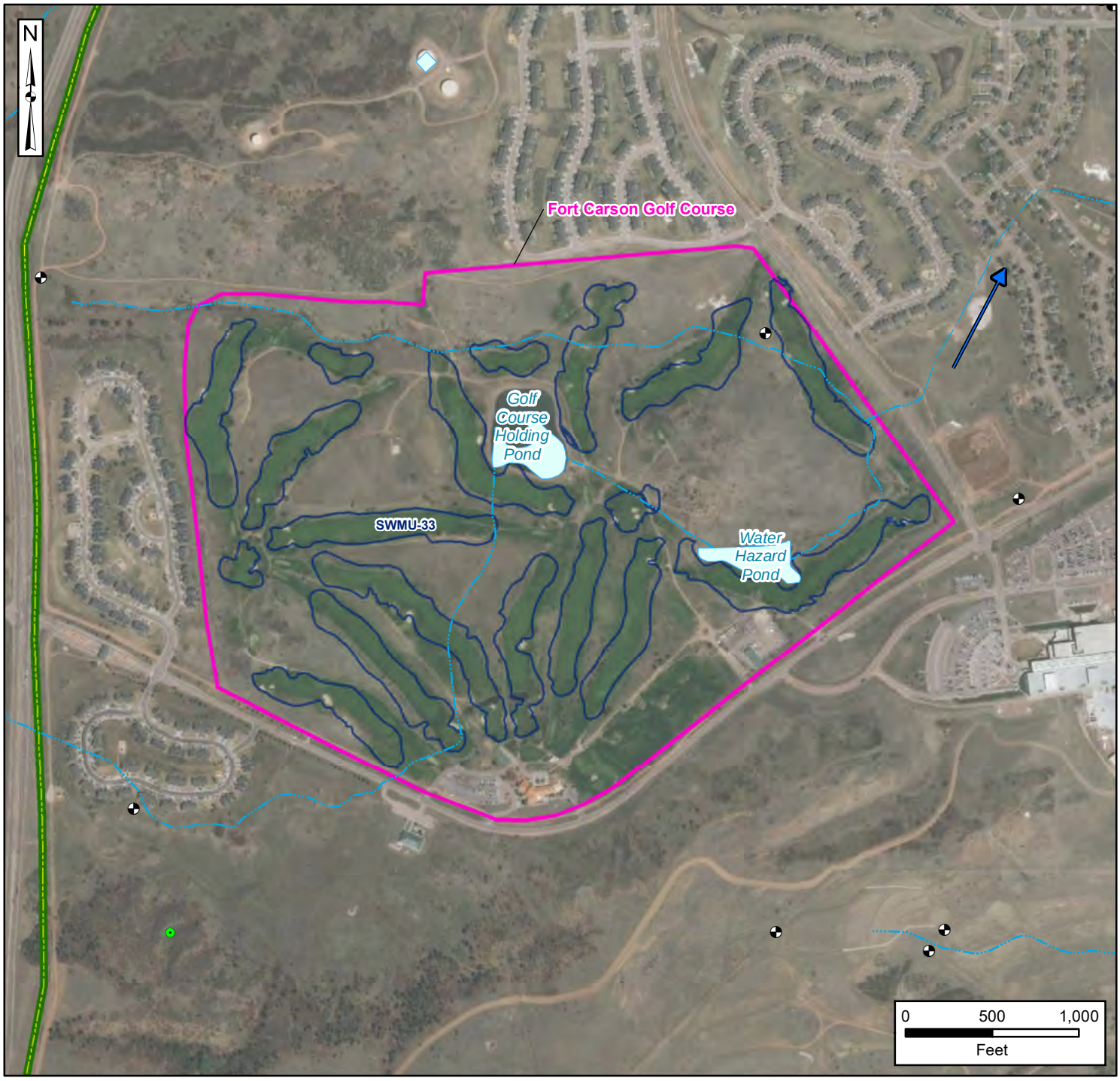
Data Sources:
Fort Carson, GIS Data, 2018
EDR Well Data, 2018
CO, DWR, Well Data, 2019
ESRI ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 13 North

USAEC PFAS Preliminary Assessment / Site Inspection
Fort Carson, Colorado

Figure 5-6
Aerial Photo of
Fort Carson Golf Course AOPI





Installation Boundary
AOPI
Installation Restoration Program Site
Surface Water Flow Direction
Stream (Intermittent)
Canal/Ditch
Water Body
State Water Well
(Other Potable / Potentially Potable)
Monitoring Well

AOPI = area of potential interest
SWMU = solid waste management unit

Data Sources:
Fort Carson, GIS Data, 2018
EDR Well Data, 2018
CO, DWR, Well Data, 2019
ESRI ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 13 North

USAEC PFAS Preliminary Assessment / Site Inspection
Fort Carson, CO

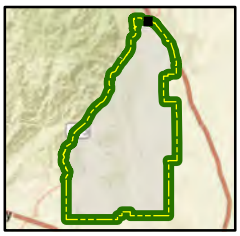
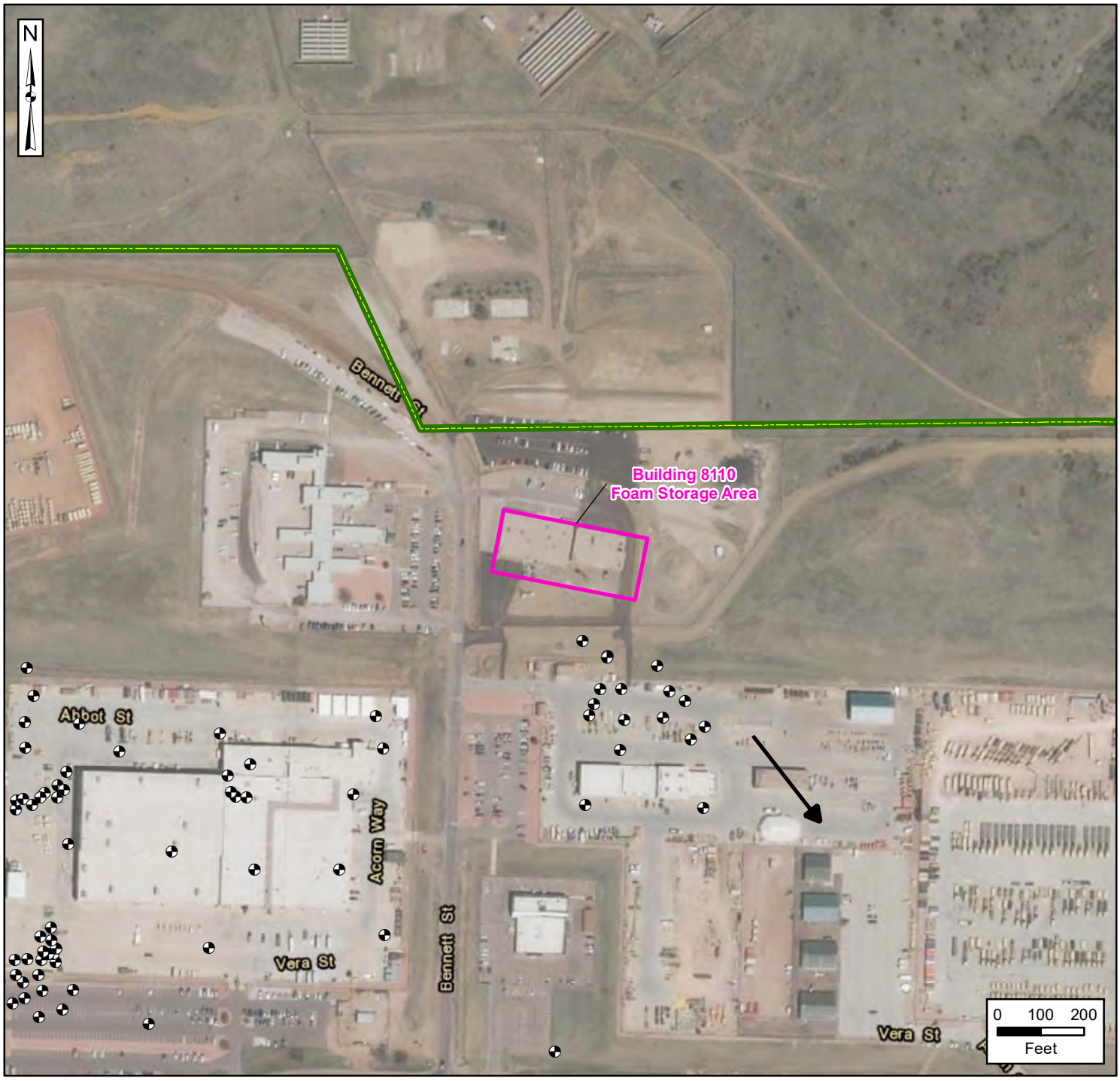


Figure 5-7
Aerial Photo of
Building 8110 Foam Storage Area AOPI



Installation Boundary
AOPI
Groundwater Flow Direction
Monitoring Well

AOPI = area of potential interest

Data Sources:
Fort Carson, GIS Data, 2018
ESRI ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 13 North

USAEC PFAS Preliminary Assessment / Site Inspection
Fort Carson, CO

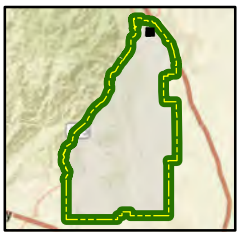
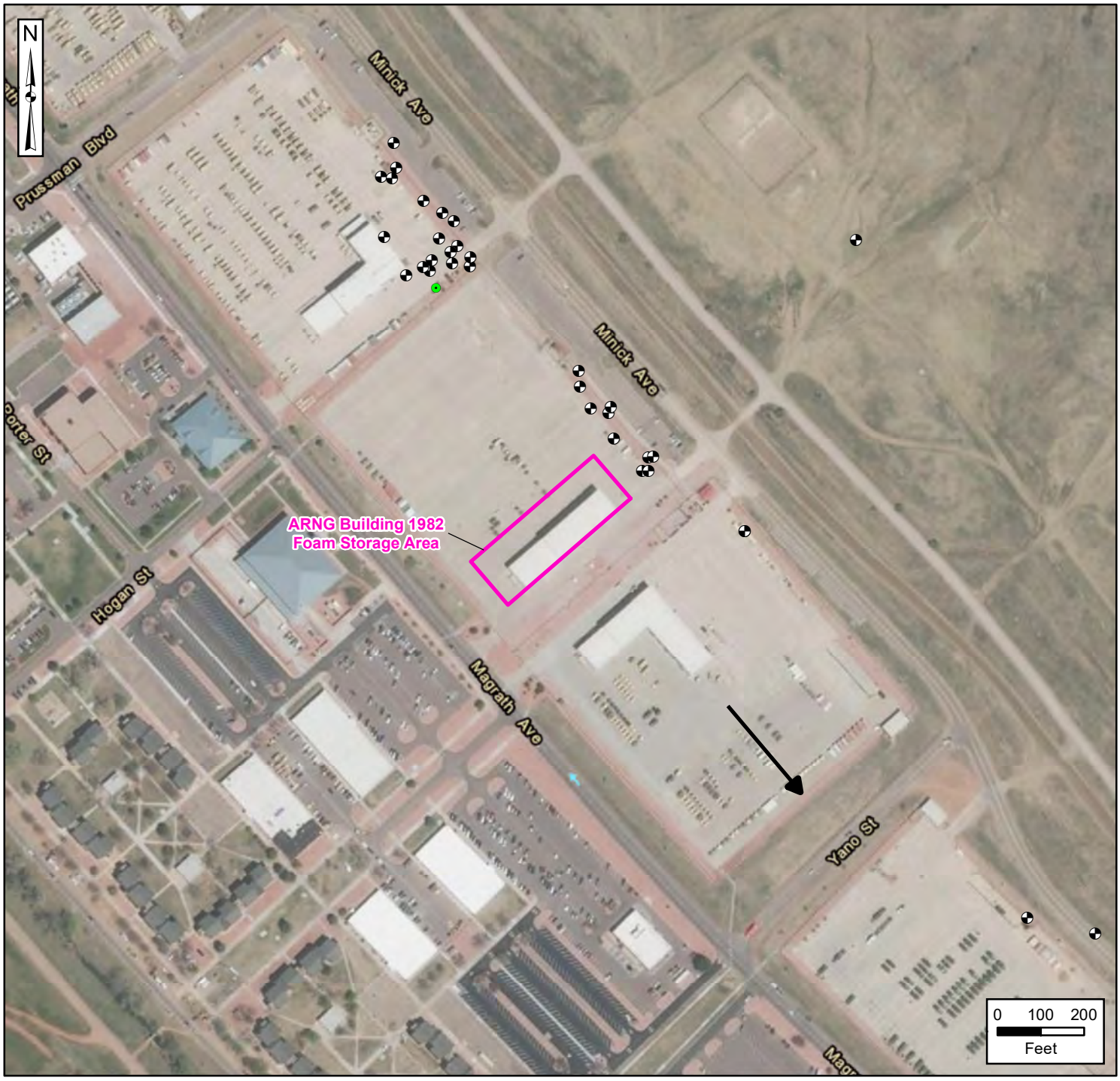


Figure 5-8
Aerial Photo of
ARNG Building 1982 Foam Storage Area AOPI



Installation Boundary
AOPI
Groundwater Flow Direction
Monitoring Well
State Water Well
(Other Potable / Potentially Potable)

AOPI = area of potential interest
ARNG = Army National Guard

Data Sources:
Fort Carson, GIS Data, 2018
ESRI ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 13 North

USAEC PFAS Preliminary Assessment / Site Inspection
Fort Carson, CO

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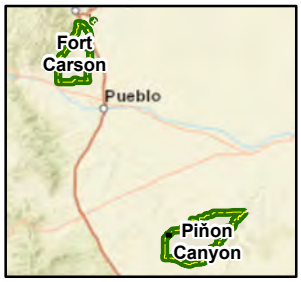
Figure 5-9
Aerial Photo of
PCMS Hill Ranch AFFF Storage Area AOPI



Installation Boundary
AOPI

AFFF = aqueous film-forming foam
AOPI = area of potential interest
PCMS = Pinon Canyon Maneuver Site

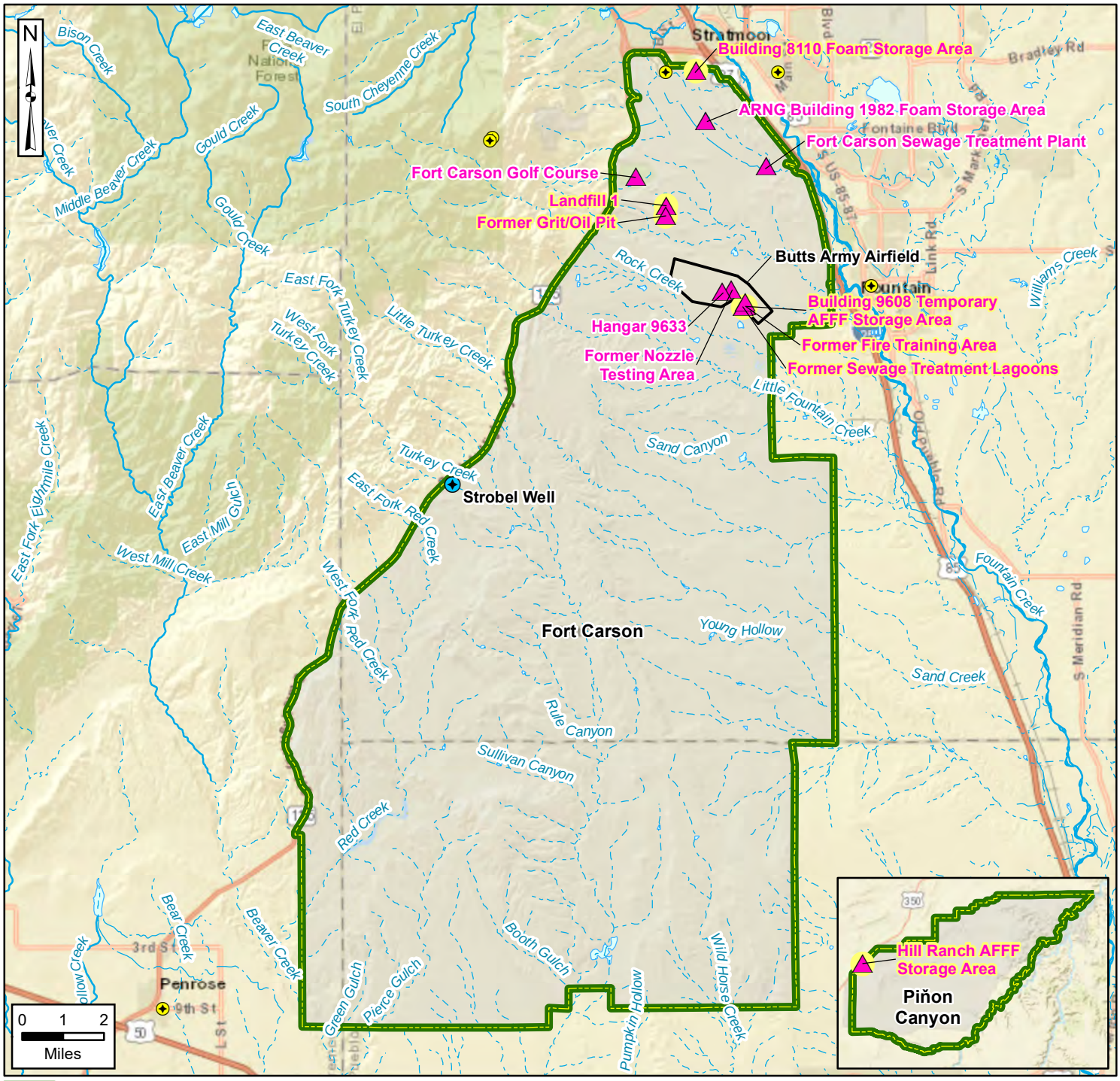
Data Sources:
Fort Carson, GIS Data, 2018
ESRI ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 13 North

USAEC PFAS Preliminary Assessment / Site Inspection
Fort Carson, Colorado

ARCADIS

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



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

AOPI
AOPI with OSD Risk Screening Level Exceedance
Public Water Supply System Well
Drinking Water Well

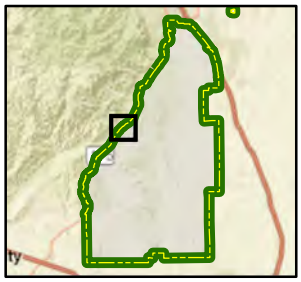
AFFF = aqueous film-forming foam
AOPI = area of potential interest
OSD = Office of the Secretary of Defense

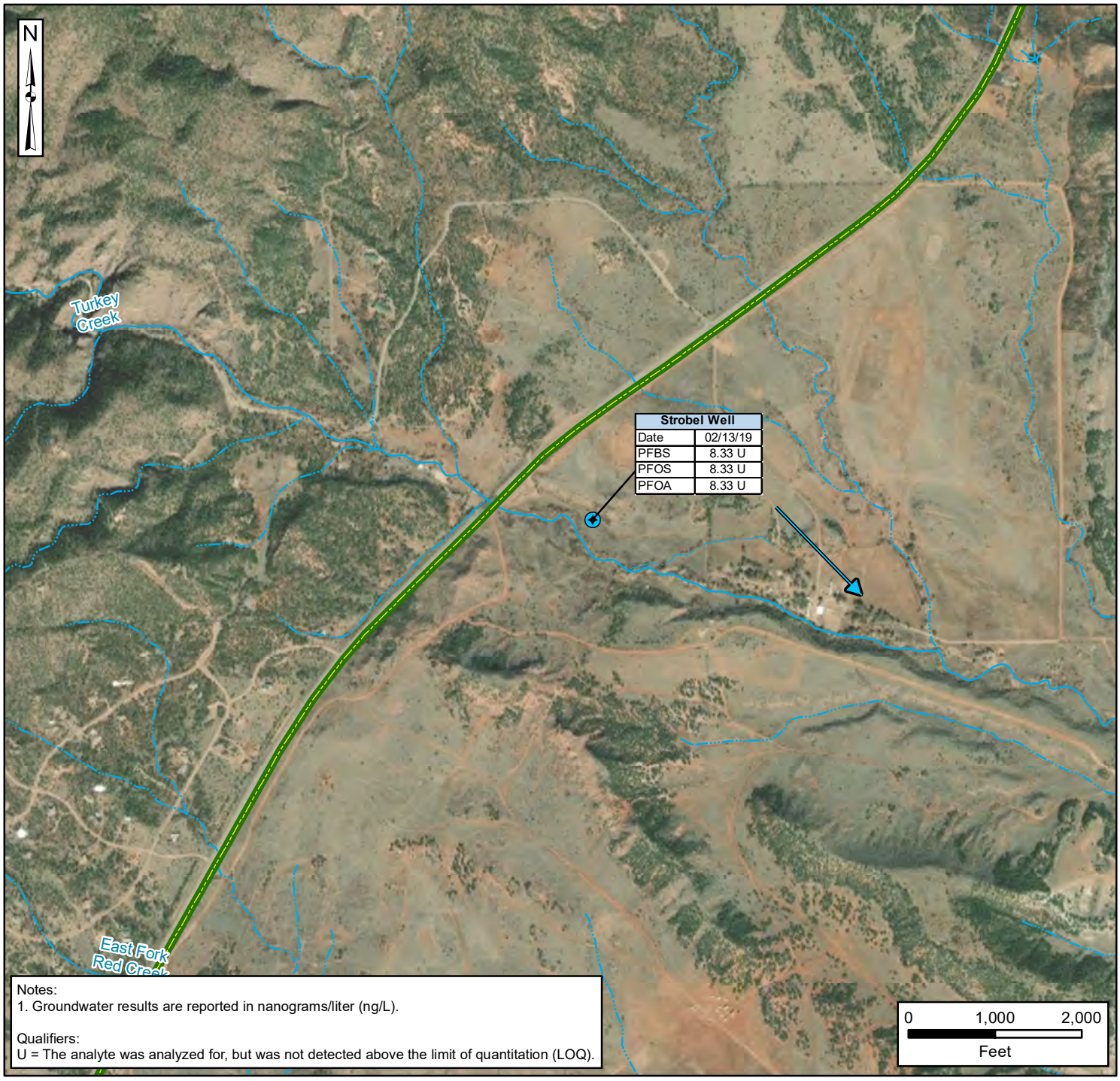
Data Sources:
Fort Carson, GIS Data, 2018
EDR Well Data, 2018
ESRI ArcGIS Online, StreetMap Data

Coordinate System:
WGS 1984, UTM Zone 13 North

USAEC PFAS Preliminary Assessment / Site Inspection
Fort Carson, Colorado

Figure 7-2
PFOS, PFOA, and PFBS Analytical Results for the Strobel Well





Notes:
1. Groundwater results are reported in nanograms/liter (ng/L).

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

Installation Boundary
River/Stream (Perennial)
Stream (Intermittent)
Approximate Groundwater Flow Direction
Groundwater Sampling Location (Drinking Water Well)

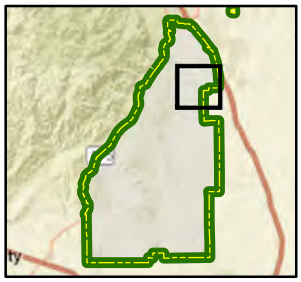
PFBS = perfluorobutanesulfonic acid
PFOA = perfluorooctanoic acid
PFOS = perfluorooctane sulfonate

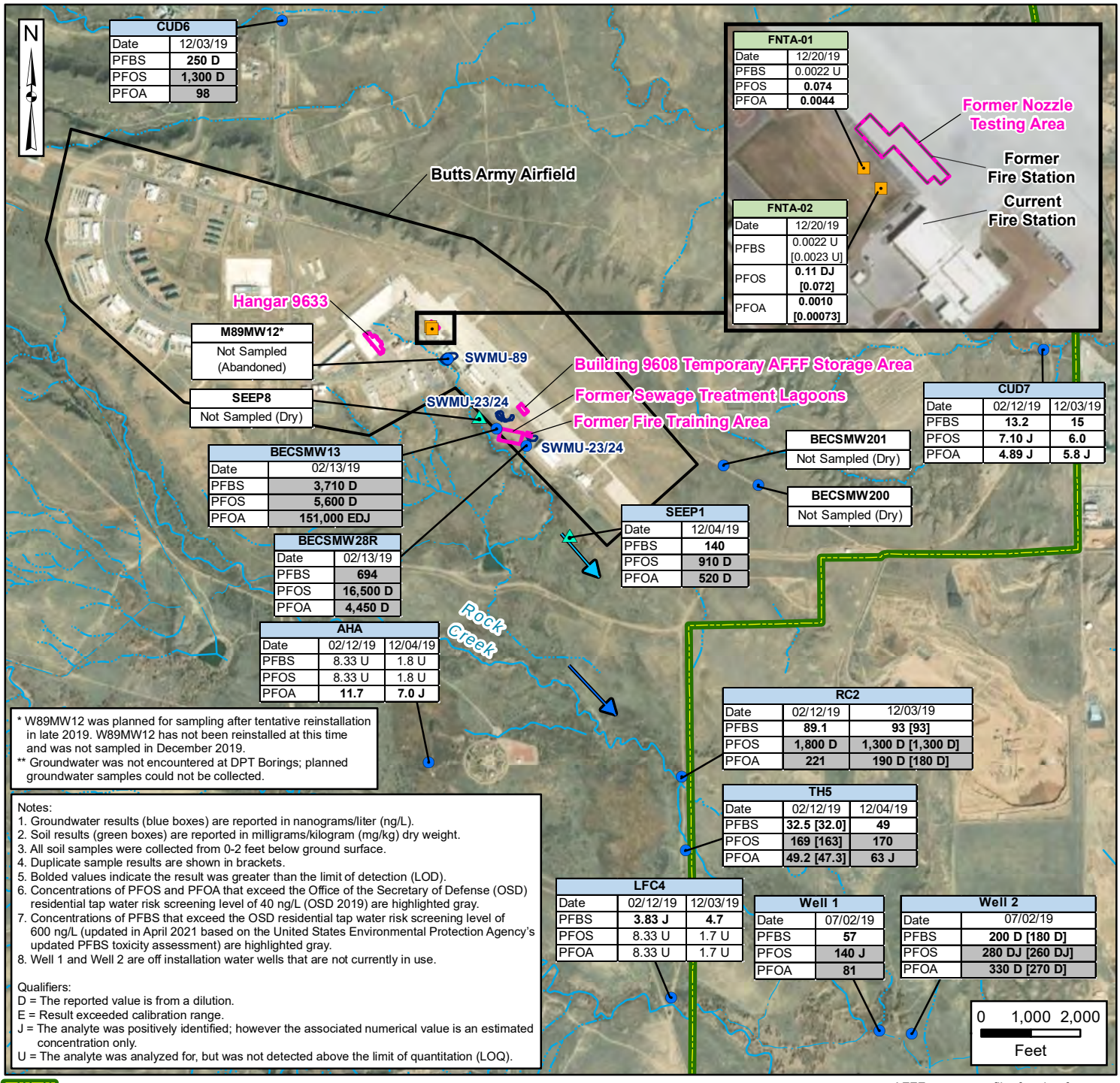
Data Sources:
Fort Carson, GIS Data, 2018
ESRI ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 13 North

USAEC PFAS Preliminary Assessment / Site Inspection
Fort Carson, Colorado

Figure 7-3
PFOS, PFOA, and PFBS Analytical Results for the Butts Army Airfield AOPIs and Off-Installation Water Supply Wells





* W89MW12 was planned for sampling after tentative reinstallation in late 2019. W89MW12 has not been reinstalled at this time and was not sampled in December 2019.
** Groundwater was not encountered at DPT Borings; planned groundwater samples could not be collected.

Notes:
1. Groundwater results (blue boxes) are reported in nanograms/liter (ng/L).
2. Soil results (green boxes) are reported in milligrams/kilogram (mg/kg) dry weight.
3. All soil samples were collected from 0-2 feet below ground surface.
4. Duplicate sample results are shown in brackets.
5. Bolded values indicate the result was greater than the limit of detection (LOD).
6. Concentrations of PFOS and PFOA that exceed the Office of the Secretary of Defense (OSD) residential tap water risk screening level of 40 ng/L (OSD 2019) are highlighted gray.
7. Concentrations of PFBS that exceed the OSD residential tap water risk screening level of 600 ng/L (updated in April 2021 based on the United States Environmental Protection Agency's updated PFBS toxicity assessment) are highlighted gray.
8. Well 1 and Well 2 are off installation water wells that are not currently in use.

Qualifiers:
D = The reported value is from a dilution.
E = Result exceeded calibration range.
J = The analyte was positively identified; however the associated numerical value is an estimated concentration only.
U = The analyte was analyzed for, but was not detected above the limit of quantitation (LOQ).

- Installation Boundary
- AOPI
- Installation Restoration Program Site
- River/Stream (Perennial)
- Stream (Intermittent)
- Approximate Groundwater Flow Direction
- Surface Water Flow Direction
- Groundwater Sampling Location (Existing Monitoring Well)
- Groundwater Sampling Location (Seep)
- Soil Sample Location (DPT Boring) **

AFFF = squeous film-forming foam
AOPI = area of potential interest
DPT = direct push technology
ft bgs = feet below ground surface
PFBS = perfluorobutanesulfonic acid
PFOA = perfluorooctanoic acid
PFOS = perfluorooctane sulfonate
SWMU = solid waste management unit

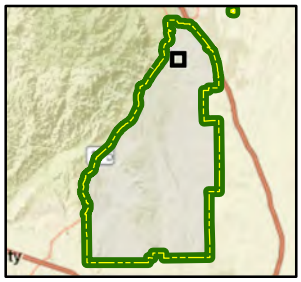
Data Sources:
Fort Carson, GIS Data, 2018
ESRI ArcGIS Online, Aerial Imagery

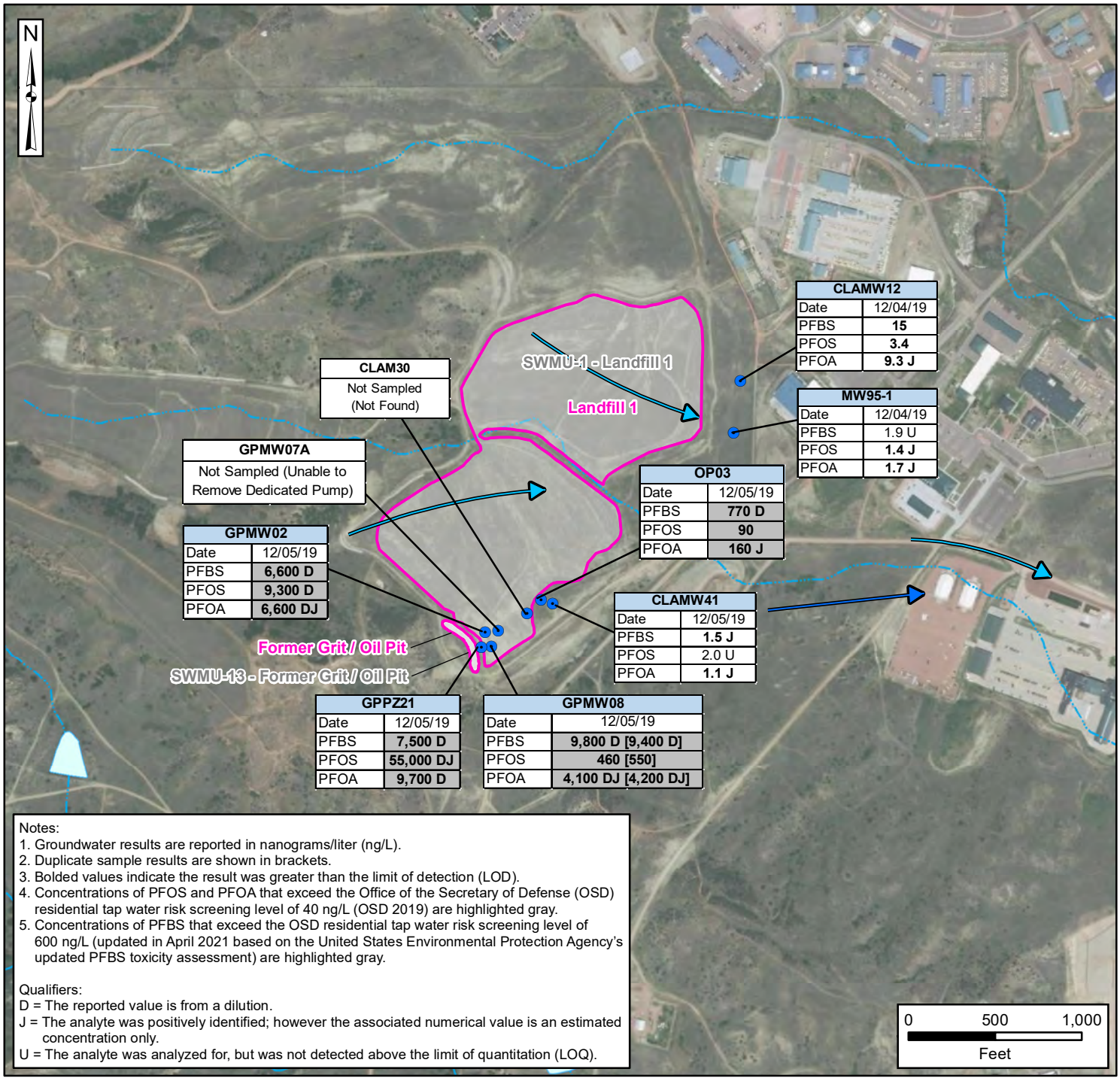
Reference: Office of the Secretary of Defense (OSD). 2019. Memorandum: Investigating Per- and Polyfluoroalkyl Substances within the Department of Defense Cleanup Program. October.

Coordinate System:
WGS 1984, UTM Zone 13 North

USAEC PFAS Preliminary Assessment / Site Inspection
Fort Carson, Colorado

Figure 7-4
PFOS, PFOA, and PFBS Analytical Results for Landfill 1 and the Grit/Oil Pit





Notes:
1. Groundwater results are reported in nanograms/liter (ng/L).
2. Duplicate sample results are shown in brackets.
3. Bolded values indicate the result was greater than the limit of detection (LOD).
4. Concentrations of PFOS and PFOA that exceed the Office of the Secretary of Defense (OSD) residential tap water risk screening level of 40 ng/L (OSD 2019) are highlighted gray.
5. Concentrations of PFBS that exceed the OSD residential tap water risk screening level of 600 ng/L (updated in April 2021 based on the United States Environmental Protection Agency's updated PFBS toxicity assessment) are highlighted gray.

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

Installation Boundary
AOPI
Installation Restoration Program Site
Stream (Intermittent)
Groundwater Flow Direction
Surface Water Flow Direction
Groundwater Sampling Location (Existing Monitoring Well)

AOPI = area of potential interest
PFBS = perfluorobutanesulfonic acid
PFOA = perfluorooctanoic acid
PFOS = perfluorooctane sulfonate
SWMU = solid waste management unit

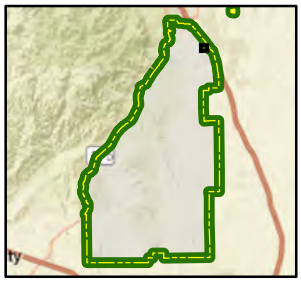
Data Sources:
Fort Carson, GIS Data, 2018
ECC, Groundwater Flow Direction, 2020/2021
ESRI ArcGIS Online, Aerial Imagery

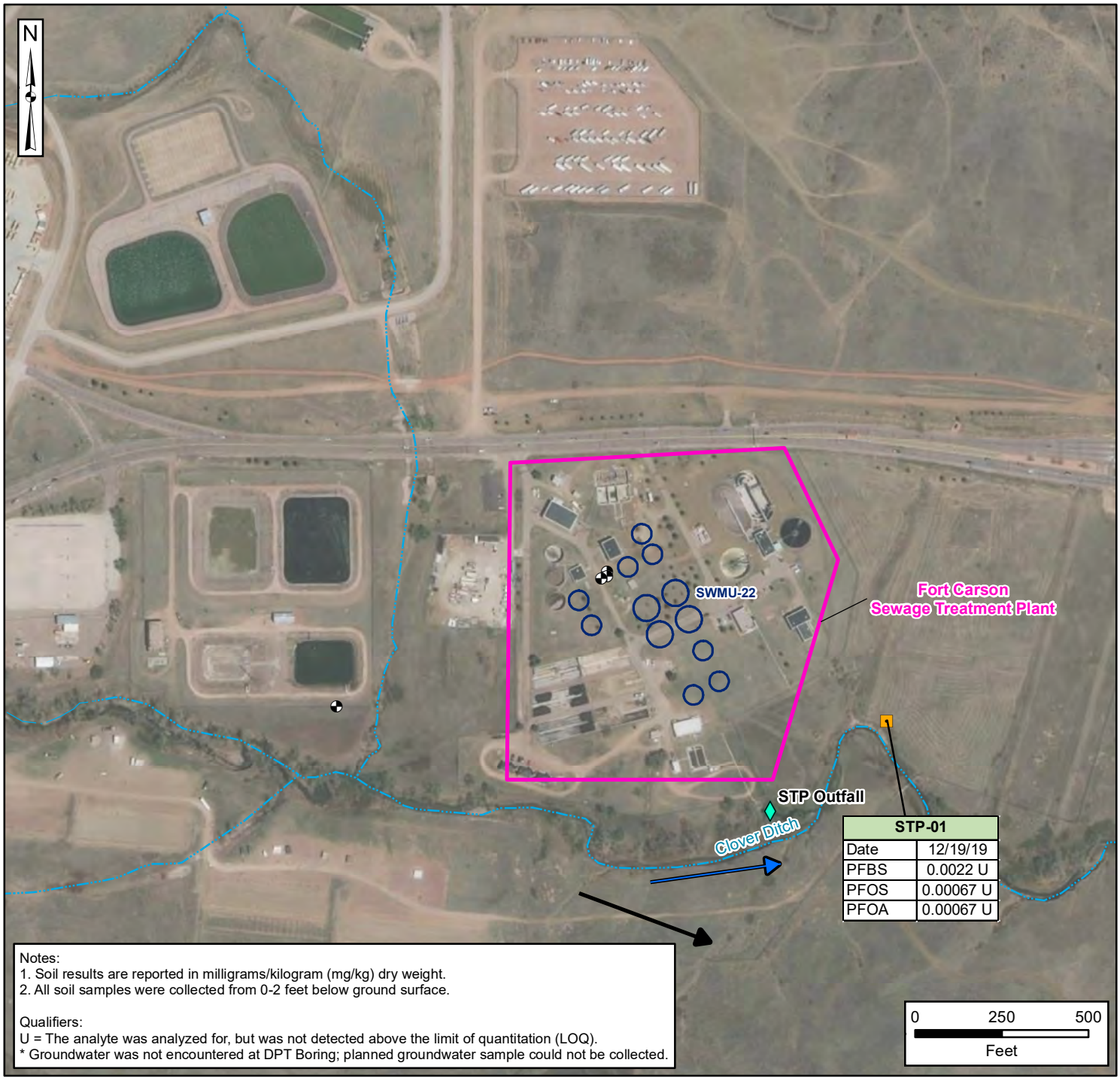
Reference: Office of the Secretary of Defense (OSD). 2019. Memorandum: Investigating Per- and Polyfluoroalkyl Substances within the Department of Defense Cleanup Program. October.

Coordinate System:
WGS 1984, UTM Zone 13 North

USAEC PFAS Preliminary Assessment / Site Inspection
Fort Carson, Colorado

Figure 7-5
PFOS, PFOA, and PFBS Analytical Results for the Fort Carson Sewage Treatment Plant





Notes:
1. Soil results are reported in milligrams/kilogram (mg/kg) dry weight.
2. All soil samples were collected from 0-2 feet below ground surface.

Qualifiers:
U = The analyte was analyzed for, but was not detected above the limit of quantitation (LOQ).
* Groundwater was not encountered at DPT Boring; planned groundwater sample could not be collected.

- Installation Boundary
- AOPI
- Installation Restoration Program Site
- Stream (Intermittent)
- Canal/Ditch
- Surface Water Flow Direction
- Groundwater Flow Direction
- Monitoring Well
- Soil Sample Location (DPT Boring) *
- STP Outfall

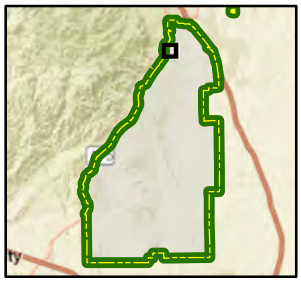
AOPI = area of potential interest
DPT = direct push technology
PFBS = perfluorobutanesulfonic acid
PFOA = perfluorooctanoic acid
PFOS = perfluorooctane sulfonate
STP = sewage treatment plant

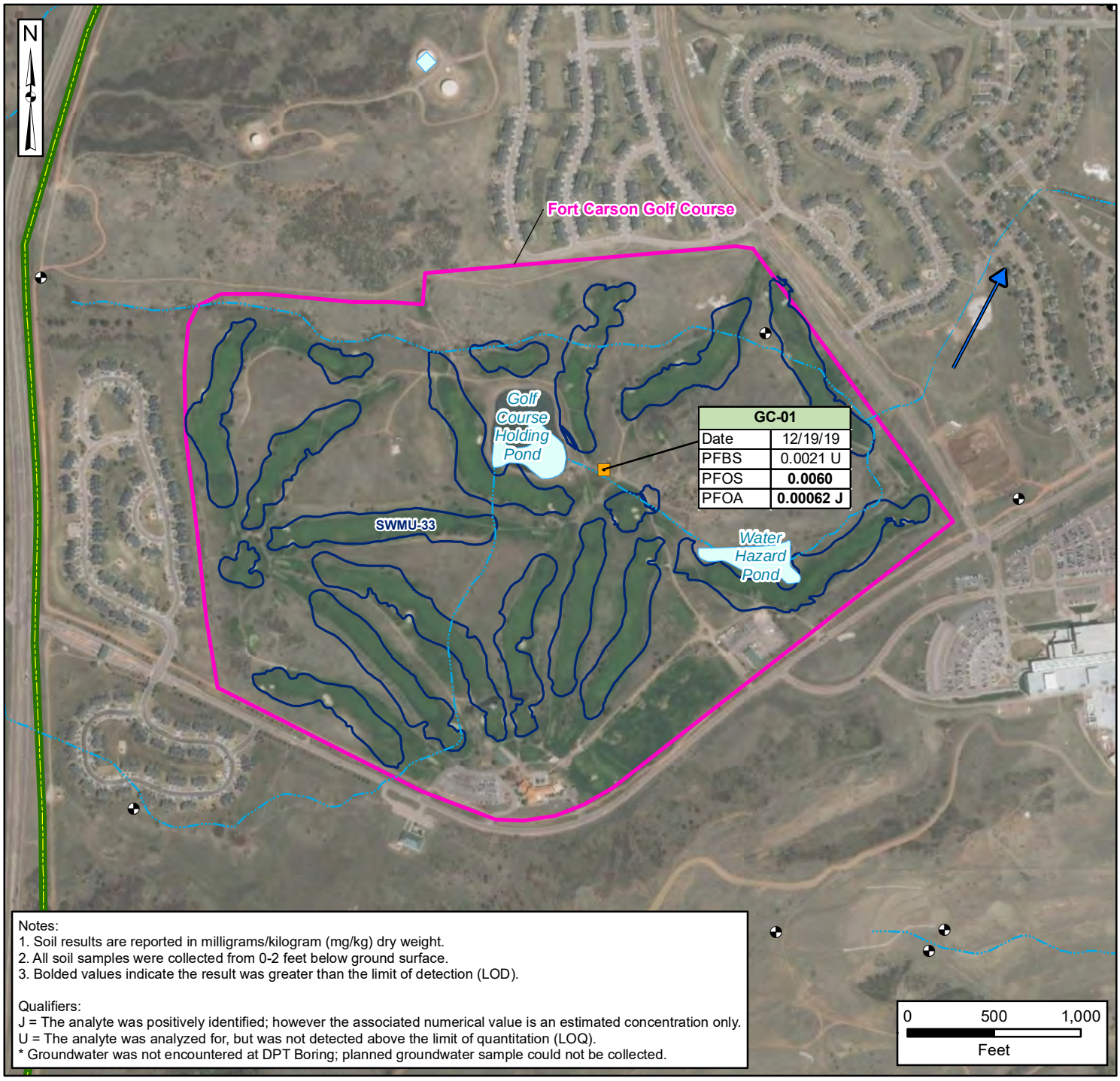
Data Sources:
Fort Carson, GIS Data, 2018
ESRI ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 13 North

USAEC PFAS Preliminary Assessment / Site Inspection
Fort Carson, Colorado

Figure 7-6
PFOS, PFOA, and PFBS Analytical Results for the Fort Carson Golf Course





Notes:
1. Soil results are reported in milligrams/kilogram (mg/kg) dry weight.
2. All soil samples were collected from 0-2 feet below ground surface.
3. Bolded values indicate the result was greater than the limit of detection (LOD).

Qualifiers:
J = The analyte was positively identified; however the associated numerical value is an estimated concentration only.
U = The analyte was analyzed for, but was not detected above the limit of quantitation (LOQ).
* Groundwater was not encountered at DPT Boring; planned groundwater sample could not be collected.

- Installation Boundary
- AOPI
- Installation Restoration Program Site
- Stream (Intermittent)
- Canal/Ditch
- Water Body
- Surface Water Flow Direction
- Monitoring Well
- Soil Sample Location (DPT Boring) *

AOPI = area of potential interest
DPT = direct push technology
ft bgs = feet below ground surface
PFBS = perfluorobutanesulfonic acid
PFOA = perfluorooctanoic acid
PFOS = perfluorooctane sulfonate
SWMU = solid waste management unit

Data Sources:
Fort Carson, GIS Data, 2018
ESRI ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 13 North

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Fort Carson, CO

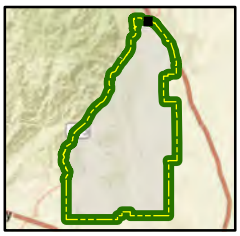
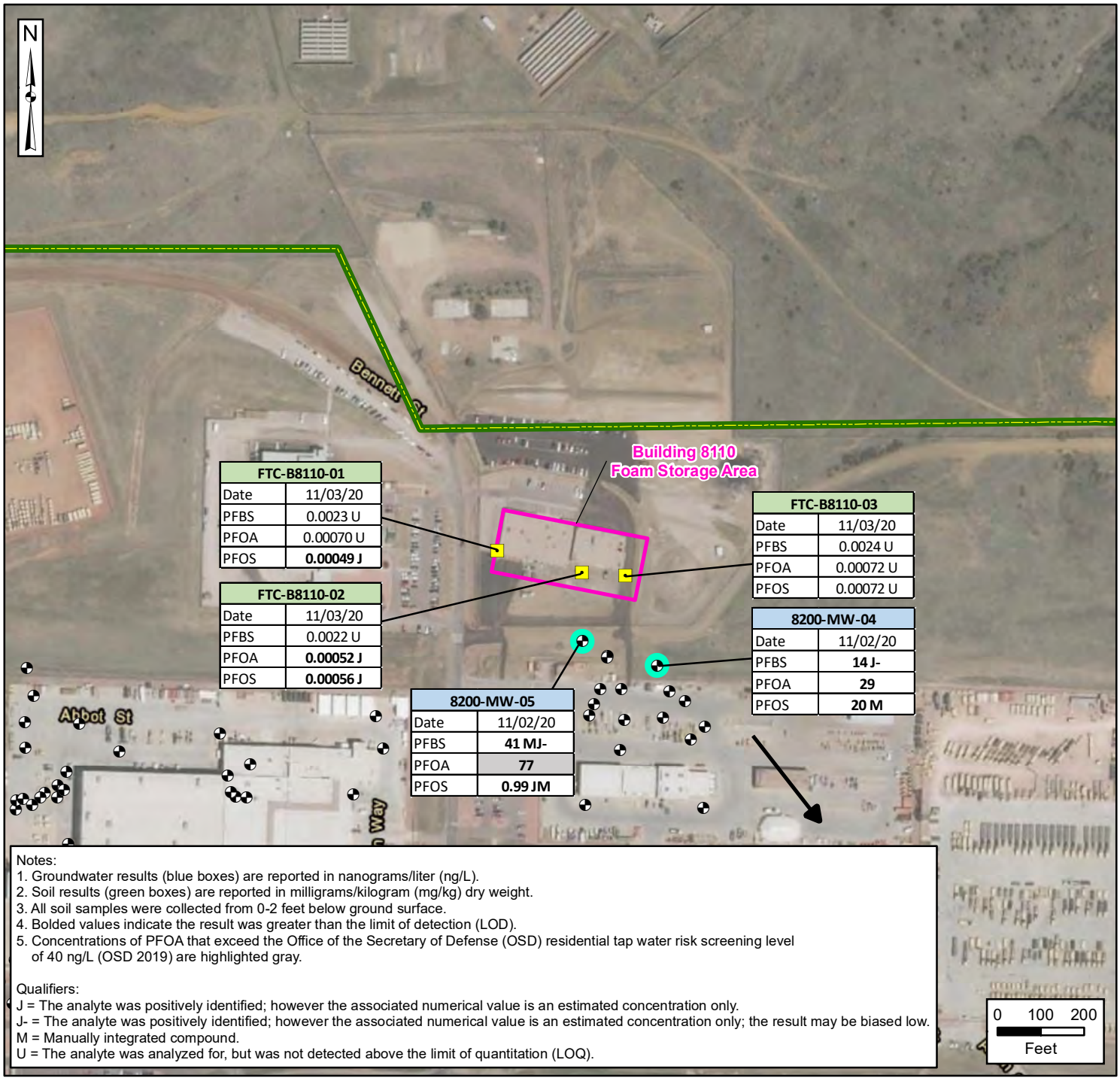


Figure 7-7
PFOS, PFOA, and PFBS Analytical Results for the Building 8110 Foam Storage Area AOPI



Notes:
1. Groundwater results (blue boxes) are reported in nanograms/liter (ng/L).
2. Soil results (green boxes) are reported in milligrams/kilogram (mg/kg) dry weight.
3. All soil samples were collected from 0-2 feet below ground surface.
4. Bolded values indicate the result was greater than the limit of detection (LOD).
5. Concentrations of PFOA that exceed the Office of the Secretary of Defense (OSD) residential tap water risk screening level of 40 ng/L (OSD 2019) are highlighted gray.

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

Installation Boundary
AOPI
Groundwater Flow Direction
Monitoring Well
Surface Soil Sampling Location (Hand Auger)
Groundwater Sampling Location (Existing Well)

AOPI = area of potential interest
PFAS = per- and polyfluoroalkyl substances
PFBS = perfluorobutanesulfonic acid
PFOA = perfluorooctanoic acid
PFOS = perfluorooctane sulfonate

Data Sources:
Fort Carson, GIS Data, 2018
ESRI ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 13 North

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Fort Carson, CO

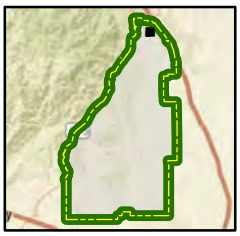
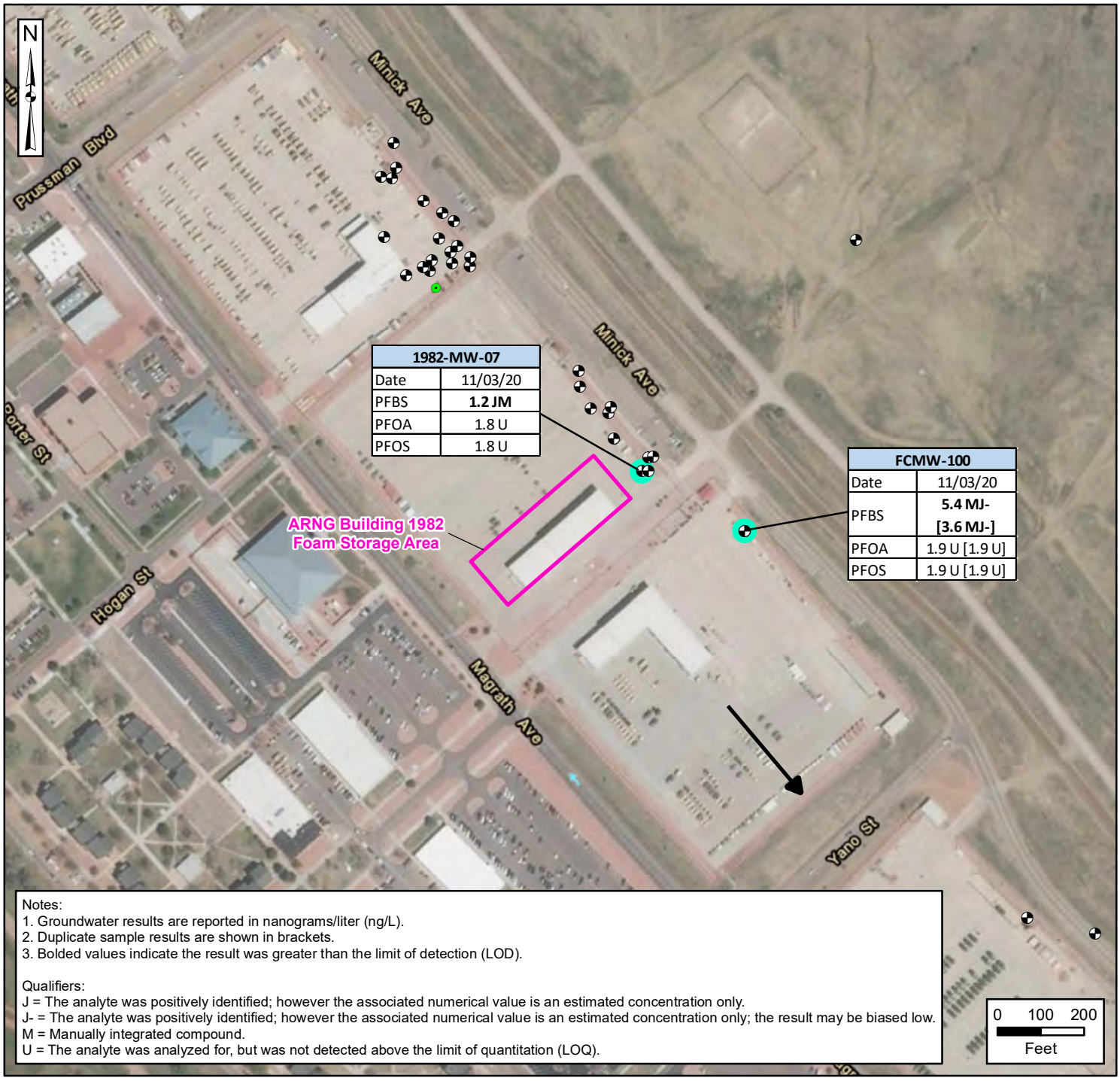


Figure 7-8
PFOS, PFOA, and PFBS Analytical Results for the ARNG Building 1982 Foam Storage Area AOPI



Notes:
1. Groundwater results are reported in nanograms/liter (ng/L).
2. Duplicate sample results are shown in brackets.
3. Bolded values indicate the result was greater than the limit of detection (LOD).

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

Installation Boundary
AOPI
Groundwater Flow Direction
Monitoring Well
State Water Well (Other Potable / Potentially Potable)
Groundwater Sampling Location (Existing Well)

AOPI = area of potential interest
ARNG = Army National Guard
PFBS = perfluorobutanesulfonic acid
PFOA = perfluorooctanoic acid
PFOS = perfluorooctane sulfonate

Data Sources:
Fort Carson, GIS Data, 2018
ESRI ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 13 North

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Fort Carson, CO

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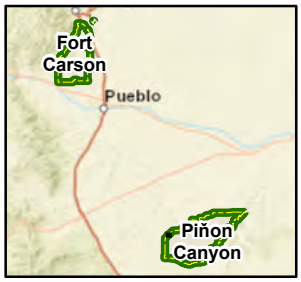
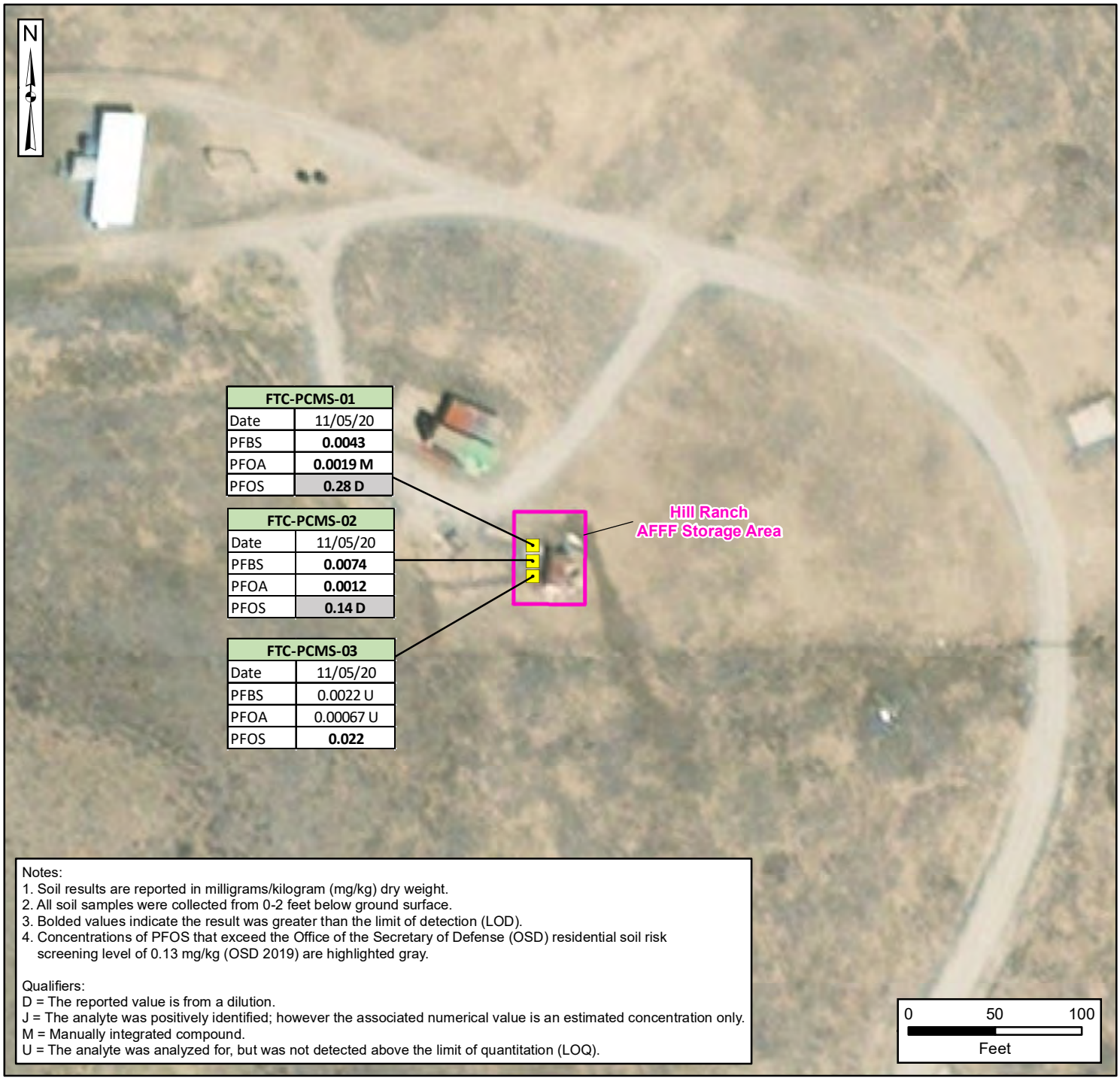
Figure 7-9
PFOS, PFOA, and PFBS Analytical Results for the PCMS Hill Ranch AFFF Storage Area AOPI





Notes:
1. Soil results are reported in milligrams/kilogram (mg/kg) dry weight.
2. All soil samples were collected from 0-2 feet below ground surface.
3. Bolded values indicate the result was greater than the limit of detection (LOD).
4. Concentrations of PFOS that exceed the Office of the Secretary of Defense (OSD) residential soil risk screening level of 0.13 mg/kg (OSD 2019) are highlighted gray.

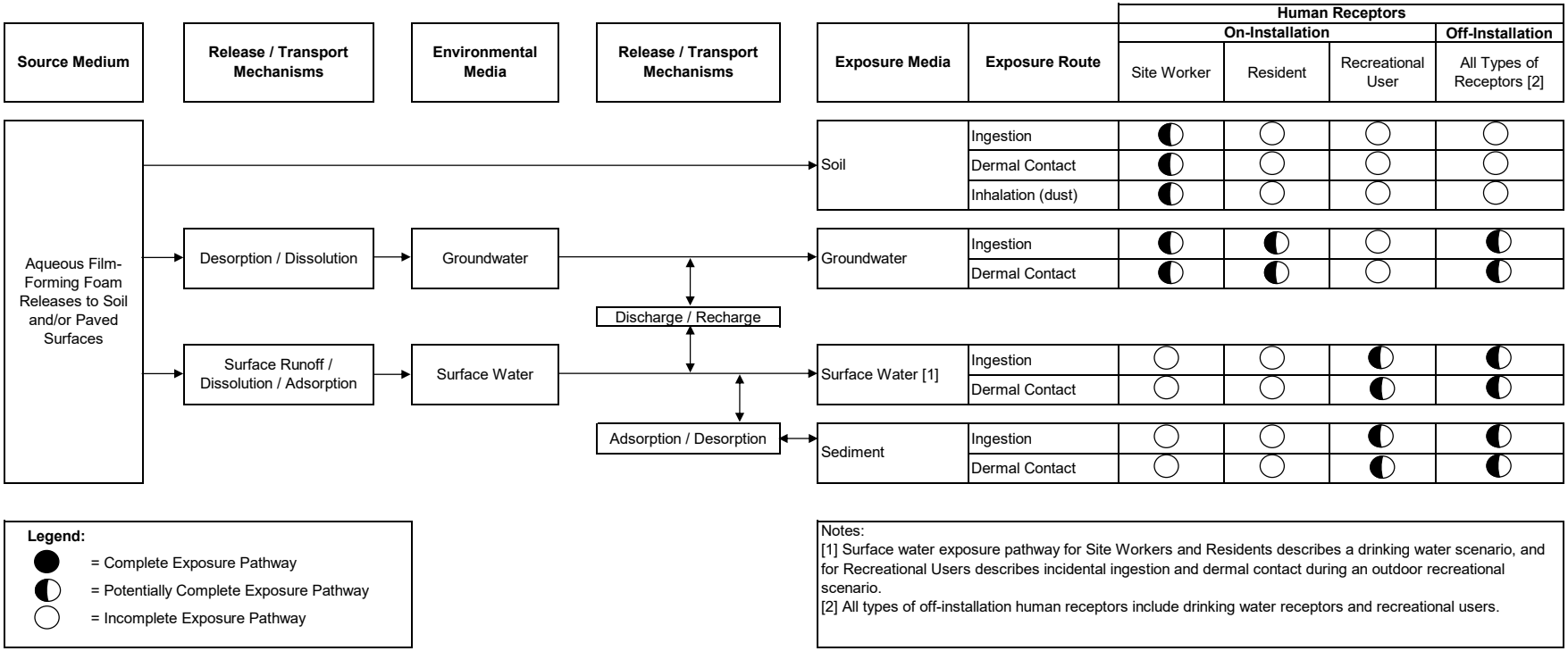
Qualifiers:
D = The reported value is from a dilution.
J = The analyte was positively identified; however the associated numerical value is an estimated concentration only.
M = Manually integrated compound.
U = The analyte was analyzed for, but was not detected above the limit of quantitation (LOQ).

Installation Boundary
AOPI
Surface Soil Sampling Location (Hand Auger)

AFFF = aqueous film-forming foam
AOPI = area of potential interest
PCMS = Pinon Canyon Maneuver Site
PFAS = per- and polyfluoroalkyl substances
PFBS = perfluorobutanesulfonic acid
PFOA = perfluorooctanoic acid
PFOS = perfluorooctane sulfonate

Data Sources:
Fort Carson, GIS Data, 2018
ESRI ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 13 North



Conceptual Site Model - Former Fire Training Area, Former Sewage Treatment Lagoons, Building 9608 Temporary AFFF Storage Area, and Hangar 9633), and ARNG Building 1982 Foam Storage Area

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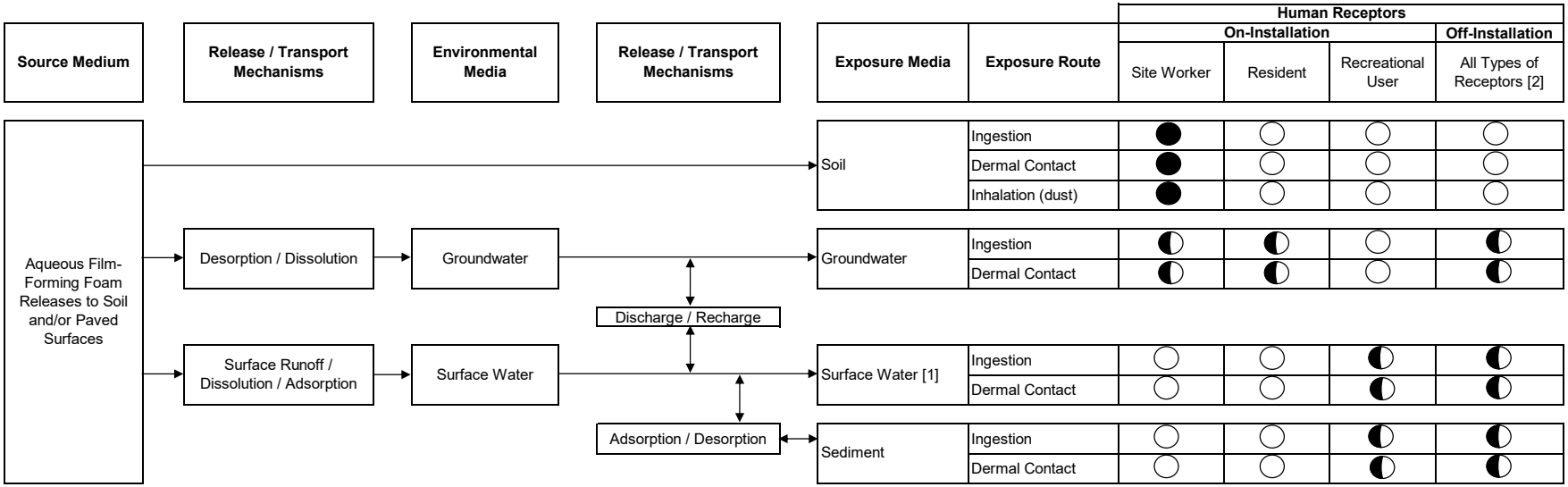
Fort Carson, Colorado

Figure 7-10



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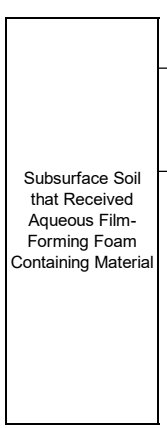
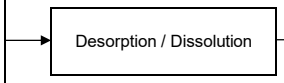
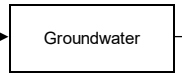
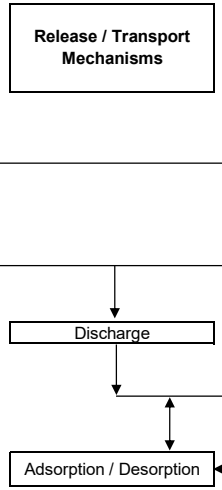
Conceptual Site Model - Former Nozzle Testing Area and Building 8110 Foam Storage Area
USAEC PFAS Preliminary Assessment / Site Inspection
Fort Carson, Colorado

Figure 7-11









Exposure Media	Exposure Route	Human Receptors: On-Installation: Site Worker	On-Installation: Resident	On-Installation: Recreational User	Off-Installation: All Types of Receptors [2]
Subsurface Soil	Ingestion	◐	○	○	○
	Dermal Contact	◐	○	○	○
	Inhalation (dust)	◐	○	○	○
Groundwater	Ingestion	◐	◐	○	◐
	Dermal Contact	◐	◐	○	◐
Surface Water [1]	Ingestion	○	○	◐	◐
	Dermal Contact	○	○	◐	◐
Sediment	Ingestion	○	○	◐	◐
	Dermal Contact	○	○	◐	◐

Legend:

● = Complete Exposure Pathway

◐ = Potentially Complete Exposure Pathway

○ = Incomplete Exposure Pathway

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

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Conceptual Site Model - Landfill 1 and Grit/Oil Pit
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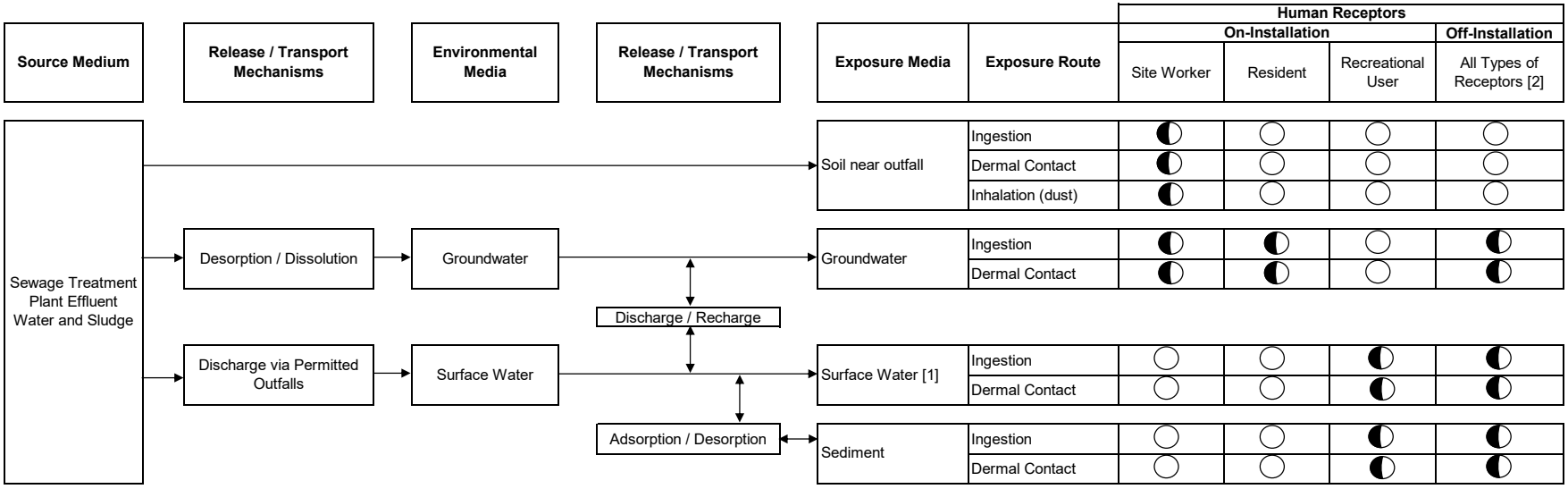
Fort Carson, Colorado

Figure 7-12



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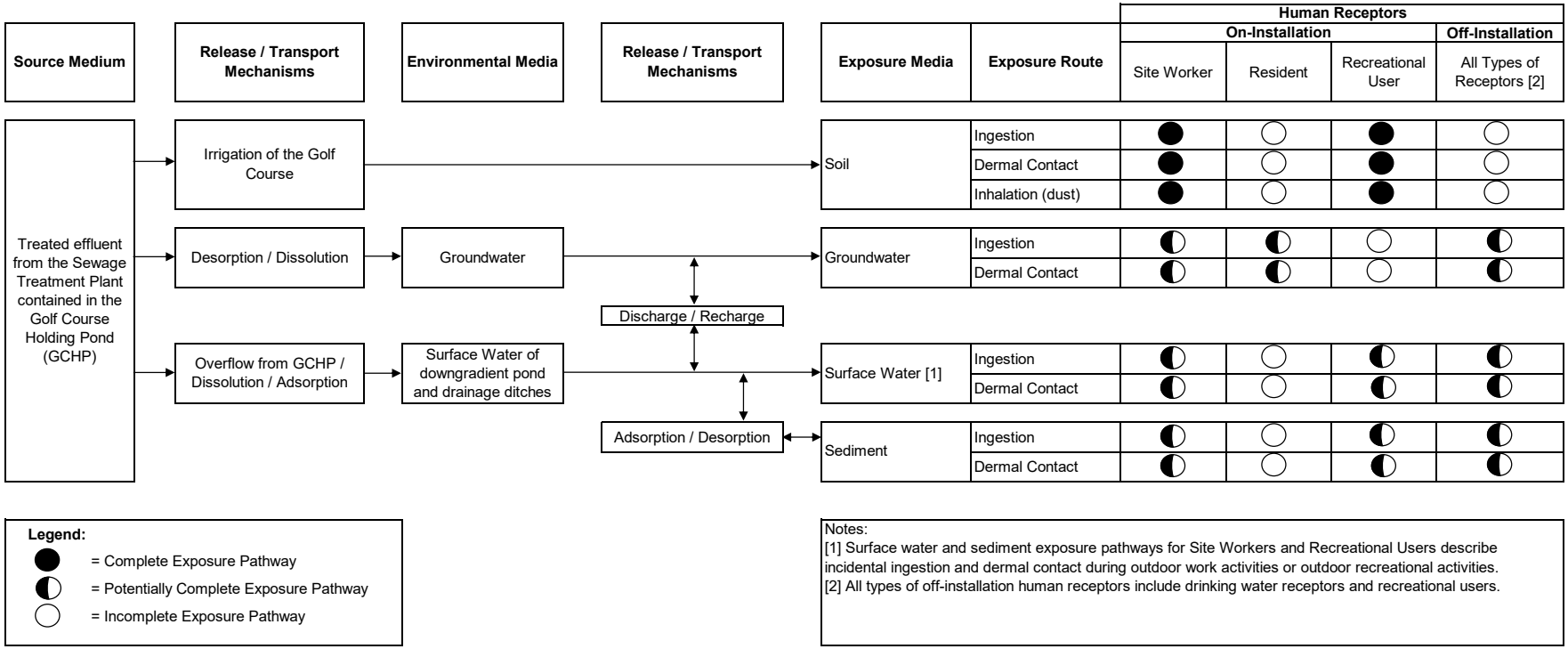
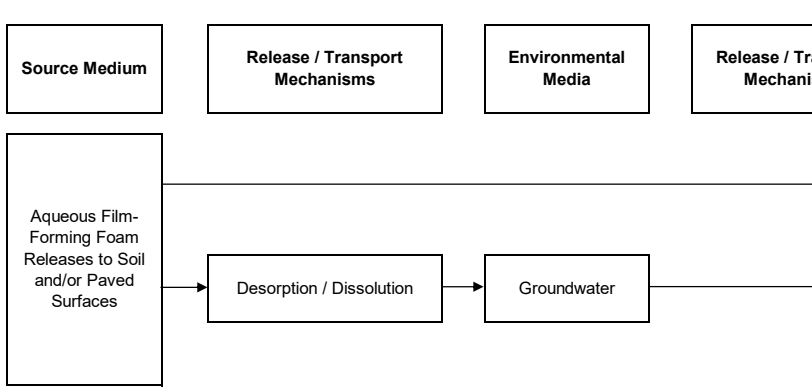
Conceptual Site Model - Fort Carson Sewage Treatment Plant
USAEC PFAS Preliminary Assessment / Site Inspection
Fort Carson, Colorado

Figure 7-13



Conceptual Site Model - Fort Carson Golf Course
USAEC PFAS Preliminary Assessment / Site Inspection
Fort Carson, Colorado

Figure 7-14



Exposure Media	Exposure Route	Human Receptors: On-Installation: Site Worker	On-Installation: Resident	On-Installation: Recreational User	Off-Installation: All Types of Receptors [1]
Soil	Ingestion	●	○	○	○
	Dermal Contact	●	○	○	○
	Inhalation (dust)	●	○	○	○
Groundwater	Ingestion	◐	○	○	◐
	Dermal Contact	◐	○	○	◐

Legend:

● = Complete Exposure Pathway

◐ = Potentially Complete Exposure Pathway

○ = Incomplete Exposure Pathway

Notes:
[1] All types of off-installation human receptors include drinking water receptors and recreational users.

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Conceptual Site Model - PCMS Hill Ranch AFFF Storage Area
USAEC PFAS Preliminary Assessment / Site Inspection
Fort Carson, Colorado

Figure 7-15

APPENDIX A

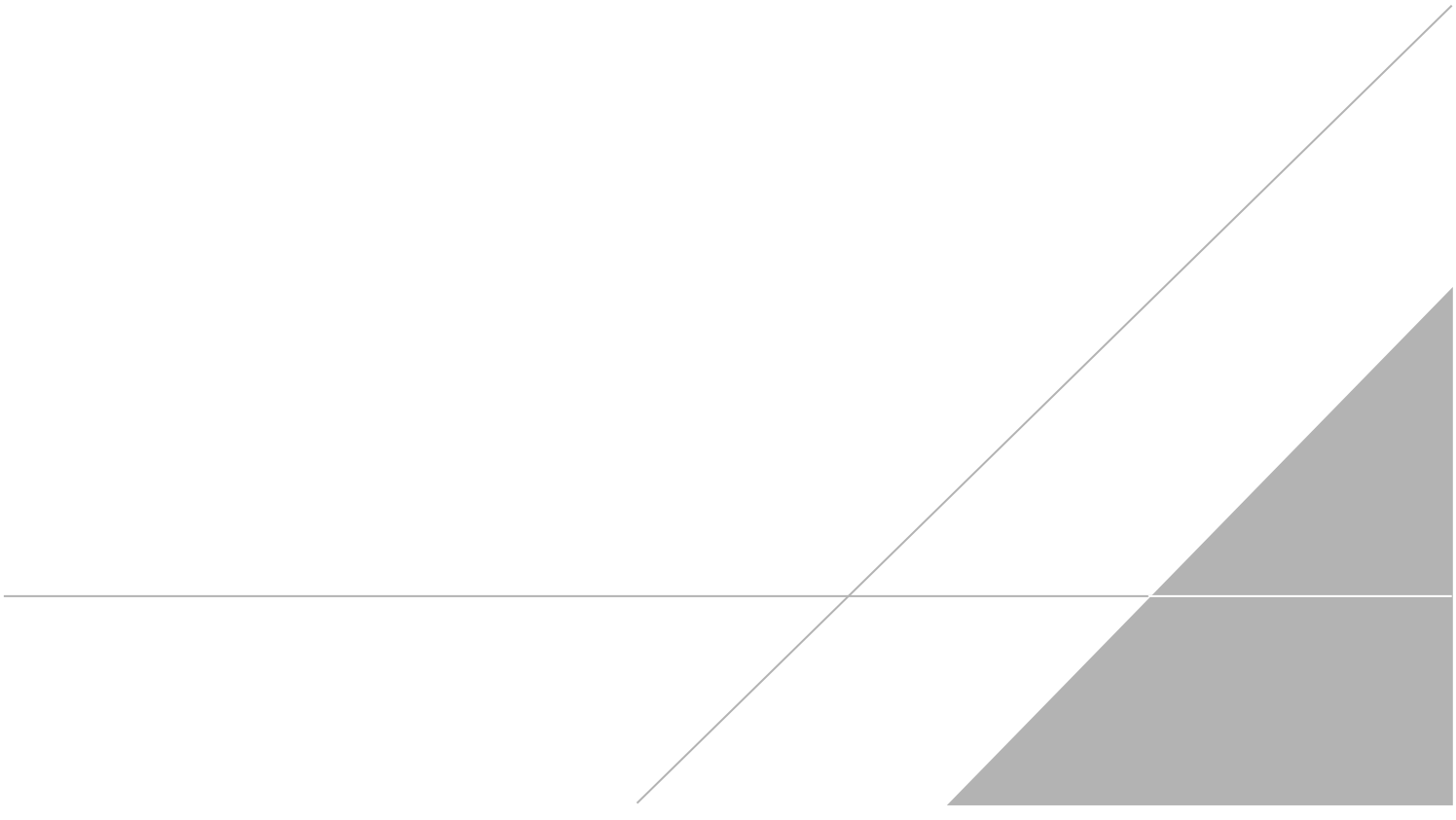
Office of the Secretary of Defense. 2021. Memorandum: Investigating Per- and Polyfluoroalkyl Substances within the Department of Defense Cleanup Program. September 15.

APPENDIX B

Preliminary Assessment/Site Inspection Quality Control Checklist

APPENDIX C

Antiterrorism/Operations Security Review Cover Sheet



APPENDIX E

Installation EDR Survey Reports

APPENDIX F

Compiled Research Log

APPENDIX G

Compiled Interview Logs

APPENDIX H

Site Reconnaissance Photo Log

APPENDIX I

Compiled Site Reconnaissance Logs

APPENDIX J

Site Inspection Field Notes

APPENDIX K

Site Inspection Field Forms

APPENDIX L

Site Inspection Photo Log

APPENDIX M

Non-Conformance Reports

APPENDIX N

Field Change Reports

APPENDIX O

Data Usability Summary Report

APPENDIX P

Site Inspection Laboratory Analytical Results

Arcadis U.S., Inc.

7550 Teague Road

Suite 210

Hanover, Maryland 21076

Tel 410 987 0032

Fax 410 987 4392

www.arcadis.com