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

Cornhusker Army Ammunition Plant, Nebraska

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U.S. Army Corps of Engineers, Baltimore District
2 Hopkins Plaza
Baltimore, Maryland 21201

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Preliminary Assessment and Site Inspection of Per- and Polyfluoroalkyl Substances

Cornhusker Army Ammunition Plant, Nebraska

Kendra Keon
Site Inspection Project Manager, Arcadis U.S., Inc.

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

Joseph Quinnan
Technical Expert, Arcadis U.S., Inc.

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Prepared by:

Arcadis U.S., Inc.

7550 Teague Road

Suite 210

Hanover

Maryland 21076

Arcadis Ref.:

30001997

Date:

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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), perfluorobutanesulfonic acid (PFBS), perfluorononanoic acid (PFNA), perfluorohexane sulfonate (PFHxS), and hexafluoropropylene oxide dimer acid (HFPO-DA) 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 Cornhusker Army Ammunition Plant (CHAAP) 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 policy and guidance.

CHAAP is located approximately 2 miles west of Grand Island, Nebraska, and consists of 11,936 acres of land. The plant was operated intermittently from 1942 through 1973 and has remained inactive since 1973. As of September 2009, approximately 97 percent of the original property at CHAAP has been excessed. The land that has not been excessed at CHAAP remains federally-owned and under United States Army Corps of Engineers control.

The CHAAP PA identified two AOPIs for investigation during the SI phase. SI sampling results from the two AOPIs were compared to risk-based screening levels calculated by the Office of the Secretary of Defense (OSD) for PFOS, PFOA, PFBS, PFNA, and PFHxS. Of the six PFAS compounds presented in the 06 July 2022 OSD memorandum, HFPO-DA (commonly referred to as GenX) was not included as an analyte at the time of this SI. Based on the conceptual site model (CSM) developed during the PA and revised based on SI findings, the presence of HFPO-DA is not anticipated at Cornhusker Army Ammunition Plant because HFPO-DA is generally not a component of military specification (MIL-SPEC) aqueous film forming foam (AFFF) and based on its history, including distribution limitations that restricted use of GenX, it is generally not a component of other products the military used. In addition, it is unlikely that GenX would be an individual chemical of concern in the absence of other PFAS. PFOA and PFBS were detected in groundwater at one AOPI; none of the AOPIs had PFOS, PFOA, PFBS, PFNA, and/or PFHxS present at concentrations greater than the risk-based screening levels. The CHAAP PA/SI did not identify the need for further study in a CERCLA remedial investigation. **Table ES-1** below summarizes the PA/SI sampling results and provides recommendations for further study in a remedial investigation or no action at this time at each AOPI.

Table ES-1. Summary of AOPIs Identified during the PA, PFOS, PFOA, PFBS, PFNA, and PFHxS Sampling at Cornhusker Army Ammunition Plant, and Recommendations

AOPI Name	PFOS, PFOA, PFBS, PFNA, and/or PFHxS detected greater than OSD Risk Screening Levels? (Yes/No/ND)		Recommendation
	GW	SO	
Former Fire Station F-3	No	ND	No action at this time
Former Fire and Guard Headquarters and Fire Training Pit	ND	ND	No action at this time

Notes:
GW – groundwater
ND – non-detect
SO – soil

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), perfluorobutanesulfonic acid (PFBS), perfluorononanoic acid (PFNA), perfluorohexane sulfonate (PFHxS), and hexafluoropropylene oxide dimer acid (HFPO-DA) 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 Cornhusker Army Ammunition Plant (CHAAP) based on the use, storage and/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 has occurred, and the analytical results were compared to the Office of the Secretary of Defense (OSD) PFOS, PFOA, PFBS, PFNA, and PFHxS risk screening levels to determine whether further investigation is warranted. HFPO-DA was not in the suite of PFAS compounds analyzed during the SI; therefore, there are no HFPO-DA SI analytical results to screen against the OSD risk screening levels. This report provides the PA/SI for CHAAP 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.

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 Department of Defense (DoD) restoration sites (OSD 2019). The DoD guidance provides risk screening levels for PFOS, PFOA, and PFBS in tap water and 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 (OSD 2021). On 18 May 2022, the USEPA published an update to the RSLs table. The May 2022 RSL table included six PFAS constituents: PFOS, PFOA, PFBS, PFNA, PFHxS, and HFPO-DA (USEPA 2022). On 06 July 2022, the OSD issued a memorandum to include

revised risk screening levels based on the May 2022 USEPA RSLs (OSD 2022). The July 2022 Memorandum: Investigating Per- and Polyfluoroalkyl Substances within the Department of Defense Cleanup Program is provided for reference as **Appendix A**. These screening criteria are discussed further in **Section 6.5**.

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. 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

An SI is conducted when the PA determines an AOPI exists based on probable use, storage, and/or disposal of PFAS-containing materials. 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.

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

1.3.1 Pre-Site Records Review and Interviews

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), and Arcadis U.S., Inc. (Arcadis). The kickoff call occurred on 28 January 2021, 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 PFAS-containing materials were used, stored, and/or disposed, as well as to gather information on the physical setting and site history at CHAAP.

A read-ahead package was prepared and submitted to the appropriate POCs. 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
- 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 records review to be evaluated for use, storage, and/or disposal of PFAS-containing materials, where additional information on those areas will be collected through personnel interviews and additional document review.
- A list of roles for the installation POC to consider when recommending potential interviewees.

1.3.2 Preliminary Assessment Site Visit

No site visit was conducted for CHAAP due to no personnel or remaining structures being present on-site. The original buildings and footprint of the installation have been demolished and the majority of the land has been sold and subsequently repurposed for agricultural use. Personnel interviews were conducted with individuals having significant historical knowledge at CHAAP. The interviews focused on confirming information discussed in historical documents, collecting information that may have not been in historical documents, and corroborating other interviewees' information. **Section 3** includes information regarding personnel interviewed.

1.3.3 Post-Records Review and Interview

Information collected was reviewed and corroborated by cross-referencing records and reviewing interview details. The information collected during records review and interview 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. After the Research Status Report was submitted, a teleconference was scheduled to discuss the preliminary findings and finalize the list of AOPIs. The post-Research Status Report teleconference took place on 16 September 2021, and it was determined that an SI phase sampling was warranted.

1.3.4 Site Inspection Planning and Field Work

The SI process was initiated at the installation to evaluate PFOS, PFOA, PFBS, PFNA, and PFHxS presence or absence at each AOPI and determine whether further investigation is warranted. A combined SI kickoff and scoping teleconference was held to obtain concurrence on the SI sampling plan from USAEC and USACE.

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 requirements or preferences
- 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
- 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 2019). 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 2019) and the approved installation-specific QAPP Addendum. A Site Safety and Health Plan (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 2018), 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 CHAAP (Arcadis 2022) 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.

1.3.5 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 PFOS, PFOA, PFBS, PFNA, and PFHxS analysis by liquid chromatography with tandem mass spectrometry and compliant with the DoD Quality Systems Manual (QSM) 5.3 (DoD and Department of Energy 2019). 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 OSD risk screening levels (defined in **Section 6.5**).

2 INSTALLATION OVERVIEW

The following subsections provide general information about CHAAP, 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

CHAAP is located in north-central Hall County, approximately 2 miles west of Grand Island, Nebraska and consists of 11,936 acres of land as shown on **Figure 2-1**. The area surrounding CHAAP is primarily rural (USACE 2015).

2.2 Mission and Brief Site History

CHAAP was constructed in 1942. It was constructed for the production of artillery shells, mines, bombs, and rockets for Word War II and the Korean and Vietnam conflicts. The plant was operated intermittently over a period of 30 years with the most recent operation terminating in 1973 (USACE 2015).

World War II operations were directed by Quaker Oats Ordnance Corporation where bombs, shells, and boosters were produced. From September 1945 to February 1950, the installation was in standby status under the control of the U.S. Army Ordnance Corps (U.S. Army Toxic and Hazardous Materials Agency [USATHAMA] 1980). Under the direction of Mason and Hanger-Silas Mason Company, the plant was reactivated in 1950 to produce artillery shells and rockets to support the Korean War and was placed on standby status in 1957. Later, between the years 1965 and 1973 the plant was reactivated to produce bombs, projectiles, and micrograve mines used for the Vietnam conflict. Around 809 acres from three parcels of land situated in the northeast, northwest, and southeast corners of the facility were sold to the State of Nebraska for use as wildlife management areas in 1963. The plant was placed on standby in 1973 and has not been reactivated to date (ICF Kaiser Engineers, Inc. [ICF KE] 1996a). Explosives wastes and residues associated with plant operations resulted in soil and groundwater contamination onsite and groundwater contamination offsite to the northeast. Groundwater monitoring was conducted between 1981 and 1987 and found the explosives groundwater contamination plume to extend 4 miles downgradient beyond the eastern boundary of the facility. CHAAP was placed on the National Priorities List in 1987 (USACE 2015).

Historically, CHAAP contained 645 buildings, including 11 housing units and 219 ammunition storage magazines. The site also contained four large munitions production facilities referred to as load lines. Raw materials for munitions production were stored in large warehouses at the south end of each load line. A fifth load line, substantially smaller, was used to produce fuses and boosters during the Korean War and the manufacturing of micrograve mines for the Vietnam War (RKG Associates, Inc. 1997). Other facilities at CHAAP included the Administration and Base Housing Area (ABHA), which is in the southeast corner of the installation. Past activity at the ABHA is not well documented. Records indicate that other than administration and housing facilities, there was a hospital, cafeteria, and trap shooting facility (ICF KE 1996a).

2.3 Current and Projected Land Use

Since being placed on standby, 11,936 acres of land, the equivalent of 19 square miles has been declared as excess to the Army (RKG Associates, Inc. 1997). Currently, activities on the excessed portion of CHAAP are limited to leasing of property for agriculture; leasing of buildings for storage and limited manufacturing; wildlife management; and minor maintenance of the grounds, roads, and leased facilities (URS Group Inc. 2006). As of September 2009, approximately 97 percent (%) of the original property at CHAAP has been excessed. All property excessed to date has been consistent with the intentions specified in the 1997 Comprehensive Reuse Plan. The land that has not been excessed at CHAAP and remains federally owned is currently used for wildlife conservation and for the groundwater treatment plant operations (USACE 2015). **Figure 2-2** shows the layout of the former installation.

2.4 Climate

The Hall County area has relatively low precipitation, low humidity, hot summers, and cold to severe winters. The average annual high and low temperatures are 62 and 39 degrees Fahrenheit (°F). Summers are usually warm and dry with occasional thunderstorms, and winters are cold with a few snowstorms and an infrequent blizzard. July is the warmest month with daytime highs averaging 89 °F and occasionally topping 100 °F. January is the coolest month with highs averaging 34 °F and lows averaging 12 °F. Average annual precipitation is 26.6 inches with the majority falling in the spring. The area averages 29 inches of snow annually. Prevailing winds are from the south in the summer and from the northeast in the winter (U.S. Climate Data 2022).

2.5 Topography

CHAAP is located approximately 7 miles north of the Platte River, but it is not within the 100-year floodplain of the Platte River. The sites are located near the eastern margin of the Great Plains Physiographic Province, 2 miles west of the city of Grand Island in south-central Nebraska. The terrain is nearly level to slightly undulatory, and elevations range from 1,950 feet above the sea level in the southeast to approximately 1,850 feet in the northeast as shown on **Figure 2-3** (ICF KE 1996b).

2.6 Geology

CHAAP is underlain by moderately to highly permeable deposits from the Quaternary age containing fluvial sands and gravels and eolian and fluvial silts and clays. These unconsolidated deposits rest uncomformably on the semi-consolidated Tertiary Ogallala Formation (**Figure 2-4**). The Ogallala consists of lenticular, shoestring deposits of sand, silt, clay and poorly cemented sandstone, siltstone, and claystone. The Cretaceous bedrock surface is an unconformity with moderate relief sculpted by pre-Ogallala erosion. In some areas, post-Ogallala erosional surface controls the thickness and lithology of the overlying Quaternary deposits. Accumulations of Quaternary sediments are thicker and tend to contain a greater percentage of sand and gravel where valleys were carved into the Ogallala and Cretaceous layers (ICF KE 1997).

In the western portion of CHAAP, Quaternary sediments are approximately 100 feet thick, consisting of approximately 55 feet of Alluvial sand and gravel, 15 feet of blue clay, and 30 feet of paleovalley fill silt.

The Quaternary sediments thicken to the east. At the eastern edge of CHAAP, the Quaternary is approximately 170 feet thick and consists of approximately 60 feet of alluvial sand and gravel, 5 feet of blue clay, 35 feet of paleovalley fill sand, and 70 feet of paleovalley fill silt. Outside of the eastern boundary edge of CHAAP, the thickness of Quaternary sediments exceeds 290 feet. The Quaternary consists of approximately 60 feet of alluvial sand and gravel, 5 to 23 feet of blue clay, and greater than 220 feet of paleovalley fill sand, gravel, and silt (ICF KE 1997).

2.7 Hydrogeology

The primary source for groundwater for Hall County is unconsolidated Quaternary sands and gravels. An investigation conducted in 1993, indicated that the Quaternary Aquifer System is divided into three hydrologic units. The Alluvial aquifer, which consists of sand and gravel, has a saturated thickness ranging from 28 to 65 feet. Beneath the Alluvial aquifer, a greenish gray to light gray, silty clay aquitard is present; it is known as the Blue Clay with a thickness from 4 feet to greater than 35 feet. The lowermost hydrologic unit is the Paleovalley Fill unit, which consists of alluvial sand, silt and clay and ranges in thickness between 63 feet to greater than 290 feet (ICF KE 1996b).

Shallow groundwater underlying CHAAP occurs as an unconfined water table aquifer within the alluvial sands and gravels of the Grand Island Formation. The water table surface is generally less than 10 feet below the ground surface. Total thickness of the water table aquifer ranges from about 50 to 60 feet. Hydraulic conductivity values range up to 670 feet per day (USACE 2002).

The predominant groundwater flow direction within the water table aquifer near the CHAAP facility is to the northeast toward the City of Grand Island. Regional horizontal gradients of 4 to 7 feet per mile have been measured in the area (**Figure 2-4**). The Grand Island Formation aquifer is used regionally as a water supply source for irrigation and potable water. Locally, there are several irrigation wells in use east of the facility. However, in the vicinity of the explosives contamination plume, all private domestic water is being supplied by the City of Grand Island. The city's municipal wellfield is located southeast of the city near the Platte River, approximately 10 miles southeast of CHAAP (USACE 2002).

2.8 Surface Water Hydrology

The major source of surface water for Hall County is the Platte River, which flows northeast across the southeastern portion of the county. The Platte River has a slope of approximately 6.5 feet per mile and is located approximately 7 miles south of CHAAP. There are no known perennial creeks or rivers within CHAAP. Silver Creek and Wood River, two ephemeral streams, are within or near CHAAP. Silver Creek is the largest surface water present in the area, crossing the northwest corner of the facility and flowing eastward along the northern boundary of the facility. During the winter, discharge is low, and these drainages are commonly covered with ice or are frozen solid. During the summer months the streams are typically dry and flow only during large storms events (USACE 1991).

All surface water runoff during large storm events at CHAAP drains either directly to Silver Creek or to two man-made ditches which eventually drain to Silver Creek. The two man-made drainage ditches (East and West Drainage Channels) were constructed in 1973. These ditches trend in north-south direction and are located west and east of the former load lines. Several minor ditches drain into each of these larger ditches (USACE 1991).

Silver Creek is the largest surface-water feature in CHAAP. Where there is sufficient water in Silver Creek, it flows northward from an area approximately 1 mile west of CHAAP, then turns to the east-northeast and flows approximately 0.5 mile north of CHAAP. It continues to flow to the east-northeast to the north of Grand Island. At its closest point, Silver Creek is approximately 0.125 to 0.25 mile north of the Capital Heights area of Grand Island (USACE 1991).

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 constituents at CHAAP.

2.9.1 Stormwater Management System Description

Silver Creek is the largest surface water feature of the CHAAP. It flows in a northeasterly direction at the west boundary of the CHAAP to the northeast corner of the plant. It continues northeast through rural and outlying residential subdivisions of Grand Island. All stormwater runoff at the CHAAP enters Silver Creek directly or by way of the east and west drainage canals. The east and west canals were constructed in 1973, trend north-south, and are located at 3rd Avenue and 90th Road (USACE 1997).

2.9.2 Sewer System Description

The Southwest Sewage Treatment Plant, located in the southwest part of the installation, served the administration area, staff housing area, and Fire and Guard Headquarters from 1942 and 1974. The facility consisted of an Imhoff tank, two sludge pits, a chlorinator building, and an evaporation pond. Solids from the Imhoff tank drained into two sludge pits to the south. Sludge was periodically removed and spread over the adjacent fields. Liquid from the Imhoff tank was chlorinated in the chlorinator building north of the Imhoff tank and released into a ditch that meandered north and east into an evaporation pond. The system was replaced in 1974 by two interconnected, bentonite-lined stabilization lagoons located adjacent to the former leaching lagoon, however they were never placed into service (USACE 2001).

The wastewater derived from production operations at CHAAP was discharged into a total of 40 sack sumps where the solid explosives residue was collected in bags. The bags were destroyed at a burning ground located in the northwest portion of the facility. Effluent from the sack sumps was discharged into 42 cesspools and nine open leaching pits. It was noted that the bottoms of the cesspools and leaching pits were unlined (USACE 1991).

2.10 Potable Water Supply and Drinking Water Receptors

The Grand Island Formation aquifer is used regionally as a water supply source for irrigation and potable water. Locally, there are a few wells in use east of the facility. However, in the vicinity of the explosives contamination plume, all private domestic water is being supplied by the City of Grand Island. The city's municipal wellfield is located southeast of the city near the Platte River (approximately 10 miles southeast of CHAAP).

An Environmental Data Resources, Inc. (EDR) report includes search results from a variety of environmental, state, city, and other publicly available databases for a referenced property. An EDR report was generated for CHAAP which along with state and county geographic information system provided by the installation identified several off-post public and private wells within 5 miles of the installation boundary (**Figure 2-5**). The EDR report with well search results is provided as **Appendix C**.

2.11 Ecological Receptors

The PA team collected information regarding ecological receptors that was available in the installation documents. The following information is provided for future reference should the Army decide to evaluate exposure pathways relevant to the ecological receptors.

Wildlife found on CHAAP include native and non-native game species such as white-tailed and mule deer, cottontail and jackrabbit, wild turkey, bobwhite quail, mourning dove, ring-necked pheasant, fur-bearing mammals, and many non-game birds. More than 35 species of mammals and 200 species of birds are known to be present at CHAAP or may possibly occur there. In addition, eight species of amphibians and 16 species of reptiles may also be present. According to the U.S Fish and Wildlife Service, one federally listed plant could potentially occur at CHAAP, the western prairie fringe orchid, but its presence is considered unlikely due to the absence of undisturbed prairie (USACE 2011).

Agricultural crops are the main vegetation and surface cover present at CHAAP. The three main cultivated crops are corn, soybeans, and alfalfa, which are periodically treated with herbicides and insecticides. A few open fields are also present, dominated by the non-native smooth brome, a cool seasonal grass. The installation checklist of vascular plants contains 19 plants of trees, seven shrubs and/or woody vines, 17 grasses, and more than 50 species of forbs (USACE 2011).

2.12 Previous PFAS Investigations

Previous (i.e., pre-PA) PFAS investigations relative to CHAAP, including both those conducted and not conducted by the Army, are summarized to provide full context of available PFAS data for CHAAP. However, only data collected by the Army will be used to make recommendations for further investigation.

In response to the third Unregulated Contaminant Monitoring Rule (UCMR3) and IMCOM Operations Order 16-088, one public water systems (NE310790) located within 5-miles of CHAAP was sampled for six PFAS compounds, including PFOS, PFOA, PFBS, PFHxS, and PFNA in 2015. All compounds were not detected at concentrations above the laboratory limit of quantitation (LOQ; 40, 20, 90, 30 and 20 ng/L for PFOS, PFOA, PFBS, PFHxS, and PFNA, respectively). The laboratory that analyzed samples under UCMR3 met the USEPA's UCMR3 Laboratory Approval Program application and Proficiency Testing criteria for USEPA Method 537 Version 1.1.

3 SUMMARY OF PA ACTIVITIES

To document areas where any potential current and/or historical PFAS-containing materials were used, stored and/or disposed at CHAAP, data was collected from two principal sources of information and are described in the subsections below:

1. Records review
2. Personnel interviews

Preliminary locations of potential use, storage, and/or disposal of PFAS-containing materials were then evaluated in the PA (during records review and/or personnel interviews) and were categorized as AOPIs or as areas not retained for further investigation at this time based on a combination of information collected (e.g., records reviewed, personnel interviews, internet searches). A summary of the observations made, and data collected through records reviews (**Appendix D**), and installation personnel interviews (**Appendix E**), during the PA process for CHAAP is presented in **Section 4**. Further discussion regarding rationale for not retaining areas for further investigation is presented in **Section 5.1**, and further discussion regarding categorizing areas as AOPIs is presented in **Section 5.2**.

3.1 Records Review

The records reviewed for this PA included, but were not limited to, various Installation Restoration Program administrative record documents, compliance documents, CHAAP fire department documents, CHAAP Directorate Of Public Works Documents, and geographic information system files. Internet searches were also conducted to identify publicly available and other relevant information. A list of the specific documents reviewed for CHAAP is provided in **Appendix D**.

3.2 Personnel Interviews

Interviews were conducted via telephone. The list of roles for the installation personnel interviewed during the PA process for CHAAP is presented below:

- Groundwater Treatment Plant Manager
- Technical Document Reviewer

The compiled interview logs are provided in **Appendix E**.

4 POTENTIAL PFAS USE, STORAGE, AND/OR DISPOSAL AREAS

CHAAP was evaluated for all potential current and historical use, storage, and/or disposal of PFAS-containing materials. As such, this section is organized to summarize the aqueous film-forming foam (AFFF)-related uses first, and all remaining potential PFAS-containing materials in the subsequent section.

4.1 AFFF Use, Storage, and Disposal Areas

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% 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 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 formulations of AFFF contain significantly lower amounts of PFOS, PFOA, 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.

Fire Stations and Fire Training Areas

Former fire stations and fire training areas were identified at CHAAP through records review and personnel interviews. There were two known fire stations on the installation: Former Fire Station F-3 and Former Fire and Guard Headquarters. The Former Fire Station F-3 was active until 1974 and was then turned into a miscellaneous storage area. It was later demolished in the 2010s.

The Former Fire and Guard Headquarters (Building A-12) was a former fire station located within the ABHA portion of CHAPP. The Former Fire Training Pit (located south of Building A-11) was active until 1979 when it turned into a miscellaneous storage area. These properties were sold in 2001 and later demolished in the 2010s.

AFFF may have been used, stored, or disposed at the fire stations and fire training areas at CHAAP; however, limited information is available regarding the historical operations at CHAAP related to use, storage, and/or disposal of PFAS-containing materials. No concrete confirmation of AFFF on the installation was reported or discovered through personnel interviews or records research.

4.2 Other PFAS Use, Storage, and/or Disposal Areas

Following document research and personnel interviews at CHAAP, training and demolition areas, production and maintenance areas, miscellaneous storage areas, waste areas, and pesticide storage areas were also identified as preliminary locations for use, storage, and/or disposal of PFAS-containing materials. A summary of information gathered in the PA for each of these preliminary locations is

described below. Specific discussion regarding areas not retained for further investigation is presented in **Section 5.1** and specific discussion regarding areas retained as AOPIs is presented in **Section 5.2**.

Training and Demolition Areas

Training, detonation, burning, and demolition occurred at the Pistol Range and at the Demo and Burning Ground Area at CHAAP. The Pistol Range was used for target practice training along with detonation and disposal of explosive wastes. The Demo and Burning Ground Area was used for the burning, demolition, and disposal of munitions materials.

Production and Maintenance Areas

The Load Assembly and Pack Facilities were used in the production of munitions and the storage of the chemicals used in the production process including paints, solvents, petroleum products, and others. The Shop Area contained vehicle and equipment maintenance shops, a laundry facility, and a paint shop. The General Purpose Storage Area was historically used for ammonium nitrate and fertilizer production prior to becoming a storage area.

Miscellaneous Storage Areas

Several areas at CHAAP were identified as miscellaneous storage areas during records review and personnel interviews including the North Magazine Area, South Magazine area, Shop Area, General Purpose Storage Area, and Underground and Above Ground Storage Tanks. These areas stored materials including oils, fuels, solvents, munitions, fertilizers, transformers, and others.

Waste Areas

Waste was treated, stored, and/or disposed of at several areas at CHAAP including: the Southwest Sewage Treatment Plant, Sanitary Landfill, and Former Gravel Pit. The Southwest Sewage Treatment Plant treated sanitary sewage from the administration area, staff housing area, and Former Fire and Guard Headquarters building. The Sanitary Landfill received general waste and construction debris from around the installation. The Former Gravel Pit became a disposal site for construction and demolition debris after becoming inactive.

Pesticide Storage Areas

Several areas at CHAAP were turned into pesticide storage and/or mixing areas after becoming inactive from their original use including: the South Magazine Area, Former Fire Station F-3, and Building A-11 located near the Former Fire Training Pit. However, during a telephonic interview with the IMCOM Pest Management Consultant, it was noted that products containing Sulfluramid (i.e., associated with insecticides) may have contained PFAS and were phased out in 1996. During the PA records review, the IMCOM Pest Management Consultant provided records of potentially PFAS-containing pesticides and insecticides used at and/or stored at Army installations and did not identify CHAAP as an installation having used or stored PFAS-containing pesticides/insecticides.

4.3 Readily Identifiable Off-Post PFAS Sources

An exhaustive search to identify all potential off-post PFAS sources (i.e., not related to operations at CHAAP) is not part of the PA/SI. However, no potential off-post PFAS sources within a 5-mile radius of the installation were identified during the records search.

5 SUMMARY AND DISCUSSION OF PA RESULTS

The preliminary locations evaluated for potential use, storage, and/or disposal of PFAS-containing materials at CHAAP, 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, three areas have been identified as AOPIs. The process used for refining these areas is presented on **Figure 5-1**, below.

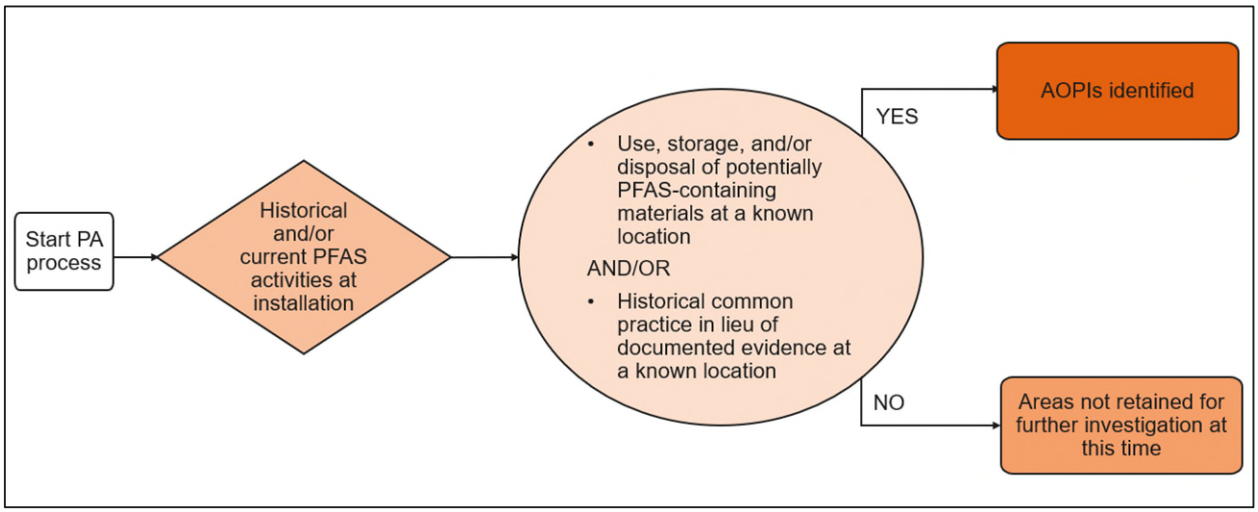

Figure 5-1: AOPI Decision Flowchart

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 CHAAP are presented in **Section 8**.

5.1 Areas Not Retained for Further Investigation

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

A brief site history and rationale for areas not retained for further investigation are 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
Load Assembly and Pack Facilities 1-5	1942 to 1974	Each load line consisted of buildings used in the production processes. This involved the storage of various paints, solvents, petroleum products, trinitrotoluene, and other chemicals.	No documented evidence of PFAS-containing materials used, stored, or disposed of in this location.
North Magazine Area	1942 to 1974	Formerly used as the primary storage facility for raw materials and finished ordnance during the CHAAP production periods. Buildings were used as storage of out-of-service transformers after production ceased.	No documented evidence of PFAS-containing materials used, stored, or disposed of in this location.
South Magazine Area	1942 to 1974	Formerly used as the primary storage facility for raw materials and finished ordnance during the CHAAP production periods. Building formerly used for pesticide and fertilizer storage including malathion, simazine, strychnine, banvel, arsenal, roundup, pramitol, dacthal, aldrin, ded-weed, DDT, chloradane, cyanogen, thiosperse, cythion, benzanor, anhydrous ammonia with dry ammonium nitrate.	No documented evidence of PFAS-containing materials used, stored, or disposed of in this location.
Southwest Sewage Treatment Plant	1942 to 1974	Serviced the administration are, staff housing area, and former Fire and Guard Headquarters. Area consisted of an Imhoff tank, two sludge pits, a chlorinator building and an evaporation pond.	No documented evidence of PFAS-containing materials used, stored, or disposed of in this location.

Area Description	Dates of Operation	Relevant Site History	Rationale
Pistol Range	1942 to 1974	Security force used the area for target practice. Area was also used for the detonation and disposal of explosive wastes.	No documented evidence of PFAS-containing materials used, stored, or disposed of in this location.
Drainage Ditches	1942 to 1974	Area consists of two long ditches that were excavated in the 1970s to relieve potential flooding around the load lines and shop area. One ditch was located between Load line 1 and 2 and the other between Load Line 3 and 4. Both ditches run in a north/south direction and discharge into Silver Creek.	No documented evidence of PFAS-containing materials used, stored, or disposed of in this location.
Sanitary Landfill	1942 to 1974	Area used as a landfill. Approximately 2,500 cubic yards of general waste, construction debris, and other wastes were buried each year in 6- to 8-foot-deep trenches. Several burning cages were located at the landfill.	No documented evidence of PFAS-containing materials used, stored, or disposed of in this location.
Underground and Above Ground Storage Tanks	1942 to 1974	Area consisted of approximately 40 underground storage tanks used to store heating oil, gasoline, diesel fuel, kerosene, solvents, and other materials. Above ground tanks were located at the load line boiler houses and stored heating oil.	No documented evidence of PFAS-containing materials used, stored, or disposed of in this location.
Former Gravel Pit	1942 to 1974	Area was a borrow pit for gravel when buildings and roads were constructed in the 1950s. The area became a disposal site for construction and other demolition debris and possibly other waste.	No documented evidence of PFAS-containing materials used, stored, or disposed of in this location.

Area Description	Dates of Operation	Relevant Site History	Rationale
Demo and Burning Ground Area	1942 to 1968	The Burning Ground has been used since the early history of CHAAP for the burning, demolition, and disposal of variety of materials including 2,4,6-trinitrotoluene, Royal Demolition Explosive, tritonal, aluminum powder, ammonium nitrate, and lead azide. In December 1967, several attempts were made to detonate canisters and drums filled with mines and mixed explosive waste. Several of these detonations resulted in scattering of explosive debris throughout the area. In April 1968, the demolition area was soaked with oil and ignited, and subsequently compacted using a tractor and roller.	No documented evidence of PFAS-containing materials used, stored, or disposed of in this location.
Shop Area	1942 to 1974	Area contained vehicle and equipment maintenance shops, a laundry facility, a paint shop, and an administrative building. Area was also used for storage of chemicals, vehicles, equipment, and other various plant materials.	No documented evidence of PFAS-containing materials used, stored, or disposed of in this location.
General Purpose Storage Area	1942 to 1974	Area was found formerly used for ammonium nitrate production during World War II and fertilizer production.	No documented evidence of PFAS-containing materials used, stored, or disposed of in this location.

5.2 AOPIs

Overviews for each AOPI identified during the PA process are presented in this section. None of the AOPIs overlap with CHAAP Installation Restoration Program sites. At the time of this PA, none of the AOPIs 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 are presented on **Figures 5-3** through **5-4** and include active monitoring wells in the vicinity of each AOPI.

5.2.1 Former Fire Station F-3

The Former Fire Station F-3 is identified as an AOPI following records research and personnel interviews due to the standard fire station activities and pesticide storage. Former Fire Station F-3 was located on the entrance road to Load Assembly and Pack Facilities #3 buildings and is surrounded by cultivated fields. The Former Fire Station F-3 was active until 1974 and demolished in the 2010s. The building was eventually considered a miscellaneous storage building and was used as a mixing and storage building for pesticides and herbicides. It contained a floor drain that discharged to a leach field outside of the building. A drainage ditch is located approximately 20 feet northeast of the building. Historical documentation stated empty 5-gallon pesticide spray containers were discovered standing adjacent to the floor drain inside the building. The presence of the pesticide spray containers indicated that the containers may have been washed inside the building and the rinse water then discharged to the floor drain (ICF KE. 1996a).

Areas of stressed vegetation were previously noted in a 1991 SI north and east of the building. Uniform vegetation was present throughout the area based on a SI conducted in August 1995 (USACE 2010).

Although there are no historical records of use and/or storage of PFAS-containing materials at the Former Fire Station F-3, there is a potential that PFAS-containing firefighting foams could have been used, stored, or disposed of within this area. Environmental investigations were conducted at Former Fire Station F-3 in the 1990s, resulting in no further action. The property was sold in 2008 and the building demolished in the 2010s (USACE 2010).

5.2.2 Former Fire and Guard Headquarters and Fire Training Pit

The Former Fire and Guard Headquarters and Fire Training Pit were identified as an AOPI following records research and personnel interviews due to the standard fire station activities. The Former Fire and Guard Headquarters (Building A-12) was a former fire station located within the ABHA portion of CHAAP. A “fire training pit” was documented south of Building A-11 during a historical site investigation. Building A-11 is located approximately 0.5 mile south of the Former Fire and Guard Headquarters, and was used as a pesticide storage and mixing area in 1979, including malathion, aldrin, Urox liquid, 2,4-dichlorophenoxyaceitc acid, chlordane, 2,4,5-trichlorophenoxyacetic acid, and thiosperse (USATHAMA 1980).

Although there are no historical records of use and/or storage of PFAS-containing materials at the Former Fire and Guard Headquarters and Fire Training Pit, there is a potential that PFAS-containing firefighting foams could have been used, stored, or disposed of within this area. Environmental investigations in the ABHA were conducted in the 1990s, resulting in no further action. These properties were sold in 2001 and the building demolished in the 2010s (USACE 2010).

6 SUMMARY OF SI ACTIVITIES

Based on the results of the PA at CHAAP, an SI for PFOS, PFOA, PFBS, PFNA, and PFHxS was conducted in accordance with CERCLA. SI sampling was completed at CHAAP at both of the two AOPIs to evaluate presence or absence of PFOS, PFOA, PFBS, PFNA, and PFHxS in comparison with the OSD risk screening levels. As such, an installation-specific QAPP Addendum (Arcadis 2022) was developed to supplement the general information provided in the PQAPP (Arcadis 2019) and to detail the site-specific proposed scopes of work for the SI. A preliminary CSM was prepared for each of the installation's AOPIs in accordance with the USACE Engineer Manual on Conceptual Site Models, EM 200-1-12 (USACE 2012). The preliminary CSMs identified potential human receptors and chemical exposure pathways based on current and/or reasonably anticipated future land uses. The preliminary CSMs identified soil, groundwater, surface water, and/or sediment pathways as potentially complete at both AOPIs, which guided the SI sampling. The QAPP Addendum details the sampling design and rationale based on each AOPI's preliminary CSM. The SI scope of work was completed in December 2022 through the collection of field data and analytical samples.

The 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 QAPP Addendum (Arcadis 2022) and PQAPP (Arcadis 2019). The subsections below summarize the DQOs, sampling design and rationale, sampling activities and methods, and data analyses procedures for the SI phase at CHAAP. 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 2022), 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 to determine if further investigation is warranted. This SI evaluated groundwater and soil for PFOS, PFOA, PFBS, PFNA, and PFHxS 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.

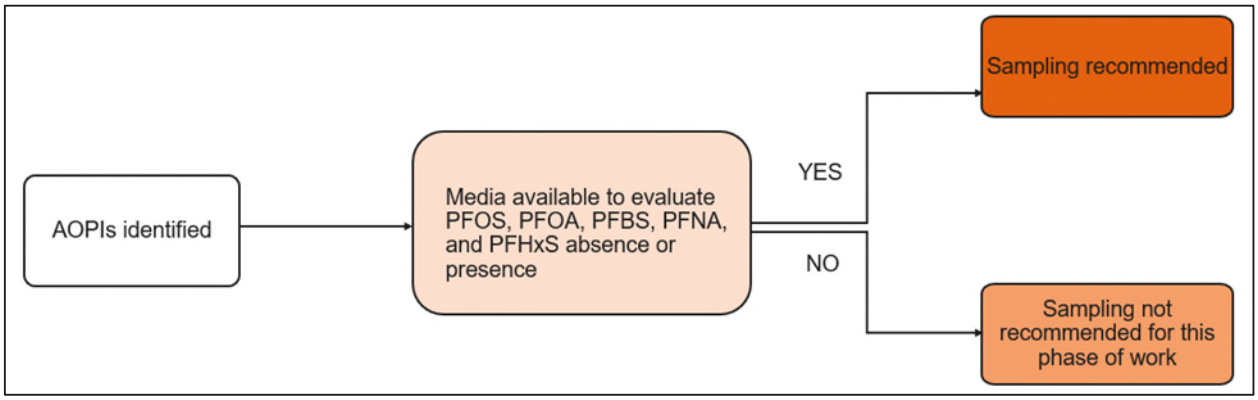

Figure 6-1: AOPI Sampling Decision Tree

The sampling design for SI sampling activities at CHAAP is detailed in Worksheet #17 of the QAPP Addendum (Arcadis 2022). Briefly, soil and groundwater samples were collected from areas of suspected PFAS-containing materials use, storage, and/or disposal. Groundwater and soil were sampled to identify PFOS, PFOA, PFBS, PFHxS, and PFNA presence, type (of the 18 selected constituents as listed in Worksheet #15 of the QAPP Addendum), and concentrations (Arcadis 2022). One soil sample per AOPI was also analyzed for total organic carbon (TOC), pH, and grain size. These data are collected as they may be useful in future fate and transport studies. These targeted sampling areas are believed to have the potential for the greatest PFAS concentrations closest to suspected use, storage, and/or disposal of PFAS-containing materials.

6.3 Sampling Methods and Procedures

Environmental data were collected and analyzed in accordance with the PQAPP (Arcadis 2019), 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 site-specific QAPP Addendum (Arcadis 2022), and the safety procedures specified in the Accident Prevention Plan (Arcadis 2018) and SSHP (Arcadis 2022). 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 2019) and QAPP Addendum (Arcadis 2022). 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, groundwater purging logs, equipment calibration forms, tailgate health and safety forms, and sample collection logs) documenting the SI sampling activities are included in **Appendices F** and **G**, respectively.

6.3.1 Field Methods

Groundwater samples were collected via direct-push technology from three discrete direct-push points at the AOPIs. Shallow (first encountered) groundwater was sampled at each of these sampling points. Direct-push technology borings were completed in accordance with the TGI for PFAS-Specific Drilling and Monitoring Well Installation P-12 in Appendix A to the PQAPP (Arcadis 2019). Groundwater samples were collected using a check valve and high-density polyethylene tubing. The QAPP stated that the grab groundwater samples would be collected using low-flow purge methods, however field conditions made this unfeasible as described in **Section 6.3.3** below.

Soil samples were collected by hand augering methods in accordance with the TGI for PFAS-Specific Drilling and Monitoring well Installation from nine discrete points at the AOPIs. At each hand auger soil sampling location, decontaminated stainless-steel trowels were used to collect soil from the borehole in the top 2 feet of native soil.

6.3.2 Quality Assurance/Quality Control

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

QA/QC samples were collected at the frequencies specified in the QAPP Addendum (Arcadis 2022), typically at a rate of 1 per 20 parent samples. Field duplicates and matrix spike/matrix spike duplicate samples were collected for media sampled for PFOS, PFOA, PFBS, PFNA, and PFHxS, and TOC only. EBs were collected for media sampled for PFOS, PFOA, and PFBS, PFNA, and PFHxS at a frequency of one per piece of relevant equipment for each sampling event, as specified in the QAPP Addendum (Arcadis 2022). The decontaminated reusable equipment from which EBs were collected include the water level meter, hand auger, drilling bit, and sample liners as applicable to the sampled media. Analytical results for blank samples are discussed in **Section 7.5**.

6.3.3 Field Change Reports

No instances of major scope modifications (i.e., those that may have had a significant impact on the project scope and/or data usability/quality, or required stop-work, and warranted discussion with USACE) were encountered during the CHAAP SI work.

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. Minor modifications from and clarifications for the procedures and scope of work detailed in the QAPP Addendum and PQAPP and that did not affect DQOs are documented in Field Change Reports (FCRs) included as **Appendix H** and are summarized below:

- FCR-CHAAP-01: The field team attempted low-flow purging for groundwater sampling at both AOPIs but was unable to keep groundwater liquid to collect parameters for stabilization requirements due to subzero/subfreezing temperatures. The field team attempted multiple times over the course of several minutes prior to concluding that low-flow purging was not feasible.

Grab groundwater samples were collected instead at all proposed locations, causing no impact on the overall scope of work.

6.3.4 Decontamination

Non-dedicated reusable sampling equipment (e.g., stainless-steel trowels, hand augers, water-level meters) 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 2019, Appendix A).

6.3.5 Investigation-Derived Waste

IDW, including soil cuttings, groundwater, and decontamination fluids were collected and placed in Department of Transportation-approved 55-gallon drums, labeled as non-hazardous, segregated by medium: waters and soil, transported to a staging area pending analysis, and subsequently disposed of. The soil IDW was spread on the ground at the source area where sampling was conducted based on the analytical results of PFAS concentrations in soil. Aqueous IDW including groundwater and decontamination fluids were treated with an onsite granular activated carbon (GAC) treatment method prior to discharge based on analytical results of PFAS concentrations in groundwater. The GAC used in the buckets was FILTRASORB® 400 GAC, which is a proven media for removing PFAS from water. Based on the PFAS concentrations from analytical results in groundwater at these sites, the use of this high performing carbon for PFAS removal was the preferred method for treatment of groundwater prior to disposal. Aqueous IDW was low-flow pumped into a 5-gallon bucket filled with GAC and the treated groundwater was discharged to the ground surface. Equipment IDW was collected in bags and disposed in municipal waste receptacles. Equipment IDW includes personal protective equipment and other disposable materials (e.g., gloves, plastic sheeting, Lexan tubes, and high-density polyethylene and silicon tubing) that may come in contact with sampling media. Analytical results for IDW samples collected during the SI are discussed in **Section 7.3**.

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 SI were submitted to Pace South Carolina (formerly Shealy Environmental Services, Inc.), an ELAP-accredited laboratory for PFAS analysis, including PFOS, PFOA, PFBS, PFNA, and PFHxS, by liquid chromatography with tandem mass spectrometry. Laboratory analyses associated with the SI were completed in accordance with Worksheets #12.1 through #12.5 in the PQAPP (Arcadis 2019). Eighteen PFAS-related compounds, including PFOS, PFOA, PFBS, PFNA, and PFHxS, were analyzed for in groundwater and soil samples using an analytical method that is ELAP-accredited and compliant with QSM 5.3 (DoD and Department of Energy 2019), Table B-15.

Additionally, the following general chemistry and physical characteristic analyses were completed for select soil samples in accordance with Worksheet #18 of the QAPP Addendum (Arcadis 2022) by the analytical method noted:

- 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.

The laboratory limit of detection (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 lowest concentration of a substance that produces a quantitative result within specified limits of precision and bias is known as the 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 Data Usability Summary Report (DUSR) (**Appendix I**).

6.4.2 Data Validation

All analytical data generated during the SI, except grain size and data generated from IDW profiling, were verified and validated in accordance with the data verification procedures described in Worksheets #34 through #36 of the PQAPP (Arcadis 2019). Each laboratory data package/sample delivery group underwent Stage 3 data validation in accordance with DoD QSM 5.3 (DoD and Department of Energy 2019). 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 I**. The Level IV analytical reports are included within **Appendix I** in the final electronic deliverable only.

6.4.3 Data Usability Assessment and Summary

A data usability assessment was completed for all analytical data associated with SI sampling at CHAAP. Documentation generated during the data usability assessments, which were compiled into a DUSR (**Appendix I**), 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 Guidelines Module 3: 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 remaining environmental data collected at CHAAP during the SI were found to be acceptable and usable for this SI evaluation with the qualifications documented in the DUSR and its associated data validation reports (**Appendix I**), and as indicated in the full analytical tables (**Appendix J**) provided for the SI results (except for 19 results, discussed further below). These data are of sufficient quality to meet the objectives and requirements of the PQAPP (Arcadis 2019) and CHAAP QAPP Addendum (Arcadis 2022). Data qualifiers applied to laboratory

analytical results for samples collected during the SI at CHAAP 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.

Though the DUSR (**Appendix I**) concluded that the overall completeness of the data set met the criteria of 95%, 19 results were qualified as potentially unusable with an "X" qualifier due to extracted internal standards (EIS) exhibiting recoveries less than 20%, which is indicative of matrix interferences. The "X" qualified data were reviewed by the project team and USACE chemist and it was determined that the compounds with EIS recoveries less than 20% but greater than 1% would be qualified as estimated and revised to "UJ", with the exception of perfluorododecanoic acid, perfluorotridecanoic acid, and perfluorotetradecanoic acid, which were revised to "R" in samples CHAAP-FQHQ-1-GW-122022 and CHAAP-FQHQ-2-GW-122022. The results that were revised to "R" qualifiers have no impact in the evaluation of recommendations for future study at the AOPI.

6.5 Office of the Secretary of Defense Risk Screening Levels

The OSD risk screening levels for PFOS, PFOA, PFBS, PFNA, PFHxS, and HFPO-DA 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 6-1**.

Table 6-1 OSD Risk Screening Levels Calculated for PFOS, PFOA, PFBS, PFNA, PFHxS, and HFPO-DA 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	4	0.013	0.16
PFOA	6	0.019	0.25
PFBS	601	1.9	25
PFNA	6	0.019	0.25
PFHxS	39	0.13	1.6
HFPO-DA[3]	6	0.023	0.35

Notes:
1. Risk screening levels for tap water and soil provided by the OSD. 2022. Memorandum: Investigating Per- and Polyfluoroalkyl Substances within the Department of Defense Cleanup Program. July 06 (**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.
3. Of the six PFAS compounds presented in the 06 July 2022 OSD memorandum, HFPO-DA (commonly referred to as GenX) was not included as an analyte at the time of this SI. Based on the conceptual site model CSM developed during the PA and revised based on SI findings, the presence of HFPO-DA is not anticipated at CHAAP because HFPO-DA is generally not a component of military specification (MIL-SPEC) aqueous film forming foam (AFFF) and based on its history including distribution limitations that

restricted use of GenX, it is generally not a component of other products the military used. In addition, it is unlikely that GenX would be an individual chemical of concern in the absence of other PFAS..
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 for this Army PFAS PA/SI. While the current and most likely future land uses of the AOPIs at CHAAP are industrial/commercial, both residential and industrial/commercial soil risk screening levels for PFOS, PFOA, PFBS, PFNA, and PFHxS will be used to evaluate detected soil concentrations. The data from the SI sampling event are compared to the OSD risk screening levels in **Section 7**. If concentrations of PFOS, PFOA, PFBS, PFNA, or PFHxS are detected greater than the applicable OSD risk screening levels, further study in a remedial investigation is recommended in **Section 8**.

7 SUMMARY AND DISCUSSION OF SI RESULTS

This section summarizes the analytical results obtained from samples collected during the SI at CHAAP (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 2022). The sample results discussion below focuses on the PFOS, PFOA, PFBS, PFNA, and PFHxS analytical results because they have OSD risk screening levels. The Army will make subsequent investigation decisions based on these constituents' concentrations relative to the OSD risk screening levels.

Tables 7-1 through **7-2** provide a summary of the groundwater and soil analytical results for PFOS, PFOA, PFBS, PFNA, and PFHxS. **Table 7-3** summarizes AOPIs and whether their SI results exceed the OSD risk screening levels. **Appendix J** includes the full suite of analytical results for these media, as well as for the QA/QC samples. **Figures 7-1** and **7-2** show the PFOS, PFOA, PFBS, PFNA, and PFHxS analytical results in groundwater and soil for each AOPI. Non-detected results are reported as less than the LOQ. Detections of PFOS, PFOA, PFBS, PFNA, and/or PFHxS 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 (as defined in **Section 6.4.3**) are presented on the analytical tables. Groundwater data collected during the SI are reported in ng/L, or parts per trillion, and soil data are reported in mg/kg, or parts per million.

Field parameters measured for groundwater during purging and sample collection are provided on the field forms in **Appendix G**. Soil descriptions are provided on the field forms in **Appendix G**. The results of the SI are grouped by AOPI and discussed for each medium as applicable. Groundwater was generally first encountered at depths of approximately 7 to 22 feet below ground surface at both AOPIs.

Table 7-3 AOPIs and OSD Risk Screening Level Exceedances

AOPI Name	OSD Exceedances (Yes/No)
Former Fire Station F-3	No
Former Fire and Guard Headquarters and Fire Training Pit	No

7.1 Former Fire Station F-3

The subsections below summarize the groundwater and soil PFOS, PFOA, PFBS, PFNA, and PFHxS analytical results associated with the Former Fire Station F-3 AOPI shown on **Figure 7-1**, **Table 7-1**, and **Table 7-2**.

7.1.1 Groundwater

One grab groundwater sample was collected at the Former Fire Station F-3 AOPI (CHAAP-FFS-1-GW [duplicate sample collected]).

- PFOS, PFNA, and PFHxS were not detected in the groundwater samples collected.

- PFOA was detected at a concentration less than the OSD risk screening level of 6 ng/L in the field duplicate only: CHAAP-FD-1-GW-122022 (2.0 J ng/L). The J qualifier indicates that the analyte was positively identified, however the result is an estimated concentration only.
- PFBS was detected at a concentration less than the OSD risk screening level of 601 ng/L in the parent sample and field duplicate: CHAAP-FFS-1-GW-122022 (2.2 J ng/L) and CHAAP-FD-1-GW-122022 (2.0 J ng/L).

7.1.2 Soil

Three soil samples were collected from three locations at the Former Fire Station F-3 AOPI (CHAAP-FFS-1-SO, CHAAP-FFS-2-SO, CHAAP-FFS-3-SO [duplicate sample collected at CHAAP-FFS-1-SO]).

- PFOS, PFOA, PFBS, PFNA, and PFHxS were not detected in the soil samples collected.

7.2 Former Fire and Guard Headquarters and Fire Training Pit

The subsections below summarize the groundwater and soil PFOS, PFOA, PFBS, PFNA, and PFHxS analytical results associated with the Former Fire and Guard Headquarters and Fire Training Pit AOPI shown on **Figure 7-2**, **Table 7-1**, and **Table 7-2**.

7.2.1 Groundwater

Two grab groundwater samples were collected at the Former Fire and Guard Headquarters and Fire Training Pit AOPI (CHAAP-FGHQ-1-GW and CHAAP-FGHQ-2-GW).

- PFOS, PFOA, PFBS, PFNA, and PFHxS were not detected in the groundwater samples collected.

7.2.2 Soil

Six soil samples were collected from six locations at the Former Fire and Guard Headquarters and Fire Training Pit AOPI (CHAAP-FGHQ-1-SO, CHAAP-FGHQ-2-SO, CHAAP-FGHQ-3-SO, CHAAP-FGHQ-4-SO, CHAAP-FGHQ-5-SO, CHAAP-FGHQ-6-SO).

- PFOS, PFOA, PFBS, PFNA, and PFHxS were not detected in the soil samples collected.

7.3 Investigation Derived Waste

A composite sample of the purge and decontamination wastewater was collected from the 55-gallon drum currently in storage at the Southwest Sewage Treatment Plant. The results indicated the following concentrations in the wastewater: 27 J ng/L PFOA, and non-detect for PFOS, PFBS, PFNA, and PFHxS (**Appendix J**). IDW water was treated with an onsite GAC treatment method prior to discharge, as agreed upon by USACE. The full analytical results (i.e., for all constituents analyzed) for IDW samples collected during the SI are included in **Appendix J**.

7.4 TOC, pH, and Grain Size

In addition to sampling soil for PFOS, PFOA, PFBS, PFNA, and PFHxS, 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 sample was 2,310 mg/kg. The TOC at this installation was within range of what is typically observed in desert soil: less than 5,000 mg/kg. The combined percentage of fines (i.e., silt and clay) in soils at CHAAP was 96.9%. In general, PFAS constituents tend to be more mobile in soils with less than 20% fines (silt and clay) and lower TOC. The percent moisture of the soil, 20.1%, was typical for clay (0 to 20%). The pH of the soil was neutral (approximately 7) standard units. While PFAS constituents are expected to be relatively less mobile in soils with high percentages of fines, depleted TOC may allow for enhanced mobility of the constituents in soil.

7.5 Blank Samples

PFOS, PFOA, PFBS, PFNA, and PFHxS were not detected in any of the blank samples collected during the SI work.

The full analytical results for blank samples collected during the SI are included in **Appendix J**.

7.6 Conceptual Site Models

The preliminary CSMs presented in the QAPP Addendum (Arcadis 2022) were re-evaluated and updated, if necessary, based on the SI sampling results. The CSMs presented on **Figures 7-3** and **7-4** and in this section therefore represent the current understanding of the potential for human exposure.

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, PFBS, PFNA, and PFHxS are each negatively charged at environmentally-relevant pH. The media potentially affected by PFOS, PFOA, PFBS, PFNA, and PFHxS 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.

Although there are no historical records of use, storage, and/or disposal of PFAS-containing materials at the AOPIs,, there is potential that PFAS-containing firefighting foams could have been used, stored, and/or disposed of within these areas. Therefore, affected media are likely to consist of soil, groundwater, 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, PFBS, PFNA, and PFHxS may be evaluated at a future date if those pathways warrant further consideration.

The following exposure pathway determinations apply to the CSMs for both AOPIs:

- There are no residents at CHAAP currently, and it is unlikely that the AOPIs will be used for residential purposes in the future based on the CHAAP reuse plan. Therefore, all exposure pathways for on-site residents are incomplete.
- PFOS, PFOA, PFBS, PFNA, and PFHxS were not detected in soil samples collected at the AOPIs. Based on the SI sample results, the soil exposure pathways for all potential human receptors are incomplete.

Additional exposure pathway determinations are listed below, by figure.

Figure 7-3 shows the CSM for the Former Fire Station F-3. Although there are no historical records of use and/or storage of PFAS-containing materials at the Former Fire Station F-3, there is a potential that PFAS-containing firefighting foams could have been used, stored, or disposed of within this area.

- PFOA and PFBS were detected in one groundwater sample collected at the Former Fire Station F-3 AOPI. The property within the former installation boundary does not have any potable water supply wells. Deed restrictions prohibit drinking water supply wells on excessed property within the explosives plume area. Therefore, the groundwater exposure pathway (via drinking water ingestion and dermal contact) for on-site workers and recreational users is incomplete.
- The surrounding area within the city limits of Grand Island obtains its drinking water from groundwater within the sand and gravel aquifer near the Platte River, southeast of the installation. Groundwater flow from the installation is generally to the north-northeast and is unlikely to impact the City of Grand Island drinking water; however, there is the potential for private drinking water receptors downgradient of the AOPI. Therefore, the groundwater exposure pathway for off-site drinking water receptors is considered to be potentially complete.
- Constituents could migrate via shallow groundwater discharge to man-made drainage ditches near the AOPI. On-site workers and recreational users could potentially contact constituents in surface water and sediment through incidental ingestion and dermal contact within these drainage ditches; consequently, these exposure pathways are potentially complete.
- Surface water runoff via drainage ditches eventually flow to Silver Creek and Wood River, which flow off-site and eventually discharge to the Platte River. Off-site receptors could potentially

contact constituents within Silver Creek, Wood River, or the Platte River; therefore, the surface water and sediment pathways for off-site receptors are potentially complete.

Figure 7-4 shows the CSM for the Former Fire and Guard Headquarters and Fire Training Pit. Although there are no historical records of use and/or storage of PFAS-containing materials, there is a potential that PFAS-containing firefighting foams could have been used, stored, or disposed of within this area.

- PFOS, PFOA, PFBS, PFNA, and PFHxS were not detected in two groundwater samples collected at the AOPI. Based on the SI sample results, the groundwater exposure pathways for all potential human receptors are incomplete.
- Based on the non-detect sample results for soil and groundwater at this AOPI, the surface water and sediment exposure pathways are also incomplete.

Following the SI sampling, one of the two AOPIs was considered to have potentially complete exposure pathways. Although the CSM indicates potentially complete exposure pathways may exist, the recommendation for remedial investigation is based on the comparison of analytical results for PFOS, PFOA, PFBS, PFNA, and PFHxS to the OSD risk screening levels (**Table 6-1**).

8 CONCLUSIONS AND RECOMMENDATIONS

The PFAS PA/SI included two distinct efforts. The PA identified AOPIs at CHAAP based on the use, storage, and/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, PFBS, PFNA, and PFHxS to the environment occurred.

OSD provided residential risk screening levels based on the USEPA oral reference dose for PFOS, PFOA, PFBS, PFNA, and PFHxS in soil and groundwater (tap water) and industrial/commercial risk screening levels for PFOS, PFOA, PFBS, PFNA, and PFHxS in soil (**Appendix A**). A combination of document review, internet searches, and interviews with installation personnel were used to identify specific areas of suspected PFOS, PFOA, PFBS, PFNA, and PFHxS use, storage, and/or disposal at CHAAP. Following the evaluation, two AOPIs were identified.

The property within the former CHAAP boundary does not have any potable water supply wells. Due to deed restrictions preventing exposure to contaminated groundwater, it is unlikely that a potable well would be installed within the former installation in the future.

All AOPIs were sampled during the SI at CHAAP to identify presence or absence of PFOS, PFOA, PFBS, PFNA, and PFHxS at each AOPI. Of the six PFAS compounds presented in the 06 July 2022 OSD memorandum, HFPO-DA (commonly referred to as GenX) was not included as an analyte at the time of this SI. Based on the conceptual site model CSM developed during the PA and revised based on SI findings, the presence of HFPO-DA is not anticipated at CHAAP because HFPO-DA is generally not a component of military specification (MIL-SPEC) aqueous film forming foam (AFFF) and based on its history including distribution limitations that restricted use of GenX, it is generally not a component of other products the military used. In addition, it is unlikely that GenX would be an individual chemical of concern in the absence of other PFAS. The SI scope of work was completed in accordance with the Final PQAPP (Arcadis 2019) and the CHAAP QAPP Addendum (Arcadis 2022).

One AOPI had detections of PFOA and PFBS in groundwater and no AOPIs exceeded OSD risk screening levels. The maximum concentrations of PFOS, PFOA, PFBS, PFNA, and PFHxS detected in groundwater are summarized below:

Groundwater

PFOA was detected at 2.0 J ng/L, below the OSD risk screening level for tap water (6 ng/L), in sample CHAAP-FD-1-GW-122022 at the Former Fire Station F-3 AOPI

PFBS was detected at 2.2 J ng/L, below the OSD risk screening level for tap water (601 ng/L), in sample CHAAP-FFS-1-GW-122022 at the Former Fire Station F-3 AOPI

PFOS, PFNA, and PFHxS were not detected in any groundwater samples collected.

Following the SI sampling, one of the two AOPIs was considered to have potentially complete exposure pathways. Due to a lack of land use controls off-installation and downgradient of CHAAP, the groundwater exposure pathway for off-installation drinking water receptors is potentially complete for one AOPI. Surface water is not used for drinking water; however on-site workers, on-site recreational users, and off-site receptors could contact constituents in surface water and sediment via incidental ingestion

and dermal contact. Therefore, the surface water and sediment exposure pathways are potentially complete for one AOPI.

Although the CSMs indicate potentially complete exposure pathways may exist, the recommendation for future study in a remedial investigation or no action at this time is based on the comparison of the SI analytical results for PFOS, PFOA, PFBS, PFNA, and PFHxS to the OSD risk screening levels (**Table 6-1**). **Table 8-1** below summarizes the AOPIs identified at CHAAP, PFOS, PFOA, PFBS, PFNA, and PFHxS sampling, and recommendations for each AOPI; further investigation is not warranted at CHAAP.

Table 8-1 Summary of AOPIs Identified during the PA, PFOS, PFOA, PFBS, PFNA, and PFHxS Sampling at Cornhusker Army Ammunition Plant, and Recommendations

AOPI Name	PFOS, PFOA, PFBS, PFNA, and/or PFHxS detected greater than OSD Risk Screening Levels? (Yes/No/ND)		Recommendation
	GW	SO	
Former Fire Station F-3	No	ND	No action at this time
Former Fire and Guard Headquarters and Fire Training Pit	ND	ND	No action at this time

Notes:
GW – groundwater
ND – non-detect
SO – soil

Data collected during the PA (**Sections 3** through **5**) and SI (**Sections 6** through **8**) were sufficient to draw conclusions and recommendations summarized above. The data limitations relevant to the development of this PA/SI for PFOS, PFOA, PFBS, PFNA, and PFHxS at CHAAP are discussed below.

The PA process was limited to records review and personnel interviews. No site visit was conducted for CHAAP due to no personnel or remaining structures being present on-site.

Records gathered for the use, storage and/or disposal of PFAS-containing materials 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, PFBS, PFNA, and PFHxS 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-containing material) 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 C**).

The searches for ecological receptors and off-post PFOS, PFOA, PFBS, PFNA, and PFHxS sources were not exhaustive and were limited to easily identifiable and readily available information evaluated during the relevant documents research and installation personnel interviews.

Finally, the available PFOS, PFOA, PFBS, PFNA, and PFHxS analytical data is limited to historical analytical results collected from off-post drinking water supply sources and results from groundwater and soil samples from two AOPIs. Available data, including PFOS, PFOA, PFBS, PFNA, and PFHxS, is listed in **Appendix J**, which were analyzed per the selected analytical method. HFPO-DA was not in the suite of PFAS compounds analyzed during the SI at CHAAP; therefore, there are no HFPO-DA SI analytical results to screen against the 2022 OSD risk screening levels.

Results from this PA/SI indicate further study in a remedial investigation is not warranted at CHAAP in accordance with the guidance provided by the OSD.

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ACRONYMS

°F	degrees Fahrenheit
%	percent
ABHA	Administration and Base Housing Area
AFFF	aqueous film-forming foam
AOPI	area of potential interest
Arcadis	Arcadis U.S., Inc.
Army	United States Army
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CHAAP	Cornhusker Army Ammunition Plant
CSM	conceptual site model
DoD	Department of Defense
DQO	data quality objective
DUSR	Data Usability Summary Report
EB	equipment blank
EDR	Environmental Data Resources, Inc.
EIS	extracted internal standards
ELAP	Environmental Laboratory Accreditation Program
FCR	Field Change Report
GAC	granular activated carbon
HFPO-DA	hexafluoropropylene oxide dimer acid
ICF KE	ICF Kaiser Engineers, Inc.
IDW	investigation-derived waste
IMCOM	Installation Management Command
installation	United States Army or Reserve installation
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
PFAS	per- and polyfluoroalkyl substances
PFBS	perfluorobutanesulfonic acid
PFHxS	perfluorohexane sulfonate
PFNA	perfluorononanoic acid
PFOA	perfluorooctanoic acid
PFOS	perfluorooctane sulfonate
POC	point of contact
ppm	parts per million
ppt	parts per trillion
PQAPP	Programmatic Uniform Federal Policy-Quality Assurance Project Plan
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
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
USATHAMA	United States Army Toxic and Hazardous Materials Agency
UCMR3	third Unregulated Contaminant Monitoring Rule
USEPA	United States Environmental Protection Agency

TABLES

Table 7-1 Groundwater PFOS, PFOA, PFBS, PFNA, and PFHxS Analytical Results
USAEC PFAS Preliminary Assessment/Site Inspection
Cornhusker Army Ammunition Plant, Nebraska

AOPI	Location	Sample/ Duplicate ID	Sample Date	Analyte	PFOS (ng/L)		PFOA (ng/L)		PFBS (ng/L)		PFNA (ng/L)		PFHxS (ng/L)	
				OSD Tapwater Risk Screening Level	4		6		601		6		39	
				Sample Type	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual
Former Fire Station F-3	CHAAP-FFS-1-GW	CHAAP-FFS-1-GW-122022 / CHAAP-FD-1-GW-122022	12/20/2022	N	3.7	U	3.7	U	**2.2**	J	3.7	U	3.7	U
			12/20/2022	FD	3.8	U	**2.0**	J	**2.1**	J	3.8	U	3.8	U
Former Fire and Guard Headquarters and Fire Training Pit	CHAAP-FGHQ-1-GW	CHAAP-FGHQ-1-GW-122022	12/20/2022	N	8.3	UJ	8.3	U	8.3	U	8.3	U	8.3	UJ
	CHAAP-FGHQ-2-GW	CHAAP-FGHQ-2-GW-122022	12/20/2022	N	9.2	UJ	9.2	UJ	9.2	UJ	9.2	UJ	9.2	UJ

Notes:
1. **Bolded** values indicate the result was detected greater than the limit of detection.
2. Data are compared to the Office of the Secretary of Defense (OSD) risk screening levels for both the residential as well as the industrial/commercial scenarios (OSD. 2022. Memorandum: Investigating Per- and Polyfluoroalkyl Substances within the Department of Defense Cleanup Program. July).

Acronyms/Abbreviations:
-- = not applicable
AOPI = area of potential interest
FD = field duplicate sample
ID = identification
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
PFNA = perfluorononanoic acid
PFHxS = perfluorohexane sulfonate
Qual = qualifier
USACE = United State Army Corps of Engineers

Qualifier	Description
J	The analyte was positively identified; however the associated numerical value is an estimated concentration only.
U	The analyte was analyzed for but the result was not detected above the limit of quantitation (LOQ).
UJ	The analyte was analyzed for but was not detected. The reported LOQ is approximate and may be inaccurate or imprecise.

Table 7-2 Soil PFOS, PFOA, PFBS, PFNA, and PFHxS Analytical Results
USAEC PFAS Preliminary Assessment/Site Inspection
Cornhusker Army Ammunition Plant, Nebraska

AOPI	Location	Sample ID / Duplicate ID	Sample Date	Analyte	PFOS (mg/kg)		PFOA (mg/kg)		PFBS (mg/kg)		PFNA (mg/kg)		PFHxS (mg/kg)	
				OSD Industrial/Commercial Risk Screening Level	0.16		0.25		25		0.25		1.6	
				OSD Residential Risk Screening Level	0.013		0.019		1.9		0.019		0.13	
				Sample Type	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual
Former Fire Station F-3	CHAAP-FFS-1-SO	CHAAP-FFS-1-SO-122022	12/20/2022	N	0.0012	U	0.0012	U	0.0012	U	0.0012	U	0.0012	U
		CHAAP-FD-1-SO-122022	12/20/2022	FD	0.0016	U	0.0016	U	0.0016	U	0.0016	U	0.0016	U
	CHAAP-FFS-2-SO	CHAAP-FFS-2-SO-122122	12/21/2022	N	0.001	U	0.001	U	0.001	U	0.001	U	0.001	U
	CHAAP-FFS-3-SO	CHAAP-FFS-3-SO-122122	12/21/2022	N	0.00098	U	0.00098	U	0.00098	U	0.00098	U	0.00098	U
Former Fire and Guard Headquarters and Fire Training Pit	CHAAP-FGHQ-1-SO	CHAAP-FGHQ-1-SO-122022	12/20/2022	N	0.001	U	0.001	U	0.001	U	0.001	U	0.001	U
	CHAAP-FGHQ-2-SO	CHAAP-FGHQ-2-SO-122022	12/20/2022	N	0.0012	U	0.0012	U	0.0012	U	0.0012	U	0.0012	U
	CHAAP-FGHQ-3-SO	CHAAP-FGHQ-3-SO-122022	12/20/2022	N	0.0011	U	0.0011	U	0.0011	U	0.0011	U	0.0011	U
	CHAAP-FGHQ-4-SO	CHAAP-FGHQ-4-SO-122122	12/21/2022	N	0.0011	U	0.0011	U	0.0011	U	0.0011	U	0.0011	U
	CHAAP-FGHQ-5-SO	CHAAP-FGHQ-5-SO-122022	12/20/2022	N	0.001	U	0.001	U	0.001	U	0.001	U	0.001	U
	CHAAP-FGHQ-6-SO	CHAAP-FGHQ-6-SO-122022	12/20/2022	N	0.0011	U	0.0011	U	0.0011	U	0.0011	U	0.0011	U

Notes:
1. Data are compared to the Office of the Secretary of Defense (OSD) risk screening levels for both the residential as well as the industrial/commercial scenarios (OSD. 2022. Memorandum: Investigating Per- and Polyfluoroalkyl Substances within the Department of Defense Cleanup Program. July).

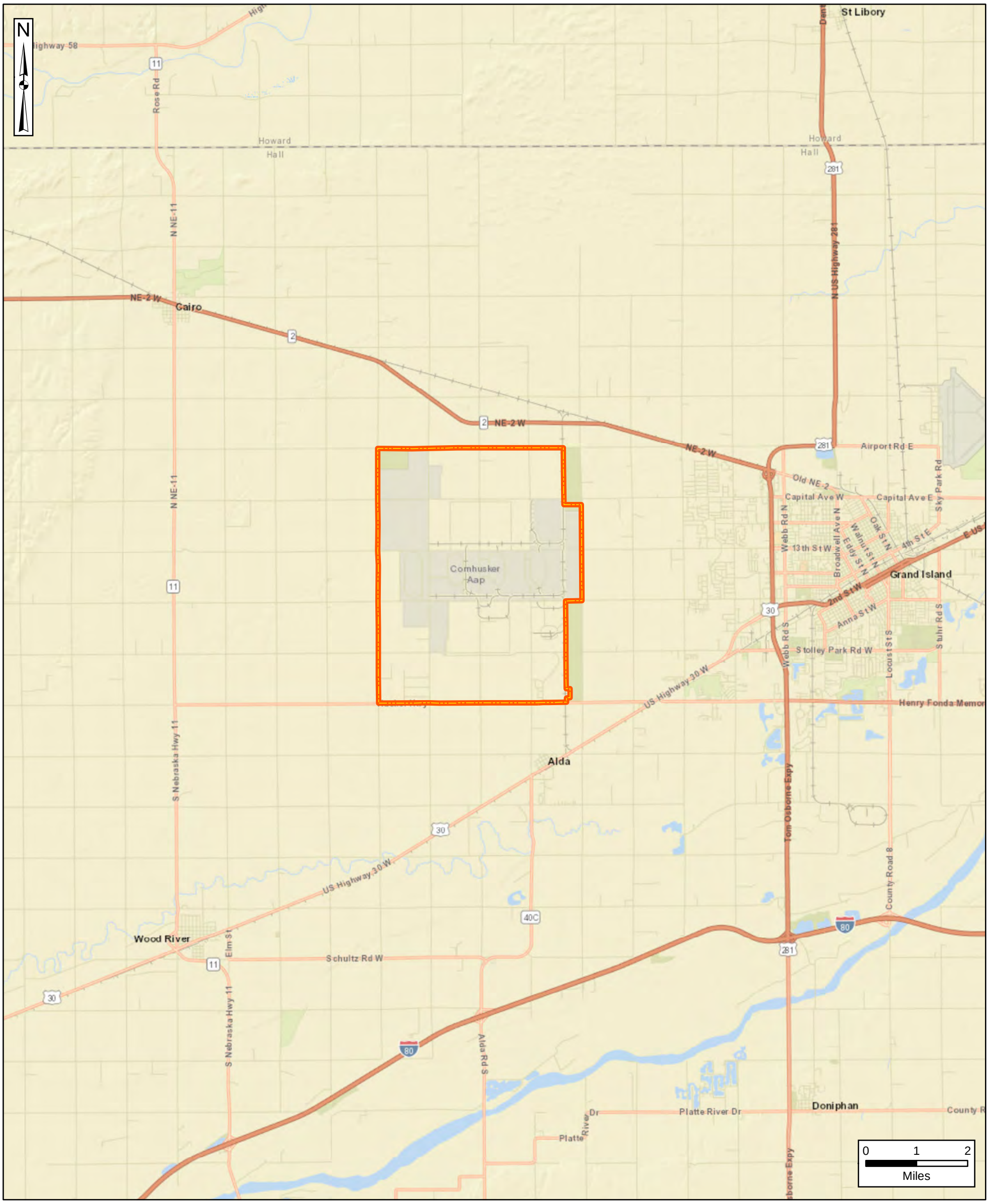
Acronyms/Abbreviations:
-- = not applicable
AOPI = area of potential interest
FD = field duplicate sample
ID = identification
mg/kg = milligrams per kilogram (parts per million)
N = primary sample
PFAS = per- and polyfluoroalkyl substances
PFBS = perfluorobutanesulfonic acid
PFOA = perfluorooctanoic acid
PFOS = perfluorooctane sulfonate
PFNA = perfluorononanoic acid
PFHxS = perfluorohexane sulfonate
Qual = qualifier

Qualifier	Description
U	The analyte was analyzed for but the result was not detected above the limit of quantitation (LOQ).

FIGURES

USAEC PFAS Preliminary Assessment / Site Inspection
Cornhusker Army Ammunition Plant, NE

Figure 2-1
Site Location



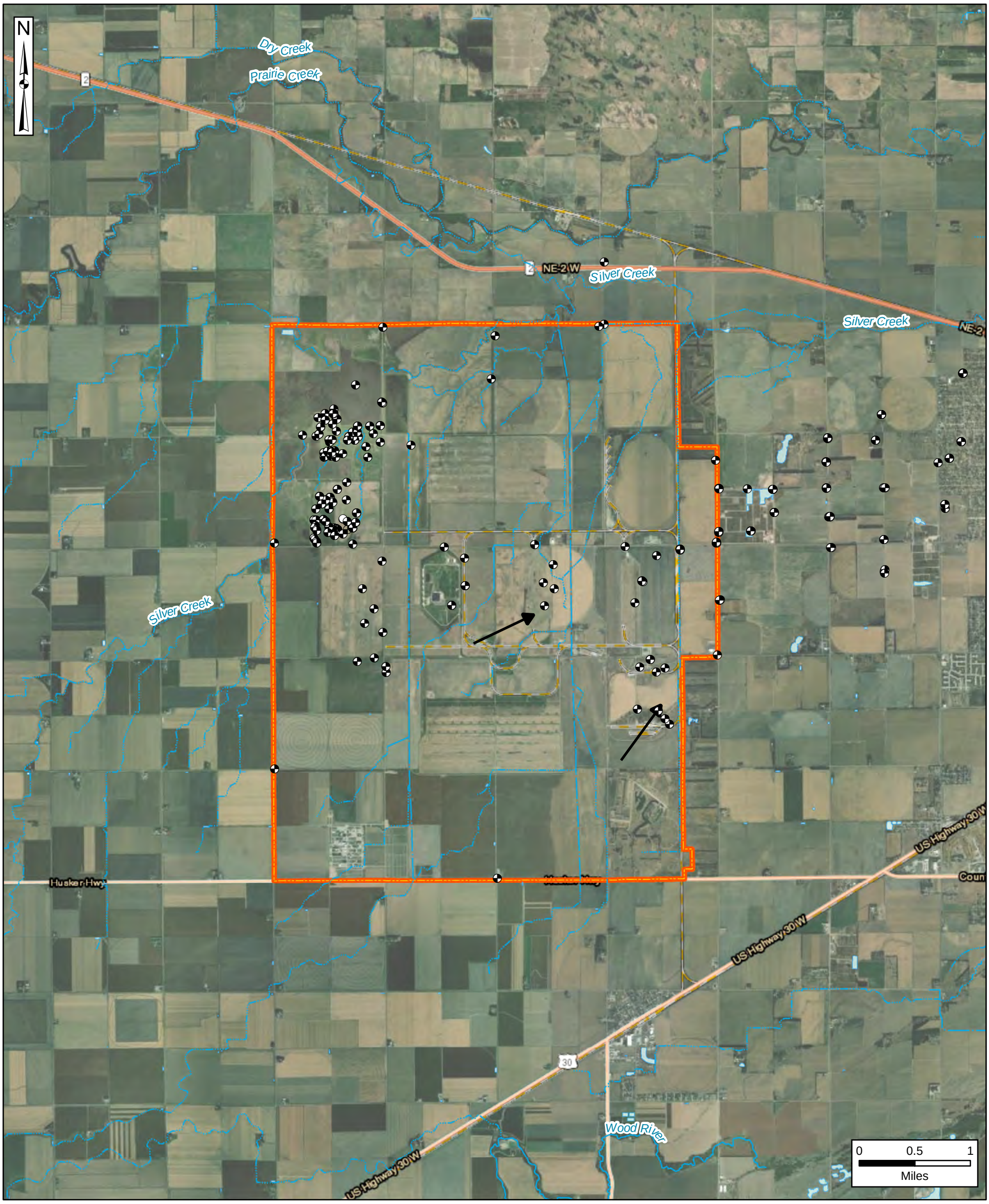
Former Installation Boundary

Data Sources:
CHAAP, GIS Data, 2021
ESRI, ArcGIS Online, Street Map Data

Coordinate System:
WGS 1984, UTM Zone 14 North

USAEC PFAS Preliminary Assessment / Site Inspection
Cornhusker Army Ammunition Plant, NE

Figure 2-2
Site Layout

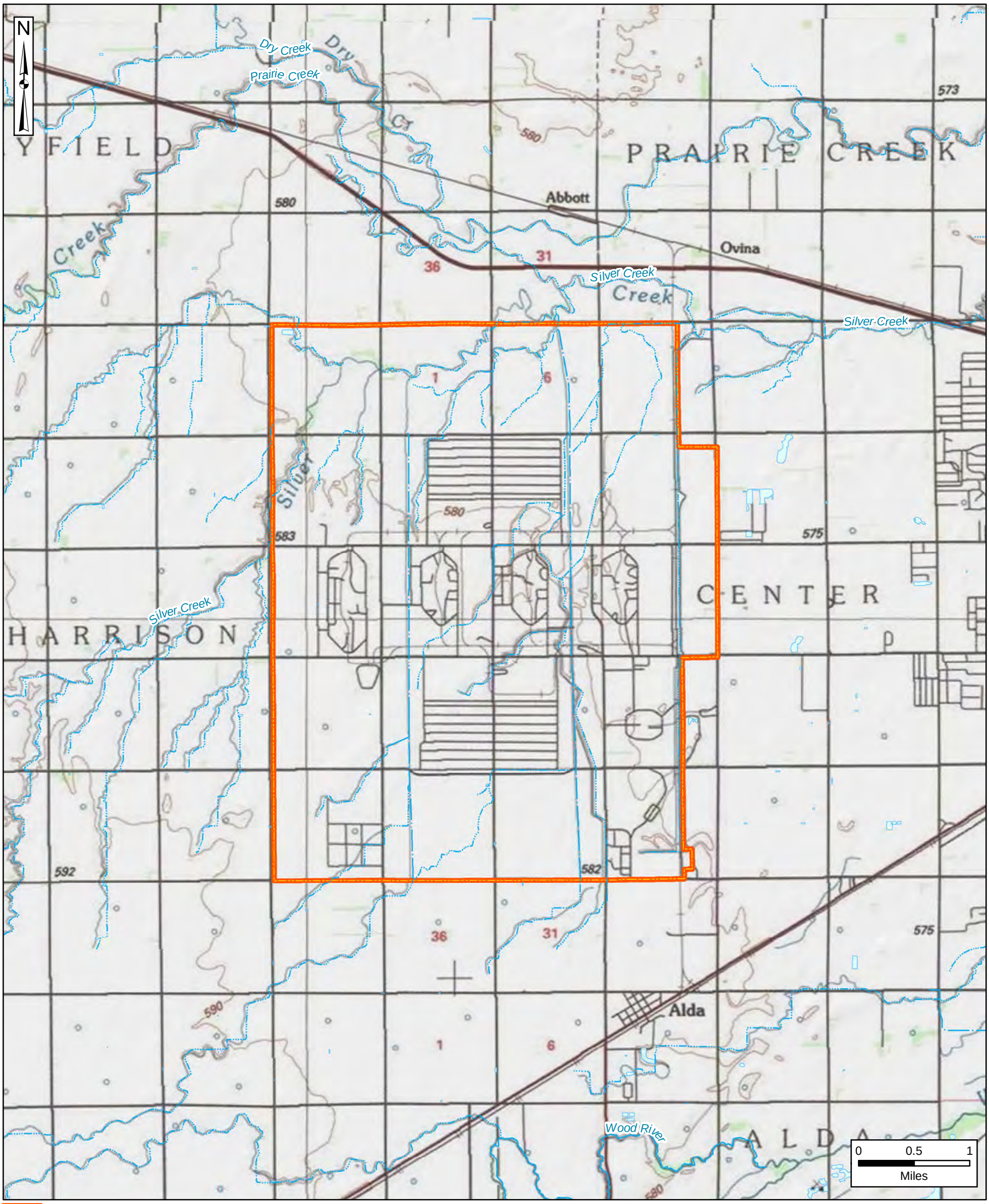


Data Sources:
CHAAP, GIS Data, 2021
USGS, NHD Data, 2021
ESRI, ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 14 North

USAEC PFAS Preliminary Assessment / Site Inspection
Cornhusker Army Ammunition Plant, NE

Figure 2-3
Topographic Map



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

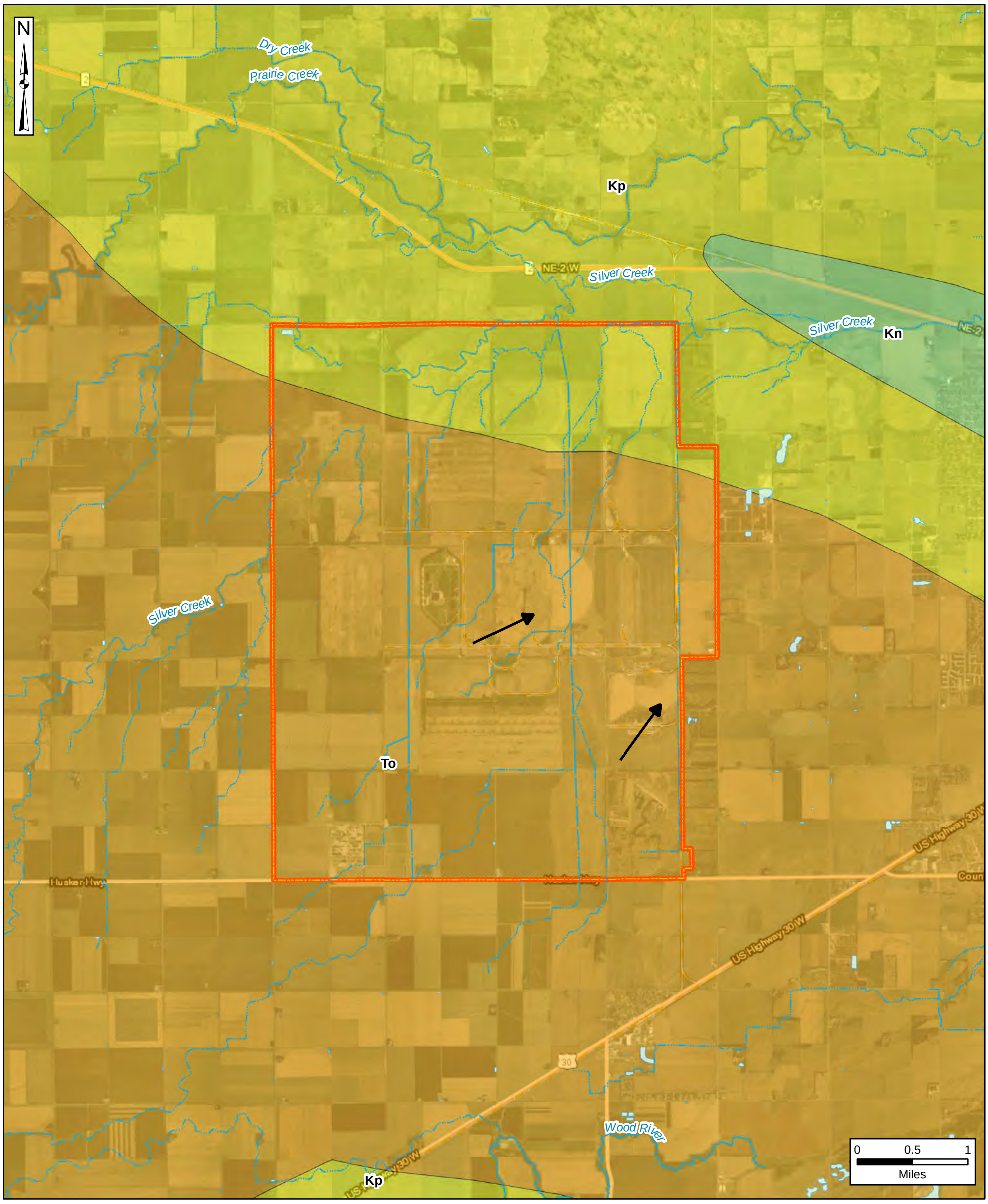
Note: Elevations shown are in feet.

Data Sources:
CHAAP, GIS Data, 2021
USGS, NHD Data, 2021
ESRI, ArcGIS Online, USA Topo Map

Coordinate System:
WGS 1984, UTM Zone 14 North

USAEC PFAS Preliminary Assessment / Site Inspection
Cornhusker Army Ammunition Plant, NE

Figure 2-4
Geology and Hydrogeology



Former Installation Boundary
River/Stream (Perennial)
Stream (Intermittent)
Canal/Ditch
Water Body
Groundwater Flow Direction

Geologic Units

Cretaceous

Niobrara Formation (Kn)
Pierre Shale (Kp)

Miocene

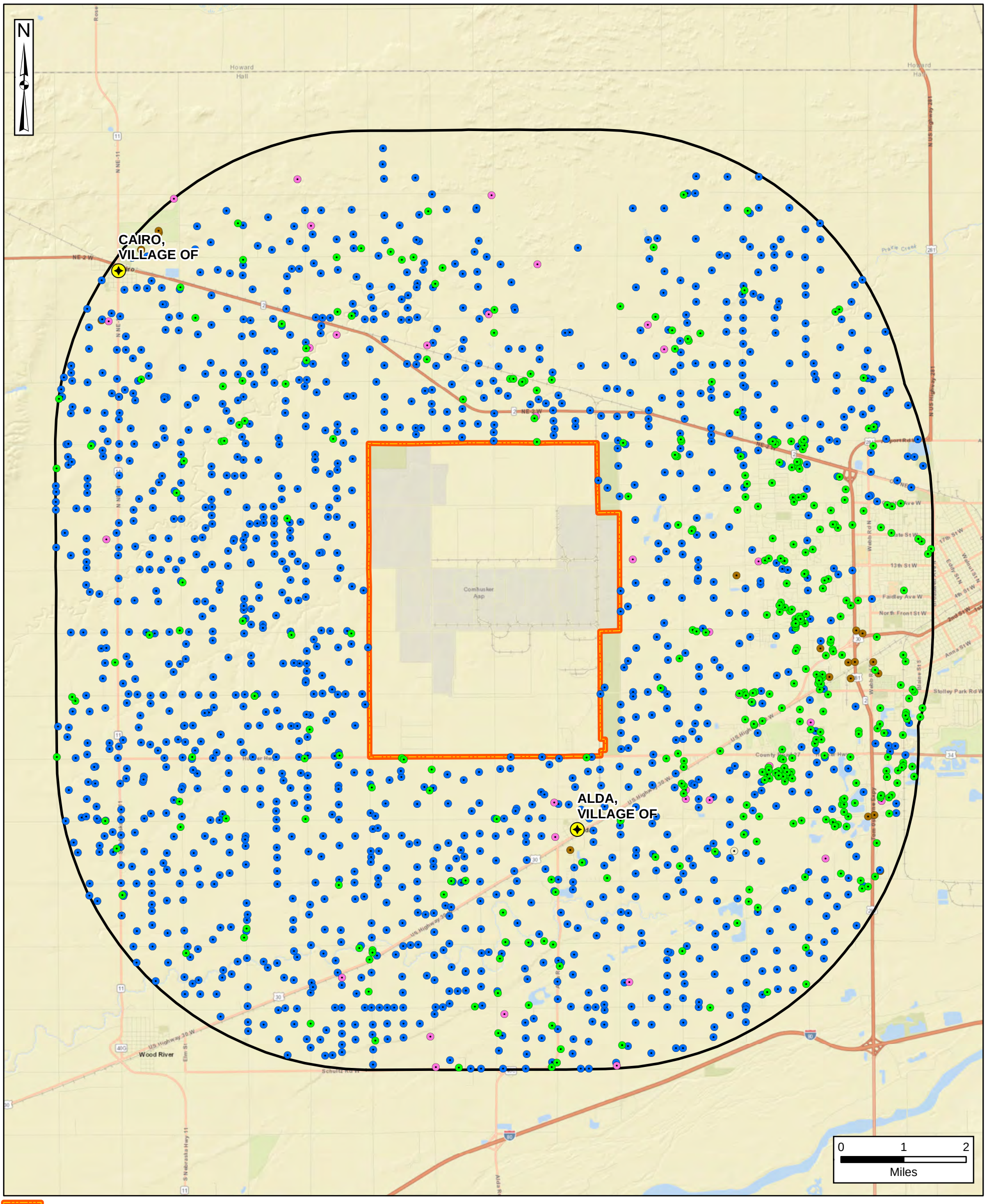
Ogallala Group or Formation (To)

Data Sources:
CHAAP, GIS Data, 2021
USGS, Geology, 2022
USGS, NHD Data, 2021
ESRI, ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 14 North

USAEC PFAS Preliminary Assessment / Site Inspection
Cornhusker Army Ammunition Plant, NE

Figure 2-5
Off-Post Potable Supply Wells



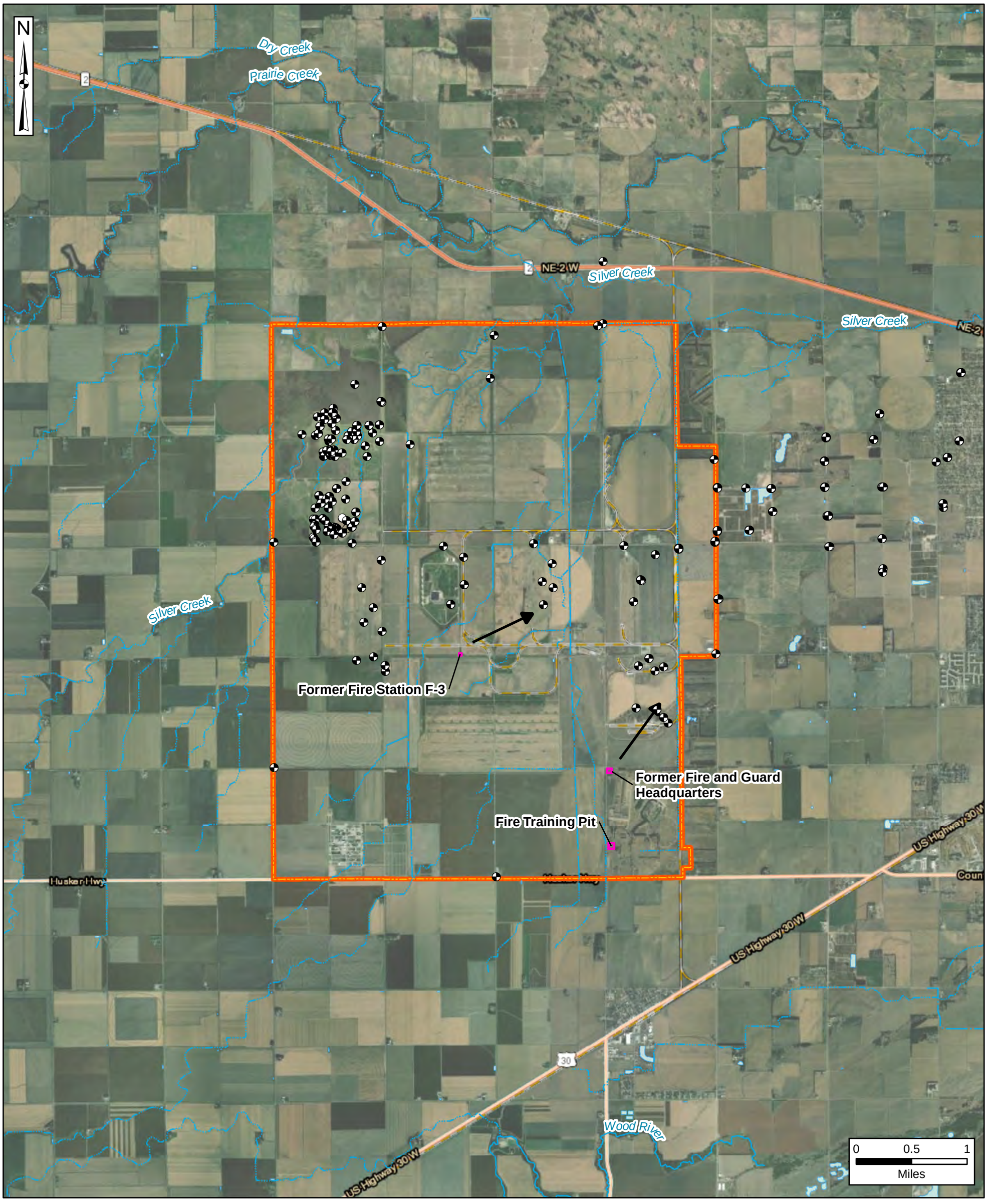
Former Installation Boundary
5-Mile Radius
Public Water Supply System Well
Domestic Well
Livestock Well
Irrigation Well
Commercial/Industrial Well

Data Sources:
EDR, Public Water Supply System Wells, 2022
NeDNR, Other Wells, 2023
CHAAP, GIS Data, 2021
ESRI, ArcGIS Online, Street Map Data

Coordinate System:
WGS 1984, UTM Zone 14 North

USAEC PFAS Preliminary Assessment / Site Inspection
Cornhusker Army Ammunition Plant, NE

Figure 5-2
AOPI Locations



Former Installation Boundary
AOPI
Groundwater Flow Direction
Monitoring Well
River/Stream (Perennial)
Stream (Intermittent)
Canal/Ditch
Water Body

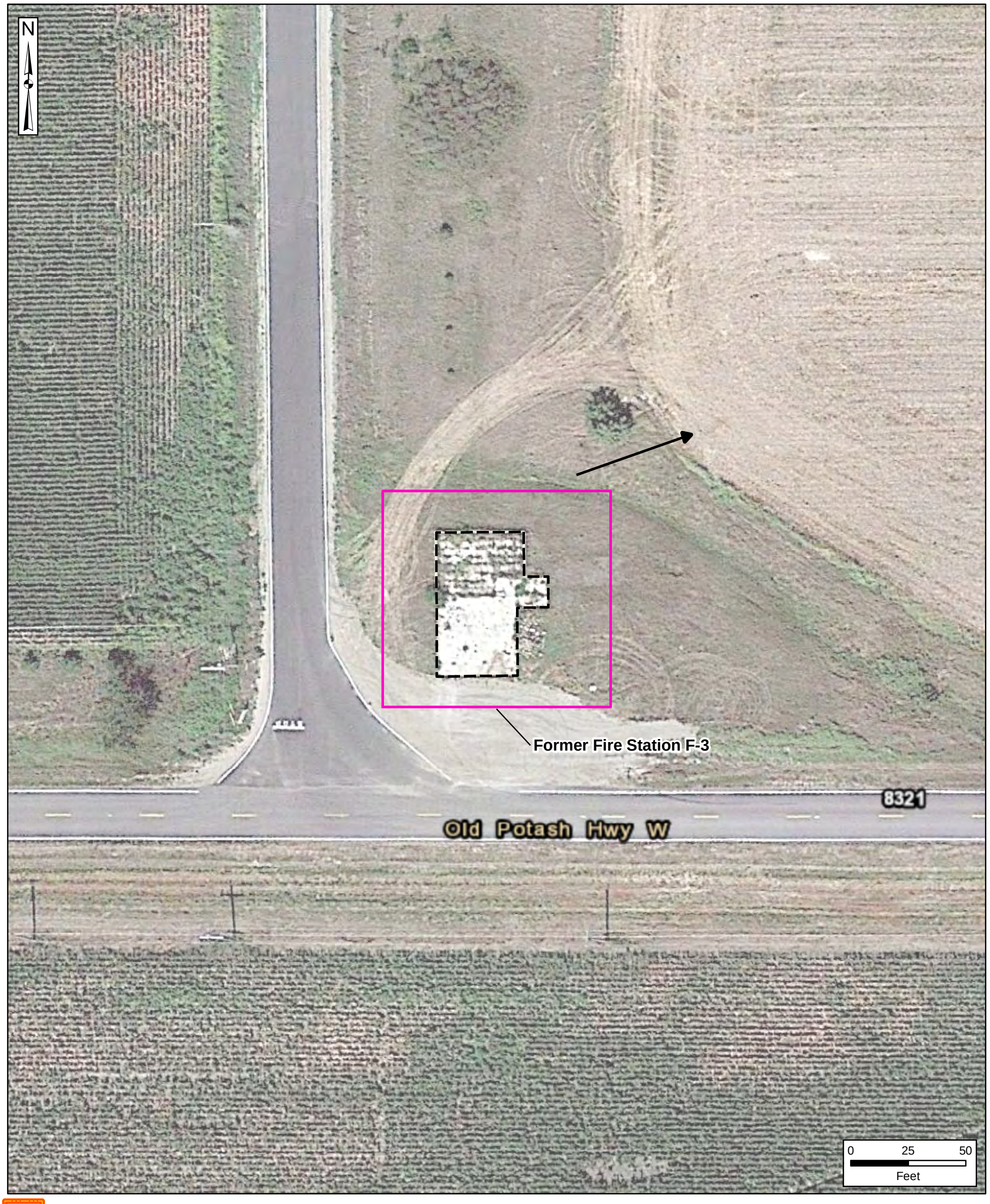
AOPI = area of potential interest

Data Sources:
CHAAP, GIS Data, 2021
USGS, NHD Data, 2021
ESRI, ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 14 North

USAEC PFAS Preliminary Assessment / Site Inspection
Cornhusker Army Ammunition Plant, NE

Figure 5-3
Aerial Photo of
Former Fire Station F-3



Former Installation Boundary
AOPI
Former Building Footprint
Groundwater Flow Direction

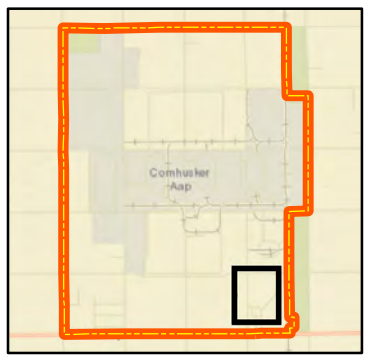
AOPI = area of potential interest

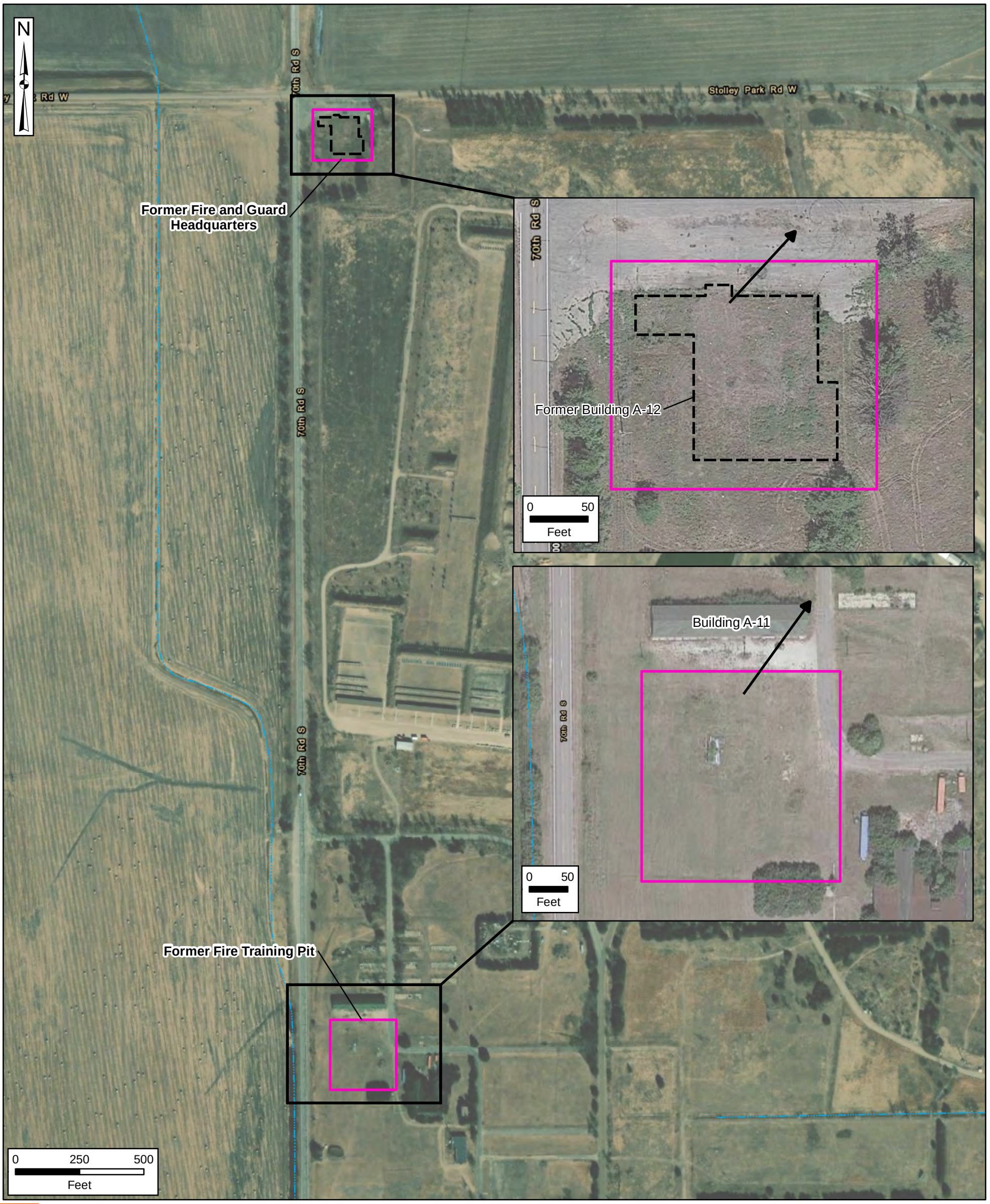
Data Sources:
CHAAP, GIS Data, 2021
Google Earth, Aerial Imagery, 2020

Coordinate System:
WGS 1984, UTM Zone 14 North

USAEC PFAS Preliminary Assessment / Site Inspection
Cornhusker Army Ammunition Plant, NE

Figure 5-4
Aerial Photo of
Former Fire and Guard Headquarters and Fire Training Pit





Former Installation Boundary
AOPI
Former Building Footprint
Groundwater Flow Direction
Stream (Intermittent)

AOPI = area of potential interest

Data Sources:
CHAAP, GIS Data, 2021
USGS, NHD Data, 2021
ESRI, ArcGIS Online, Aerial Imagery
Google Earth, Aerial Imagery (insets), 2020

Coordinate System:
WGS 1984, UTM Zone 14 North

USAEC PFAS Preliminary Assessment / Site Inspection
Cornhusker Army Ammunition Plant, NE

Figure 7-1
Former Fire Station F-3
PFOS, PFOA, PFBS, PFNA, and PFHxS Analytical Results

Chemical	Residential Scenario Risk Screening Level		Industrial/Commercial Scenario Risk Screening Level
	Tap Water (ng/L)	Soil (mg/kg)	Soil (mg/kg)
PFOS	4	0.013	0.16
PFOA	6	0.019	0.25
PFBS	601	1.9	25
PFNA	6	0.019	0.25
PFHxS	39	0.13	1.6

CHAAP-FFS-2-SO	
Date	12/21/2022
Depth	0-2 ft bgs
PFOS	0.0010 U
PFOA	0.0010 U
PFBS	0.0010 U
PFNA	0.0010 U
PFHxS	0.0010 U

CHAAP-FFS-3-SO	
Date	12/21/2022
Depth	0-2 ft bgs
PFOS	0.00098 U
PFOA	0.00098 U
PFBS	0.00098 U
PFNA	0.00098 U
PFHxS	0.00098 U

CHAAP-FFS-1-GW	
Date	12/20/2022
PFOS	3.7 U [3.8 U]
PFOA	3.7 U **[2.0 J]**
PFBS	**2.2 J [2.1 J]**
PFNA	3.7 U [3.8 U]
PFHxS	3.7 U [3.8 U]

CHAAP-FFS-1-SO	
Date	12/20/2022
Depth	0-2 ft bgs
PFOS	0.0012 U [0.0016 U]
PFOA	0.0012 U [0.0016 U]
PFBS	0.0012 U [0.0016 U]
PFNA	0.0012 U [0.0016 U]
PFHxS	0.0012 U [0.0016 U]

Former Fire Station F-3

8321

Old Potash Hwy W

Notes:
1. Groundwater results are reported in nanograms per liter (ng/L).
2. Soil results are reported in milligrams per kilogram (mg/kg).
3. Field duplicate results are shown in brackets.
4. Bolded values indicate detections.

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).

0 25 50
Feet

Former Installation Boundary
AOPI
Former Building Footprint
Groundwater Flow Direction

Sampling Locations
Shallow Soil Sampling Location
Soil/Groundwater Sampling Location (DPT Drilling)

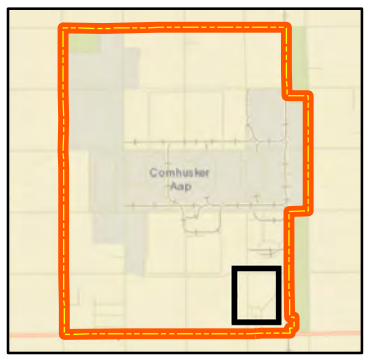
AOPI = area of potential interest
DPT = direct-push technology
ft bgs = feet below ground surface
GW = groundwater
PFBS = perfluorobutanesulfonic acid
PFHxS = perfluorohexane sulfonate
PFNA = perfluorononanoic acid
PFOA = perfluorooctanoic acid
PFOS = perfluorooctane sulfonate
SO = soil

Data Sources:
CHAAP, GIS Data, 2021
Google Earth, Aerial Imagery, 2020

Coordinate System:
WGS 1984, UTM Zone 14 North

USAEC PFAS Preliminary Assessment / Site Inspection
Cornhusker Army Ammunition Plant, NE

Figure 7-2
Former Fire and Guard Headquarters and Fire Training Pit
PFOS, PFOA, PFBS, PFNA, and PFHxS Analytical Results



CHAAP-FGHQ-4-SO	
Date	12/21/2022
Depth	0-2 ft bgs
PFOS	0.0011 U
PFOA	0.0011 U
PFBS	0.0011 U
PFNA	0.0011 U
PFHxS	0.0011 U

CHAAP-FGHQ-1-GW	
Date	12/20/2022
PFOS	8.3 UJ
PFOA	8.3 U
PFBS	8.3 U
PFNA	8.3 U
PFHxS	8.3 UJ

CHAAP-FGHQ-1-SO	
Date	12/20/2022
Depth	0-2 ft bgs
PFOS	0.0010 U
PFOA	0.0010 U
PFBS	0.0010 U
PFNA	0.0010 U
PFHxS	0.0010 U

CHAAP-FGHQ-3-SO	
Date	12/20/2022
Depth	0-2 ft bgs
PFOS	0.0011 U
PFOA	0.0011 U
PFBS	0.0011 U
PFNA	0.0011 U
PFHxS	0.0011 U

CHAAP-FGHQ-6-SO	
Date	12/20/2022
Depth	0-2 ft bgs
PFOS	0.0011 U
PFOA	0.0011 U
PFBS	0.0011 U
PFNA	0.0011 U
PFHxS	0.0011 U

CHAAP-FGHQ-2-GW	
Date	12/20/2022
PFOS	9.2 UJ
PFOA	9.2 UJ
PFBS	9.2 UJ
PFNA	9.2 UJ
PFHxS	9.2 UJ

CHAAP-FGHQ-2-SO	
Date	12/20/2022
Depth	0-2 ft bgs
PFOS	0.0012 U
PFOA	0.0012 U
PFBS	0.0012 U
PFNA	0.0012 U
PFHxS	0.0012 U

CHAAP-FGHQ-5-SO	
Date	12/20/2022
Depth	0-2 ft bgs
PFOS	0.0010 U
PFOA	0.0010 U
PFBS	0.0010 U
PFNA	0.0010 U
PFHxS	0.0010 U

Chemical	Residential Scenario Risk Screening Level		Industrial/Commercial Scenario Risk Screening Level
	Tap Water (ng/L)	Soil (mg/kg)	Soil (mg/kg)
PFOS	4	0.013	0.16
PFOA	6	0.019	0.25
PFBS	601	1.9	25
PFNA	6	0.019	0.25
PFHxS	39	0.13	1.6

Notes:
1. Groundwater results are reported in nanograms per liter (ng/L).
2. Soil results are reported in milligrams per kilogram (mg/kg).

Qualifiers:
U = The analyte was analyzed for, but was not detected above the limit of quantitation (LOQ).
UJ = The analyte was analyzed for but was not detected. The reported LOQ is approximate and may be inaccurate or imprecise.

Former Fire and Guard Headquarters
Former Building A-12
Building A-11
Former Fire Training Pit
70th Rd S
Rd W
Valley Park Rd W
N
0 50 Feet
0 250 500 Feet

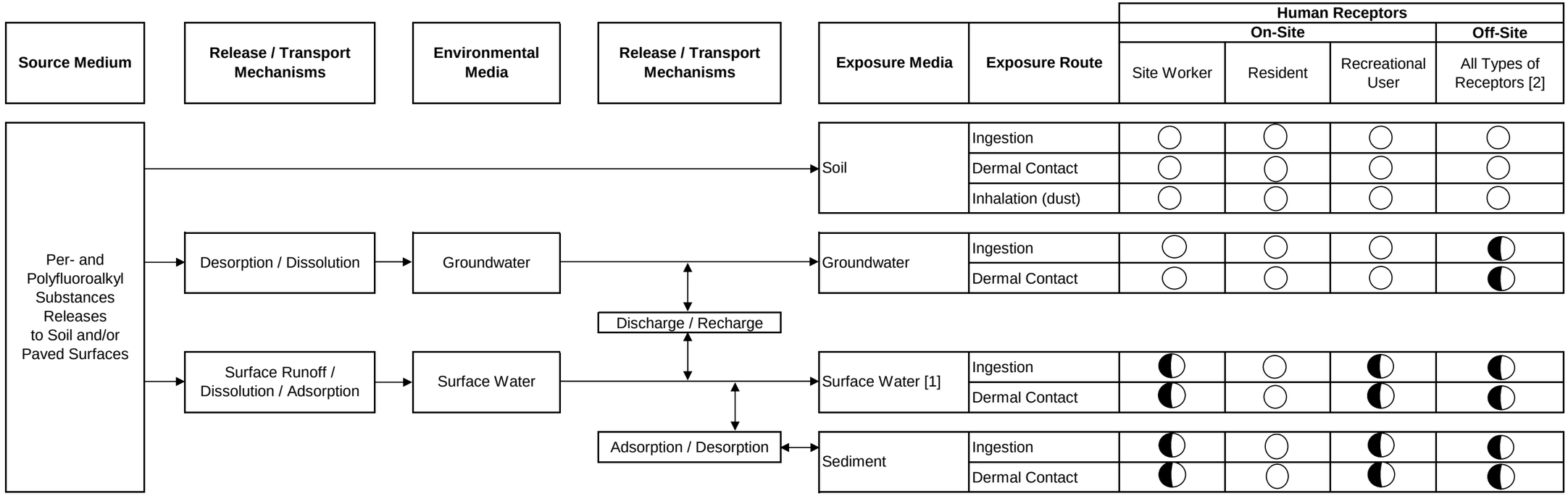
Former Installation Boundary
AOPI
Former Building Footprint
Groundwater Flow Direction
Stream (Intermittent)

Sampling Locations
Shallow Soil Sampling Location
Soil/Groundwater Sampling Location (DPT Drilling)

AOPI = area of potential interest
DPT = direct-push technology
ft bgs = feet below ground surface
GW = groundwater
PFBS = perfluorobutanesulfonic acid
PFHxS = perfluorohexane sulfonate
PFNA = perfluorononanoic acid
PFOA = perfluorooctanoic acid
PFOS = perfluorooctane sulfonate
SO = soil

Data Sources:
CHAAP, GIS Data, 2021
USGS, NHD Data, 2021
ESRI, ArcGIS Online, Aerial Imagery
Google Earth, Aerial Imagery (insets), 2020

Coordinate System:
WGS 1984, UTM Zone 14 North



Legend:

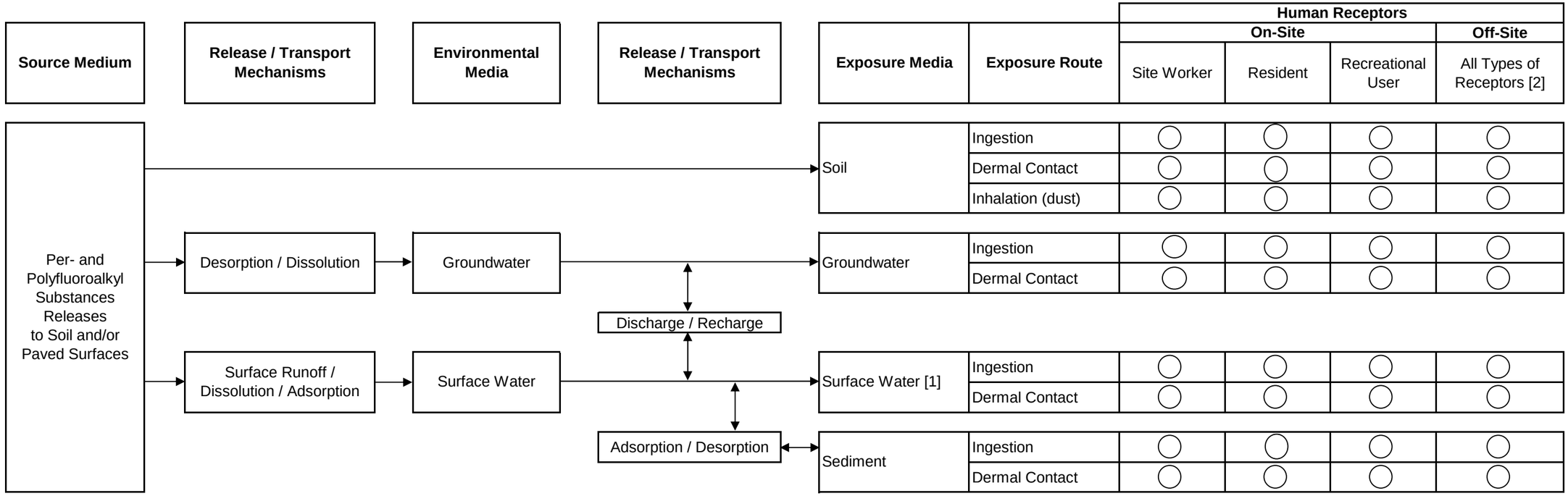
- ● = Complete Exposure Pathway
- ◐ = Potentially Complete Exposure Pathway
- ○ = Incomplete Exposure Pathway

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, recreational users, and on-site trespassers.

ARCADIS

Conceptual Site Model for Former Fire Station F-3
USAEC PFAS Quality Assurance Project Plan Addendum
Cornhusker Army Ammunition Plant, Nebraska

Figure 7-3



Legend:

- ● = Complete Exposure Pathway
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- ○ = 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, recreational users, and on-site trespassers.

ARCADIS

Conceptual Site Model for Former Fire and Guard Headquarters and Fire Training Pit
USAEC PFAS Quality Assurance Project Plan Addendum
Cornhusker Army Ammunition Plant, Nebraska

Figure 7-4

Arcadis U.S., Inc.

7550 Teague Road

Suite 210

Hanover, Maryland 21076

Tel 410 987 0032

Fax 410 987 4392

www.arcadis.com