FINAL

PRELIMINARY ASSESSMENT REPORT OF PFAS RED RIVER ARMY DEPOT, TEXAS

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ACRONYMS AND ABBREVIATIONS

Acronym	Definition
AAR	ARS Aleut Remediation
AFFF	aqueous film-forming foam
AOPI	area of potential interest
Arcadis	Arcadis U.S., Inc.
Army	U.S. Army
BRAC	Base Realignment and Closure
CERCLA	Comprehensive Environmental Response, Compensation, & Liability Act of 1980
DoD	Department of Defense
EDR	Environmental Data Resources, Inc.
GIS	geographic information system
HQDA	Headquarters, Department of the Army
installation	U.S. Army or Reserve installation
IWTP	Industrial Water Treatment Plant
LSAAP	Lone Star Army Ammunition Plant
NAICS	North American Industry Classification System
ng/L	nanograms per liter (parts per trillion)
NWSFTR	Northwest Surveillance Functional Test Range
OSD	Office of the Secretary of Defense
OTC	Ordnance Training Center
PA	Preliminary Assessment
PCTFE	polychlorotrifluoroethylene
PFAS	per- and polyfluoroalkyl substances
PFBS	perfluorobutanesulfonic acid
PFNA	perfluorononanoic acid
PFOA	perfluorooctanoic acid
PFOS	perfluorooctane sulfonate
POC	point of contact
PTFE	polytetrafluoroethylene
RCRA	Resource Conservation and Recovery Act
RRAD	Red River Army Depot
RSL	Regional Screening Levels
RWRD	Riverbend Water Resources District
SI	Site Inspection
SIC	Standard Industrial Classification
SWSFTR	Southwest Surveillance Functional Test Range
TAC	TexAmericas Center
TFE	tetrafluoroethylene
U.S.	United States
USACE	U.S. Army Corps of Engineers
USEPA	U.S. Environmental Protection Agency

EXECUTIVE SUMMARY

The objective of a PA is to identify areas of potential interest (AOPIs) based on whether use, storage, disposal, or release of potential PFAS-containing materials, including AFFF, occurred in accordance with the 2018 Army *Guidance for Addressing Releases of Per- and Polyfluoroalkyl Substances* (U.S. Army 2018). A PA for PFAS-containing materials with a focus on perfluorooctane sulfonate (PFOS), perfluorooctanoic acid (PFOA), perfluorobutane sulfonate (PFBS), perfluorononanoic acid (PFNA), perfluorohexane sulfonate (PFHxS), and hexafluoropropylene oxide dimer acid (HFPO-DA) and its ammonium salt ("GenX" chemicals) was completed at Red River Army Depot (RRAD), to assess potential PFAS release areas and exposure pathways.

RRAD is located in Bowie County, Texas. The installation is approximately 18 miles west of Texarkana, Texas. The installation is adjacent to and south of Hooks, Texas, as well as adjacent to and east of New Boston, Texas. The major facilities on the installation include the following: administrative areas, maintenance areas, general supply and storage areas, large ammunition storage areas, production facilities, two reservoirs, demolition areas, and rifle/grenade ranges.

This PA covers the 4,632 acres which were declared Federal surplus property by the 1995 and 2005 BRAC commissions and reviews the operational history of the facility prior to transfer (URS 2006, Headquarters, Department of the Army 2019).

In conducting the PA of the BRAC property at RRAD, six AOPIs were identified where a potential for release of PFAS exists resulting from site operational history. AOPIs were identified at potential PFAS-release locations on the RRAD.

Based on the potential PFAS releases at the AOPIs, the potential for exposure to PFAS contamination in soil exists. In addition, the potential for off-post exposure in groundwater exists, as on-post groundwater could influence downgradient drinking water sources. Given the findings of this PA, the AOPIs presented warrant further evaluation in a Site Investigation (SI)

Table ES-1: Summary of Locations Identified During the PA, Recommendations & Rationale

Location Name	Identifier	AOPI	Recommendation	Rationale	
Fire Station 1	--	Yes	Further study in SI	Storage of AFFF at location reported in interview, and likely also stored on fire fighting vehicles at this location	
Fire Station 1 Flushing Area	--	Yes	Further study in SI	Reported flushing of AFFF charged hoses and tanks at this location	
Fire Truck Service Extension	--	Yes	Further study in SI	Vehicles being serviced carried AFFF or AFFF residue, which may have been discharged as part of vehicle rehabilitation process	
OTC Landfill	RRAD-04	Yes	Further study in SI	Waste from treatment plants placed into landfill may have contained PFAS containing material from electroplating shops	

Location Name	Identifier	AOPI	Recommendation	Rationale	
Former Hayes Batch Treatment Plant	--	Yes	Further study in SI	Suspected accumulation of PFAS-containing material from electroplating shops through wastewater system and settling ponds	
Current IWTP		Yes	Further study in SI	Suspected accumulation of PFAS-containing material from electroplating shops and PFAS-containing lubricants	
Flammable Materials Storage Facility		No	No action at this time	No records of fire responses at this location. Use of AFFF in firefighting responses prior to 2003 could not be verified through documentation or interviews	
Pesticide Storage Facility		No	No action at this time	Mixing of pesticides was not reported as having occurred here; Ant traps containing of sulfuramid were sealed and opened only upon utilization	
Pesticide Pit and Former Pesticide Building		No	No action at this time	Pesticide pit was closed prior to the development of sulfuramid	
NWSFTR	RRAD-10	No	No action at this time	Use of PFAS-containing materials in munitions and pyrotechnic testing could not be verified through documentation or interviews	
Southwest Surveillance Functional Test Range	RRAD-09	No	No action at this time	Use of PFAS-containing materials in munitions and pyrotechnic testing could not be verified through documentation or interviews	
Communication Center	--	No	No action at this time	Use of PFAS-containing materials in the film photograph development process could not be verified through documentation or interviews	

1.0 INTRODUCTION

The Army conducted this Preliminary Assessment (PA) to investigate the potential presence of Per-and Polyfluoroalkyl Substances (PFAS) at Fort Chaffee in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA, 42 U.S.C. §9601 et. seq.), the Defense Environmental Restoration Program (DERP, 10 U.S.C. §2701 et. seq.), the National Oil and Hazardous Substances Pollution Contingency Plan (NCP, 40 CFR Part 300), and guidance documents developed by the Environmental Protection Agency and the Department of the Army. Red River is not on the National Priorities List and the Army is responsible for compliance with CERCLA in accordance with Executive Order 12580, as amended.

The purpose of this PFAS PA is to identify locations that are areas of potential interest (AOPIs) on the former RBAAP based on the use, storage and/or disposal of potential PFAS-containing materials, in accordance with the 2018 Army Guidance for Addressing Releases of Per-and Polyfluoroalkyl Substances (Army 2018). The PA was conducted in general accordance with 40 CFR §300.420(b) and the U.S. Environmental Protection Agency (USEPA) *Guidance for Performing Preliminary Assessments Under CERCLA* (USEPA 1991) and the U.S. Army (Army) *Guidance for Addressing Releases of Per- and Polyfluoroalkyl Substances* (U.S. Army 2018). This report presents findings from research conducted to assess past use of materials containing PFAS and identify areas where these materials were stored, handled, used, or disposed at RRAD.

The entire BRAC portion of RRAD property was evaluated, including Army-owned property as well as property that has been previously transferred. RRAD is in Bowie County, Texas. The installation is approximately 18 miles west of Texarkana, Texas. located six miles southeast of Fort Smith in the Ozark Mountains of the west central part of Arkansas.

1.1 Project Background

PFAS are a group of synthetic compounds that have been manufactured and used extensively worldwide since the 1950s for a variety of purposes. PFAS are stable, man-made fluorinated organic chemicals that repel oil, grease, and water. Common industrial uses of PFAS include paints, varnishes, sealants, hydraulic fluid, surfactants, and firefighting foams. PFAS include both per- and polyfluorinated compounds. Perfluorinated compounds, such as perfluorooctane sulfonate (PFOS), perfluorooctanoic acid (PFOA), perfluorobutanesulfonic acid (PFBS), perfluorononanoic acid (PFNA), perfluorohexane sulfonate (PFHxS), and hexafluoropropylene oxide dimer acid (HFPO-DA or Gen X) are a subset of PFAS with completely fluorinated carbon chains, while polyfluorinated compounds have at least one carbon chain atom that is not fully fluorinated. These six PFAS compounds together, and for the purposes of this PA, are referred to in this report as “target PFAS.”

Fort Chaffee was evaluated for all potential use, storage, and/or disposal of PFAS-containing materials. There are a variety of PFAS-containing materials used in relation to current and historical Army operations. However, the use, storage, and/or disposal of aqueous film-forming foam (AFFF) is the most common potential source of PFAS chemicals at DoD facilities. As such, this section is organized to summarize the AFFF-related sources first, and all remaining potential PFAS-containing materials in the subsequent paragraph. AFFF is used as a firefighting agent to suppress petroleum hydrocarbon fires and vapors. Firefighting foams like AFFF were developed in the 1960s (ITRC 2020a), but AFFF did not see widespread DoD use until the early 1970s. Older fire training facilities often were unlined and not constructed to prevent infiltration of firefighting foams and combustion products leaching into the subsurface. Large quantities of AFFF may have been released into the environment as a result of fire training exercises, fire responses, fire suppression system activations, and tank and pipeline leaks/spills.

Other potential PFAS sources considered include installation storage warehouses, some pesticide use, automobile maintenance shops, photo processing facilities, laundry/water-proofing facilities, car washes, stormwater or sanitary sewer components, and biosolid application areas.

Many PFAS compounds are highly soluble in water and have low volatility due to their ionic nature. The specific gravity/relative density for PFOS and PFOA is 1.8 (ITRC 2020c). Long-chain perfluorinated compounds have low vapor pressure and are expected to persist in aquatic environments. These compounds do not readily degrade by most natural processes. They are thermally, chemically, and biologically stable, and are resistant to biodegradation, atmospheric photooxidation, direct photolysis, and hydrolysis. The structure of these compounds increases their resistance to degradation; the carbon-fluorine bond is one of the strongest in nature, and the fluorine atoms shield the carbon backbone.

When PFAS are released to the environment, they can readily migrate into soil, groundwater, surface water, and sediment. Once in the environment, the compounds are persistent and may continue to migrate through airborne transport, surface water, groundwater, and/or biologic uptake. The amount of PFAS entering the environment depends on the type and amount of the PFAS material that may have been released, where and when it was used, the type of soil, and other factors. If private or public wells are located nearby, they potentially could be affected by PFAS. Similarly, surface water features may be impacted and may convey PFAS to downgradient receptors.

Of the thousands of PFAS chemicals, some are considered precursor compounds (typically polyfluoroalkyl substances). Precursor compounds can abiotically or biotically transform into PFOS and PFOA. PFOS and PFOA are referred to as terminal PFAS, meaning no further degradation products will form from them (ITRC 2020b).

The purpose of a PA under the NCP is to 1) eliminate from further consideration those sites that pose no threat to public health or the environment; 2) determine if there is any potential need for removal action; 3) set priorities for Site Inspections (SIs); and 4) gather existing data to facilitate evaluation for the release pursuant to the Hazard Ranking System, if warranted (40 CFR §300.420(b)(1)).

The primary objective of the PA is to identify locations at RBAAP where there was use, storage, or disposal of PFAS-containing materials resulting in a potential release of PFAS to the environment and conduct an initial assessment of possible migration pathways of potential contamination. This PA also includes development of a preliminary conceptual site model (CSM) for areas of potential interest (AOPIs) related to PFAS.

This PA covers the 4,632 acres which were declared Federal Surplus by the 1995 and 2005 BRAC commissions and reviews the operational history of the facility prior to transfer (URS 2006, Headquarters, Department of the Army [HQDA] 2019). The remaining 14,481 acres of land currently operated by the Army as the active RRAD is not covered by this report.

1.0.1 PFAS REGULATORY OVERVIEW AND SCREENING CRITERIA

In May 2016, USEPA issued lifetime health advisories (LHAs) for PFOA and PFOS under the Safe Drinking Water Act (SDWA). To provide Americans, including the most sensitive populations, with a margin of protection from a lifetime of exposure to PFOS and PFOA in drinking water, USEPA established an HA level for PFOS and PFOA (individually or combined) of 70 ng/L (USEPA 2016).

In October 2019, the Office of the Assistant Secretary of Defense (OSD) issued guidance on investigation PFOS, PFOA, and PFBS at Department of Defense restoration sites. The OSD guidance provided risk screening levels for PFOS, PFOA, and PFBS in (groundwater) tap water and soil, based on the EPA Regional Screening Level calculator for residential and industrial reuse and using the oral reference dose of 2E-05 mg/kg-day. These screening levels are used during a Site Inspection (SI) to determine if further investigation in a Remedial Investigation (RI) is warranted.

In April 2021, USEPA issued an updated toxicity assessment for PFBS. USEPA developed chronic (0.0003 mg/kg-day) and subchronic (0.001 mg/kg-day) oral reference doses (RfDs) for PFBS as part of USEPA's toxicity assessment. The regional screening level (RSL) for PFBS was previously calculated using the RfD of 0.02 mg/kg day. New toxicity values resulted in revisions to the RSLs for PFBS in May 2021 (USEPA 2021).

In September 2021, OSD issued a revision to Investigating Per- and Polyfluoroalkyl Substances within the Department of Defense Cleanup Program (DoD 2021). The revised memorandum accounts for the updated PFBS screening levels attributable to USEPA's reassessment of PFBS toxicity in 2021. Based on USEPA research, the RSLs for PFOS and PFOA are calculated using an RfD of 2E-05 mg/kg-day. The RSL for PFBS is calculated using an RfD of 3E-04 mg/kg-day. When multiple PFAS are encountered at a site, a 0.1 factor is applied to the screening level when it is based on noncarcinogenic endpoints.

In May 2022, based on continued evaluation of target PFAS compounds by the Agency for Toxic Substances and Disease Registry (ATSDR) and the EPA Office of Water, EPA provided new screening levels for PFOA, PFOS, PFNA, PFHxS, and HFPO-DA.

In July 2022, OSD issued a policy memorandum adopting these new screening levels to be used during the SI-phase to determine whether further investigation in a RI is warranted. Therefore, the screening level for target PFAS compounds are: This revised guidance is in effect as of July 2022 and is applicable to investigating PFOS, PFOA, PFBS, PFNA, PFHxS, and HFPO-DA at DOD restoration sites, including BRAC (DoD 2022). Currently, no legally enforceable Federal standards exist for PFAS in groundwater, surface water, soil, or sediment.

Table 1-1. Screening Levels (SL) from the 2022 OSD Memorandum

Chemical	Residential Tap Water HQ = 0.1 (ng/L or ppt)	Residential Soil HQ = 0.1 (µg/kg or ppb)
HFPO-DA (GenX)	6	23
PFBS	601	1,900
PFHxS	39	130
PFNA	6	19
PFOA	6	19
PFOS	4	13

Note:
The Residential Tap Water SLs are used to evaluate groundwater and surface water data. The Residential Soil SLs are used to evaluate soil and sediment data.
HFPO-DA Hexafluoropropylene oxide dimer acid
HQ Hazard Quotient
OSD Office of the Secretary of Defense
PFBS Perfluorobutane Sulfonate
PFHxS Perfluorohexane Sulfonate
PFNA Perfluorononanoic Acid
PFOA Perfluorooctanoic Acid
PFOS Perfluorooctane Sulfonate

The Army's strategy is to continue to assess and investigate potential releases and implement necessary response actions in accordance with CERCLA to ensure that no human health-based exposures are above the CERCLA risk-based values in drinking water. Therefore, sites where human exposure to contaminated drinking water exists will be addressed first and as quickly as possible to eliminate the exposure, and then will be subsequently prioritized and sequenced to conduct the investigations and response actions necessary to characterize and, if necessary, remediate the source of PFAS contamination (U.S. Army 2018).

1.2 PA Process Description

The PA for RRAD included a site visit, aerial photographic analysis, records review, and interviews that were conducted in accordance with the methods detailed in PA Quality Control Checklist (Appendix B). The Checklist outlines the approach and methodology for conducting the PFAS PA. As detailed in the Checklist, the PA activities focused on ascertaining and documenting the following information regarding PFAS history and use, storage or disposal at RRAD.

- On-post fire training activities.
- Use of PFAS-based AFFF in fire suppression systems or other systems.
- AFFF stored, used, and/or disposed of at buildings and crash sites.
- Activities or use of materials that are likely to contain PFAS constituents, such as chrome plating operations.
- Wastewater treatment plants (WWTPs) and landfills that may have received PFAS-containing materials.
- Studies conducted to assess environmental impacts at the facility.

- Potential PFAS use at parcels post transfer.
- Potential off-post sources that may impact RRAD.

The data gathered during PA activities are summarized in Sections 1.3.1 through 1.3.3 below. Section 3 provides a summary of the PA activities completed at RRAD.

1.3.1 Pre-Site Visit

First, an installation kickoff teleconference was held between applicable points of contact (POC) from the USACE, the Army BRAC organization, ARS Aleut Remediation, LLC (AAR), and Arcadis U.S., Inc. (Arcadis). The kickoff call occurred on 19 May 2022, before the site visit, to discuss the goals and scope of the PA, project scheduling, installation access, timeline for the site visit, access to installation-specific databases, and to request available records.

Records research 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 RRAD.

1.3.2 Preliminary Assessment Site Visit

The site visit was conducted on 31 May through 02 June 2022. An in-briefing was held to provide the staff at RRAD with the objectives of the site visit and team introductions.

Personnel interviews were conducted with military and civilian individuals having significant historical knowledge at RRAD. The interviews focused on confirming information discussed in historical documents, collecting information that may have not been in historical documents, corroborating other interviewees' information. **Section 3.2** includes information regarding personnel interviewed.

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

The findings identified during the PA were communicated during a conference call held on 27 June 2022.

1.3.3 Post-Site Visit

Information collected before, during, and after the site visit was reviewed and corroborated by cross-referencing records and reviewing interview details and observations noted during site visit reconnaissance. A site visit trip report was completed and provided to the installation POC, applicable U.S. Army Environmental Command POCs, and USACE regional POCs following the site visit. Map document files and associated geographic information system (GIS) data are provided as ***Appendix C***. GIS data layers created for the project are included in a Spatial Data Standards for Facilities, Infrastructure, and Environment-compliant geodatabase.

2.0 INSTALLATION OVERVIEW

The following subsections provide general information about RRAD, 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 Terminology

RRAD, and its other iterations (e.g., Red River Ordnance Depot and Red River Arsenal) was established in 1941 as an ammunition storage facility.

The historical extent of RRAD is shown on ***Figure 2-1***. Several rounds of BRAC have impacted RRAD (1988, 1995, and 2005), including transfer of missions into and out of the installation, as well as property conveyances. Property conveyances were recommended during BRAC 1995 and BRAC 2005, illustrated on ***Figure 2-2***. Much of the installation is still operational and the portions of RRAD remains active. Further, some transferred property is currently leased back to the Active Army for RRAD operations. There are 14,481 acres within RRAD that are retained by RRAD as a reserve enclave and are not included as part of this assessment. This PA covers the 4,632 acres which were declared Federal surplus property by the 1995 and 2005 BRAC commissions and reviews the operational history of the facility prior to transfer (URS 2006, Headquarters, Department of the Army 2019).Therefore, this report only discusses the DoD/Active Army operation of federal surplus areas prior to their transfer as described in sections below. Discussions related to any mission or activity prior to BRAC is referred to as “Pre-BRAC” throughout this document.

2.2 Site Location

RRAD is located in Bowie County, Texas. The installation is approximately 18 miles west of Texarkana, Texas. The installation is adjacent to and south of Hooks, Texas, as well as adjacent to and east of New Boston, Texas (AMC 2017). The location of the installation is depicted on ***Figure 2-1***.

The major facilities on the installation included the following: administrative areas, maintenance areas, general supply and storage areas, large ammunition storage areas, production facilities, two reservoirs, demolition areas, and rifle/grenade ranges (Department of the Army, Office of the Project Manager for Chemical Demilitarization, and Installation Restoration 1978; Hartfield, Price, and Green, Inc. 1984). The layout of the installation is depicted on ***Figure 2-2***.

2.2 Pre-BRAC Mission and Brief Site History

The mission of RRAD was originally only to function as an ammunition storage facility. However, in the 1940s, its mission expanded to include general supply storage; tank repair and modification; and tank, artillery, and small firearms shipping. From 1943 to 1944, Lone Star Ordnance Plant (later named Lone Star Army Ammunition Plant [LSAAP]) was associated with RRAD as the Texarkana Ordnance Center. In 1945, the Texarkana Ordnance Center was abolished and LSAAP was then incorporated with Red River Ordnance Depot (and later named RRAD). These merged installations were referred to Red River Arsenal and conducted primarily demilitarization and renovation work under the jurisdiction of Red River Arsenal until 1951.

From 1945 to 1950, RRAD conducted demilitarization activities that included munitions destruction and equipment renovation. In 1950, RRAD was utilized as the designated assembly site for the Hawk missile system, servicing 25% of the Army's needs. In the 1970s, RRAD began conversation of 5,000 M113 vehicles from gasoline to diesel power; conducted in their industrial complex which had the capacity and capability to overhaul and remanufacture tactical vehicles as well as combat systems (ELM Consulting, LLC 2008; ALL Consulting, LLC 2016; HQDA 2020). By 1978, the installation had a general mission to operate a supply depot providing for the receipt, storage, issue, maintenance, and disposal of assigned commodities. The most significant activities included recovery and maintenance of Army motorized vehicles; storage, surveillance, maintenance, and demilitarization of ammunition; and provision of utilities and support services to LSAAP and various branches of the U.S. Military (HQDA 2019, Department of the Army, Office of the Project Manager for Chemical Demilitarization, and Installation Restoration 1978). In the 1980s, facilities began modernizing, and RRAD was established as the only depot to have major missions in supply, ammunition, and maintenance.

Any PFAS AOPIs related to BRAC properties are described further in **Section 4.3**.

2.3.1 Pre-BRAC Tenants and Operations

Prior to BRAC, RRAD hosted a handful of tenants. In order to support its missions, three primary tenants were hosted at the installation, including Defense Logistics Agency Disposition Services, Defense Logistics Agency, and Red River Munitions Center (RRAD 2016).

2.4 BRAC EVENTS

Several rounds of BRAC have impacted RRAD (1988, 1995, and 2005), including transfer of missions into and out of the installation, as well as property conveyances. Across these events, total of 4,632 acres have been declared excess.

There were no property conveyances performed as part of the 1988 BRAC event.

2.4.1 BRAC 1995 – Transfer Complete

In 1995, the Commission directed the realignment of RRAD to include moving all maintenance missions, except for those related to the Bradley Fighting Vehicle Series, from RRAD to other depot maintenance activities, including into the private sector. RRAD retained the conventional ammunition storage mission, the Intern Training Center, the Rubber Production Facility, and civilian training education missions. The 797 acres of property which was not required to support these missions was excessed through the Red River Redevelopment Authority, which would later become TexAmericas Center (TAC) in May 2011. TAC leases some buildings in this area back to the Army. RRAD utilities became privatized under this determination as well. Riverbend Water Resources District (RWRD) began providing potable water services, wastewater services, and industrial wastewater services for the installation in 2002 (URS 2006).

2.4.2 BRAC 1995 – To Be Transferred

There are approximately 60 acres associated with the surplus 797 acres which are known as the "Western Industrial Area" and has not yet been transferred due to ongoing environmental cleanup by BRAC. This area has been remains owned by the Army and remains under BRAC control until cleanup can be achieved, although several buildings and operations have been transferred to TAC and RWRD for use (HQDA 2019). Although the Current Industrial Water Treatment Plant (IWTP) facility has not been transferred by the Army and is under BRAC control, the IWTP property is leased by TAC in furtherance of conveyance and the facility is operated by RWRD under their own permit (Lawson 2021; RRAD 2021).

2.4.3 BRAC 2005 – Transfer Complete

The 2005 BRAC Commission recommended the realignment of RRAD, including the relocation of the storage and demilitarization functions of the Munitions Center to the McAlester Army Ammunition Depot, Oklahoma and Blue Grass Army Depot, Kentucky. The BRAC Commission also recommended the relocation of the depot maintenance of tactical missiles to Letterkenny Army Depot, Pennsylvania, and the disestablishment of the supply, storage, and distribution function for tires, packaged petroleum, oil, lubricants, and compressed gases. Open burning/open demolition, missile recertification, and ammunition storage was discontinued at the RRAD after this land transfer.

Approximately 3,835 acres were determined to be surplus property in 2005. As of 2020, the Army has transferred 3,189 of the 3,865 excess acres of the BRAC 2005 property. These transfers include the RRAD Western Excess Parcel or “RRAD-WEP”) to TAC (2,851 acres), the Texas Department of Transportation (28 acres), and a private owner (311 acres).

2.4.4 BRAC 2005 – To Be Transferred

There are 646 acres which have yet to be transferred. These are maintained by the Army BRAC and will be disposed of through public or negotiated sale, anticipated sometime in 2029 (HQDA 2020).

2.5 Climate

RRAD is in a transitional zone between the subtropical humid climate prevalent further south and the continental climate of the Great Plains and Midwest. Winters are normally mild with freezing temperatures occurring on an average of 35 days per year, while summers are hot and humid with temperatures exceeding 90 degrees Fahrenheit on an average of 89 days per year. Humidity ranges from 50 percent (%) in the pre-dawn hours to 60% in the afternoon. The average precipitation at RRAD is approximately 51 inches per year. Precipitation occurs mainly during the fall and winter months with rainfall less frequent in the spring and summer. Rainfall during the spring and summer often results in intense thunderstorms that can cause flash floods. However, RRAD is geographically on a divide of two different watersheds; therefore, flooding is not a significant concern.

Snowfall is rare at RRAD, with an average of one to two inches per year. Prevailing winds are out of the south during all months except September, when they are predominantly from the east. Severe local storms, including hailstorms and tornadoes, are most frequent in the spring, with a secondary peak from late November through early January. Hurricanes usually dissipate before they reach the area, with the greatest damage caused by the associated heavy rainfall rather than winds (Woodward-Clyde Federal Services 1996; USACE, Mobile District 2008).

2.6 Geology

The Mesozoic-Cenozoic coastal geosyncline that forms the Gulf Coastal Plains physiographic province in the region of RRAD contains formations of limestone and sandstone deposited along margins of the ancient receding coastline. The geologic strata forming Bowie County were deposited during the upper Cretaceous and lower Tertiary periods. The most extensively exposed units in the vicinity are the Wilcox Formation (Paleocene-Eocene Series) and Midway Group (Paleocene Series) of the Tertiary System. The Pleistocene-age (Tertiary) deposits are terraces of the Red River, located north of RRAD. Recent alluvium is present along the floodplain of the Red River and its tributaries, and to a lesser extent, along the narrower floodplains of Caney, Big, and Rock Creeks within RRAD. Descriptions of the geological units found in the vicinity of RRAD are provided below.

The Paleocene-age (Tertiary) Midway Group is mostly clay, locally lignitic, some calcareous siltstone concretions, thin bedded to locally massive, and of various gray shades with some silt in the upper part. The Midway Formation (part of the Midway Group) has been described as a finely laminated marine clay deposited in a slowly subsiding restricted (euxinic) basin, which contains large quantities of pyrite and other iron sulfide minerals. Marine fossils occur throughout its thickness, estimated to be up to 900 feet. This formation is not considered transmissive. The Midway Group is found at RRAD below soil horizons in the northern portion of the facility. To the south and east at LSAAP, the Midway Group lies below the lower portion of the Wilcox Formation (Kemron Environmental Services 2006).

The Paleocene-Eocene Series (Tertiary) Wilcox Group consists primarily of cross-bedded fine- to medium-grained sand, clay, and lignite. The upper and lower portions of the formation have a larger percentage of sand than the middle. However, massive beds 100 feet or more in thickness made entirely of medium sand may occur. Individual sand beds are lenticular and may grade laterally into clay, lignite, or silt in short distances. The clays are generally light to dark gray, whereas the sands tend to be reddish-brown to light gray. The total thickness of the Wilcox Group ranges up to 800 feet. Locally at RRAD, the Wilcox Group was deposited in a fluvial channel/floodplain environment, but farther south it was deposited in a combination fluvial and deltaic environment.

The Eocene-age (Tertiary) Carrizo Sand, which overlies the Wilcox Formation, consists of very fine- to medium-grained quartz sand and an interbedded sequence of fine sand, silt, and clay, generally present near the top of the formation. The highly variable thickness of the Carrizo Sand ranges from 0 to more than 100 feet. The Carrizo Sand has not been reported at RRAD but does outcrop several miles south.

Quaternary alluvium, present along streams and creek beds in the Red River drainage basin, consists primarily of unconsolidated very fine- to very coarse-grained sand interbedded with dark-colored clay silt and gravel. The deposits are highly irregular in areal extent and thickness, which range from 0 to 340 feet in portions of northeast Bowie County (Kemron Environmental Services 2006).

2.7 Topography

RRAD is situated within the west Gulf Coastal Plain physiographic province. The area can be described as flat to slightly rolling with extensive flats present in the north. The installation generally slopes gently to the southeast. The overall elevation relief on post is approximately 180 feet. The topography of the installation is depicted on ***Figure 2-3***.

An estimated 75% of the installation has a slope between 1% and 6%. Occasionally slopes near streams range up to 12%, but these steep slopes are rare. Slopes greater than 12% are not present (Woodward-Clyde Federal Services 1996; Department of the Army, Office of the Project Manager for Chemical Demilitarization, and Installation Restoration 1978).

2.8 Hydrogeology

Groundwater flow is generally in the same direction as surface water flow at areas underlain by the Midway or Wilcox Groups; groundwater and surface water across most of the installation flow to the south. Due to an east-west trending drainage divide in the northern part of the installation, a small portion of groundwater and surface water flow is to the north (***Figure 2-2***). The clay shales in the northern portion of RRAD yield small quantities of groundwater and are typically hydrostratigraphic. Depth to groundwater is usually shallow, ranging from near ground surface along creek bottoms to approximately 25 to 40 feet along ridge lines. Vertical permeabilities of the soil are low and vary with location and depth. The permeability of the Midway Group has been calculated to be between 8.2 × 10-7 and 1.08 × 10-8 centimeters per second (cm/sec). The permeability of the Wilcox Group is estimated to range from 4.0 × 10-5 to 3.4 × 10-6 cm/sec. These permeabilities correlate well with the recorded geology; the Midway Group is mostly clay, and the Wilcox Group has a mix of sand, silt, and clay.

Groundwater flow through the Quaternary terrace deposits is toward areas of discharge, such as excavations or streams. Hydraulic conductivities within these coarse-grained terrace deposit soils range from 4 × 10-4 and 6 × 10-5 cm/sec, which is much higher than those found in the Midway Group and similar to those for the Wilcox Group. The principal source of recharge to the area groundwater system is from rainfall infiltration through sandy/silty portions of the outcrop. There are few such outcrops at RRAD (Kemron Environmental Services 2006).

Aquifers in the vicinity of RRAD include the Carrizo-Wilcox Aquifer (a major aquifer within the Tertiary Wilcox Group) and the Nacatoch Aquifer (a minor aquifer within the Cretaceous sands). Locally, the formations forming the aquifers generally strike east and dip to the south.

The uppermost water bearing unit underlying the northern portion of RRAD consists of the overburden unit and the weathered clay shale unit, which operate together as a single aquifer. In the northern portion of the installation, the bottom of this shallow groundwater bearing unit is approximately 30 feet below ground surface (bgs). The weathered clay shale operates as an aquiclude (it is incapable of transmitting significant quantities of water under ordinary hydraulic gradients) to the Nacatoch Aquifer. Water movement is restricted within the weathered portion of the shale to fractures and the interface along Midway and Wilcox formations. Permeability of the Midway and Wilcox formations is low, varying with location and depth (Kemron Environmental Services 2006; USACE, Mobile District 2008). Perched groundwater present in the upper weathered portion of the Midway Group is influenced primarily by topographic features such as swales and creeks.

Irrigation and municipal water supplies in the immediate vicinity of RRAD account for 51% and 35%, respectively, of total pumping from the Carrizo-Wilcox Aquifer. In the northeast part of the state, near RRAD, water levels in the Carrizo-Wilcox aquifer have been declining. Depth to groundwater at the installation from near surface to 25 to 40 feet bgs at RRAD, although depth to water in some areas can be as deep as 455 feet below ground surface. Shallow groundwater at RRAD is categorized as Class III. Class III groundwater is generally not considered suitable for consumption by humans (USACE, Mobile District 2008).

Water from the Nacatoch Aquifer is generally alkaline and soft. Groundwater levels in the Nacatoch Aquifer were declining because of over-pumping but have begun to stabilize because of increased use and reliance on surface water for water supplies (Department of the Army, Office of the Project Manager for Chemical Demilitarization, and Installation Restoration 1978; USACE, Mobile District 2008).

2.9 Surface Water Hydrology

Surface drainage primarily flows off post to the south, with a small portion of runoff flowing off post to the north. The drainage divide is formed by a slightly east-west topographic high that crosses the installation from the north and extends eastward through the industrial area (Department of the Army, Office of the Project Manager for Chemical Demilitarization, and Installation Restoration 1978). Due to the divide of the two watersheds, flooding is not a significant concern (Woodward-Clyde Federal Services 1996).

The majority of surface water drainage of RRAD is to the south by way of Big, Rock, Caney, Nettles, Elliott, and East Fork Creeks (which eventually terminates in Wright Patman Lake and the Sulphur River). Surface water discharges eventually to Wright Patman Lake (located within 5 miles downgradient of installation boundary), which is the drinking water source for RRAD and the surrounding communities (USACE, Mobile District 2008).

The remaining surface water drainage is to the north by Panther Creek and Jones Creek tributaries (which eventually terminates in the Red River). Jones Creek tributaries exist in the most northeastern portion of the installation (Woodward-Clyde Federal Services 1996).

Several ponds and lakes on LSAAP and RRAD serve as important game-watering holes and provide some recreational fishing. There is no direct use of groundwater underlying the installation, however it is not restricted (USACE, Mobile District 2008).

2.10 Relevant Utility Infrastructure

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

2.10.1 Stormwater Management System Description

A stormwater system management was developed to serve the entire main industrial area of RRAD. It consists of approximately 11,460 linear feet of pipes with various diameters (12 to 54 inches) and one 4-foot by 6-foot box culvert, plus various trenches, and ditches. The majority of the pipes are concrete, although a few are made of vitrified clay and corrugated metal. The remainder of RRAD's stormwater is managed by various creeks and intermittent streams located across the installation.

2.10.2 Sanitary and Industrial Wastewater Management Description

The active wastewater treatment plants serving RRAD include a sanitary wastewater treatment plant located on LSAAP property and the Current IWTP located on RRAD. The industrial and wastewater sewer systems were privatized as part of the 1995 BRAC realignment and have been operated by RWRD since 2002 (URS 2006). In 2003, it was estimated that RRAD discharged approximately 66.7 million gallons of industrial wastewater and 93.8 million gallons of sanitary wastewater (USACE, Mobile District 2008).

2.10.2.1 Sanitary Wastewater Management

The sanitary sewer collection serving RRAD consists of approximately 9.5 miles of 6-inch to 12-inch pipes in a combination of gravity mains and pump/lift stations. The sanitary sewer system collects wastewater and conveys it northerly to a wet well collection reservoir and pump station.

The former Hayes Sewer Treatment Plant was constructed in 1942 and used for sanitary waste management until 1974, when a more modern sewage treatment plant was built on LSAAP (Solid Waste Management Unit 498). The former Hayes Sewer Treatment Plant hosted three concrete drying beds, six concrete filter beds, and a grease lagoon. As of 2018, the site has been used as a sanitary sewer lift station. A new lift station was added in 1995 (URS 2006).

The sanitary wastewater treatment plant is located on LSAAP shared jointly between LSAAP and RRAD and discharges the effluent to Area X, also located on LSAAP and eventually discharges into Wright Patman Lake (URS 2006).

The OTC Landfill was first used as a sanitary sewage treatment plant during the 1940s to service a large troop encampment. Waste discharges were made through vitrified clay pipe. The waste treatment area was in what is currently known as the Dunbar filter bed location. The primary and secondary treatment areas for the sewer treatment areas were located to the south and east of these filter beds. Wastes passed through a chlorinator. The use of the sewage treatment plant concluded in the 1950s (USACE, Fort Worth 1992).

2.10.2.2 Industrial Wastewater Management

The former Hayes Batch Treatment plant was an IWTP originally constructed in 1961. It was built to be a temporary facility used to treat wastewater generated from electroplating shops until the establishment of the Current IWTP. Dunbar filter beds at this IWTP that received the electroplating waste were removed between 1988 and 1990 according to the 1996 Resource

Conservation and Recovery Act (RCRA) Facility Investigation (RRAD 1996). This facility, during operation, would discharge into Panther Creek (RRAD 1996; RRAD 2003). For what is described in the 1996 RCRA Facility Investigation as “short time”, electroplating wastes were pumped via underground vitrified clay pipe to a wet well for storage (RRAD 1996). This pipeline was in poor condition and demolished at an unknown time. Industrial waste was then hauled from the wet well by pump trucks to the Batch Plant until the Current IWTP was opened. All generated sludges were containerized and buried at the OTC Landfill, and the filtered supernatant was discharged to Panther Creek. The plant ceased operations in 1978 (USACE, Fort Worth 1992).

In 1968, the Current IWTP was constructed. It began receiving waste from the electroplating shops, as well as from other operations in the Western Industrial Area (USACE, Fort Worth 1992) in 1978. Metal plating and other industrial waste continue to be sent presently to the Current IWTP for treatment. The Current IWTP discharges into Panther Creek.

Although the land comprising the Current IWTP remains owned by the Army and is under BRAC control as it continues environmental remediation operations as part of the Western Industrial Area, the IWTP building, and infrastructure was transferred to TAC in furtherance of conveyance and the facility is operated by RWRD under their own permit (Lawson 2021; RRAD 2021).

Other wastewater treatment facilities serving RRAD include a septic tank, a 1.2-acre treatment lagoon at Area K, and a 0.58-acre total retention lagoon serving the recreational area at Elliot Creek Reservoir (USACE, Mobile District 2008).

The OTC Landfill was previously used as a sewer plant for industrial batch treatment processes. This treatment included transporting hexavalent chromium and cadmium-bearing wastewaters by tank truck from a metal plating facility to a sewer settling tank here. Treated wastewater was discharged into a tributary of Big Creek. The use of the sewage treatment plant as an IWTP concluded in the early 1970s (USACE, Fort Worth 1992).

2.11 Potable Water Supply and Drinking Water Receptors

Currently, there are no potable water wells located at RRAD. Surface water has been the main source of potable water since the early 1940s. RRAD purchases their drinking water from a public utility (RWRD; Tetrahedron, Inc. 2017).

Since its construction in the early 1940s, Caney Creek Reservoir served as the primary source of potable water for RRAD. Caney Creek Reservoir is a 202-acre impounded water body, which has a total capacity of 1,340 acre-feet or approximately 440 million gallons. Elliot Creek Reservoir was also constructed in the early 1940s and used primarily for recreational purposes, but also served as a back-up raw water supply for Caney Creek Reservoir. Elliot Creek Reservoir is a 183-acre dammed lake on RRAD, which has a total capacity of 1,930 acre-feet or approximately 630 million gallons (USACE, Mobile District 2008).

RRAD transitioned from using the two reservoirs for water supply to purchasing potable water from RWRD in the early 1990s. As of 2016, RWRD receives drinking water from Wright

Patman Lake and Milwood Lake (Gschwind 2019). Wright Patman Lake is within 5 miles downgradient of the southern installation boundary. The majority of surface water drainage of RRAD is to the south by way of Big, Rock, Caney, Nettles, Elliott, and East Fork Creeks (which eventually terminate in Wright Patman Lake and the Sulphur River). The remaining surface water drainage is to the north by Panther Creek and Jones Creek tributaries (which eventually terminate in the Red River). The creeks within the installation, Red River, and Sulphur River are not used as drinking water sources (RRAD 2003).

Groundwater is not currently used, and historically has never been used, as a drinking water source for the installation. Shallow groundwater at RRAD is classified as Class III. Class III groundwater is generally not considered suitable for human consumption (USACE, Mobile District 2008). Permeability of the Midway and Wilcox formations is low, varying with location and depth. They function as an aquiclude to the Nacatoch Aquifer (Kemron Environmental Services 2006). There are several off-post water supply wells present east, southeast, and northeast of the installation, within the direction of surface water and groundwater flow paths leaving RRAD.

Water from the Carrizo-Wilcox Aquifer is extracted for irrigation and municipal water supplies in the immediate vicinity of RRAD off post. Irrigation and municipal water supplies account for 51% and 35%, respectively, of total pumping from the Carrizo-Wilcox Aquifer (Kemron Environmental Services 2006). These wells include private utility, mobile home park, and municipal water supply wells (ranging from 0 to approximately 5 miles from the eastern, southern, and northern boundary of RRAD).

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 the RRAD, which along with state and county GIS provided by the installation identified several off-post public and private wells within two miles of the installation boundary (***Figure 2-4***). The EDR report providing well search results provided as ***Appendix D***.

2.12 Ecological Receptors

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

Mammals found to be common to abundant at RRAD include white-tailed deer, gray squirrel, fox squirrel, raccoon, bobcat, skunk, and armadillo. More than 400 species of birds potentially use natural habitat at RRAD. This includes, but is not limited to, migratory waterfowl, mourning dove, wild turkey, bobwhite quail, American kestrel, red-tailed hawk, red-shouldered hawk, eastern bluebird, and green heron. Caney and Elliott Creek Reservoirs located within RRAD provide habitat for a variety of fish species. This includes spotted gar, largemouth bass, black crappie, red-eared sunfish, blue gill, and spotted sucker. Common reptiles located at the installation include cottonmouth snake, copperhead snake, timber or canebrake rattlesnake, diamondback rattlesnake, kingsnake, northern fence lizard, green anole, box turtle, common snapping turtle, and red-eared slider. Common amphibians include central newt, smallmouth salamander, marbled salamander, spadefoot, narrow-mouth toad, green treefrog, south leopard frog, and bullfrog (USACE, Mobile District 2008).

The alligator snapping turtle, a state-listed threatened species, has been observed at RRAD. It occupies perennial water bodies; deep water of rivers, canals, lakes, and oxbows; and swamps, bayous, and ponds near deep running water. At RRAD it can be found at the Elliot Creek Reservoir. Additionally, the American alligator has also been observed at RRAD in the past. It is listed as threatened by similarity of appearance with the endangered American crocodile (USACE, Mobile District 2008).

The only other federally listed species that may be occupy the area are the threatened bald eagle, endangered interior least tern, red-cockaded woodpecker, and threatened Louisiana black bear. Other state-listed bird species that may migrate through the area include the endangered American peregrine falcon and the threated article peregrine falcon (ELM Consulting, LLC 2008).

2.13 Previous PFAS Investigations

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

In response to Installation Management Command Operations Order 16-088, contract number W912BV-15-D-0017 was issued to evaluate the usage of AFFF containing PFAS including PFOS and PFOA at thirteen AMC installations throughout the contiguous U.S., including the active portion RRAD (not BRAC). Four groundwater samples were collected from groundwater within the Current IWTP, which received wastewater from conducting its missions of maintaining and rebuilding military vehicles, demilitarization of out-of-specification ordnance, maintenance, modification, and recertification of missiles, tank track and road wheel rebuild, and rubber products management. Groundwater analytical results indicated PFOS and/or PFOA were detected at the following locations: RRAD-GW-CEL(M)3A, RRAD-GW-WWT-41A, and RRAD-GW-W1A-13A (Tetrahedron, Inc. 2017; Table 2-1). Three samples exceeded 2022 OSD risk screening levels for PFOA, and two samples exceeded OSD risk screening levels for PFOS. The four monitoring wells are located on land that is remains owned by the Army and under BRAC control, pending transfer.

In response to the USEPA's third Unregulated Contaminant Monitoring Rule, PFOA and PFOS were sampled at water systems (serving less than or equal to 10,000 people) surrounding installations. No water systems in zip codes bordering RRAD were sampled as part of the third Unregulated Contaminant Monitoring Rule. One water system located approximately 5 miles east of the installation was tested but had no detections of PFOA or PFOS (USEPA 2016).

Water from the RWRD public utility which supplies RRAD with drinking water was tested for PFOS and PFOA in 2016; concentrations were reportedly not detected (below 40 and 20 ng/L, respectively; Tetrahedron, Inc. 2017).

2.14 Exposure/Migration Pathways and Targets

The evaluation of potential exposure and migration pathways and the resulting targets (i.e., receptors) for PFAS in soil, surface water, groundwater, and/or air for the potential AOPIs at the site is presented below.

2.14.1 Soil Exposure Pathways and Targets

Releases of PFAS containing material to soil are known to have occurred at one or more AOPIs at the site. The primary source of known PFAS impacts for the site is AFFF and it is reported to have been released to the ground surface at Fire Station 1 and the Fire Station 1 Flushing Area. PFAS was released to the ground in the Current Industrial Wastewater Treatment Plant and is likely to have been released to the ground surface at other locations part of the chrome plating and Fire Truck Service Extension waste processing stream (e.g., OTC Landfill, Former Hayes Batch Treatment Plant). The PFAS impacts to soil may remain present near the AOPIs (described further in Section 5.1) and may present exposure pathways for direct contact.

Potentially affected targets at RRAD for direct contact to potentially impacted soil includes commercial and construction workers. The potential for workers to be in direct contact with potentially impacted soils is generally low as the potential release areas are in locations not commonly accessed (e.g., railroad siding, roadsides, and landfills). Access to the site as a whole is generally restricted by fencing and security, and many of the potential AOPIs have additional access controls through gates and security and the potential for residential and recreational target exposure is relatively low.

2.14.2 Surface Water Migration Pathways and Targets

A well-developed intermittent surface water drainage system is present at the site. Surface drainage primarily flows off post to the south, with a small portion of runoff flowing off post to the north. The drainage divide is formed by a slightly east-west topographic high that crosses the installation from the north and extends eastward through the industrial area. The majority of surface water drainage of RRAD is to the south by way of Big, Rock, Caney, Nettles, Elliott, and East Fork Creeks (which eventually terminates in Wright Patman Lake and the Sulphur River). Surface water discharges eventually to Wright Patman Lake (located within five miles downgradient of installation boundary), which is the drinking water source for RRAD and the surrounding communities (USACE, Mobile District 2008).

The remaining surface water drainage is to the north by Panther Creek and Jones Creek tributaries (which eventually terminates in the Red River). Jones Creek tributaries exist in the most northeastern portion of the installation.

Surface water at the site has potential to be an exposure and migration pathway as precipitation drains over and through potential surface soil impacts and enters the intermittent drainages. Additionally, groundwater potentially impacted by PFAS may enter the surface water drainages. Potential surface water exposures are possible on-site and off-site as surface water originating on the site exits RRAD and ultimately enters the Red River to the north or Wright Patman Lake to the south of the site.

Targets for potential surface water impacts on-site include site workers who may rarely access intermittent surface water bodies for maintenance activities. Off-site targets include workers, residents, and recreational users that may enter the intermittent surface water drainages or surface water bodies (e.g., Red River or Wright Patman Lake) as off-site access is uncontrolled. Additionally, Wright Patman Lake also serves as a drinking water source for the Texarkana Water Utilities.

2.14.3 Groundwater Migration Pathways and Targets

Groundwater is present at the site and is potentially impacted by releases of PFAS containing materials from soil at the AOPIs. As described in ***Section 2.6***, shallow soils at the site generally exhibit low permeability with precipitation being more likely to enter the local surface water system than entering the underlying aquifers. Shallow groundwater flow at the site is reported to flow north and south based on the topographic divide, which also controls surface water flow directions. Deeper groundwater in the underlying Wilcox and Midway Groups are part of a larger aquifer system with minimally expected recharge from the site. Alluvium is present within the larger surface water conveyances that are downgradient of the site and may provide potable water supplies for residential use.

On-site exposure to groundwater is not anticipated to be an exposure pathway as water wells for purposes other than groundwater monitoring are not present at the RRAD. Drinking water is provided to RRAD by an offsite water utility.

Off-site exposure to groundwater is a potential pathway for commercial and residential targets based on the presence of domestic, public supply, and irrigation wells as shown on ***Figure 2-4***. Water supply wells installed within the Wilcox and Midway Groups are potentially but unlikely to be impacted by surficial releases from the site as shallow precipitation and shallow groundwater in soil most likely is migrating into the surface water system. Potential exists for shallow wells screened within the alluvial aquifer of creeks and rivers downgradient of the site to access PFAS impacted surface water entering the alluvial aquifer and being withdrawn as groundwater. The potentially affected targets would include residents and/or commercial workers utilizing the groundwater for a drinking water supply (i.e., ingestion).

2.14.4 Air Migration Pathways and Targets

PFAS impacts in soil or surface water present from pre-BRAC event releases are unlikely to volatize and/or migrate through air under normal atmospheric pressure, pH, and temperatures. A potential may exist for surficial soil with PFAS impacts to dry and become airborne as dust at the release point (e.g., a fire training area exposed to AFFF). Such potential exposure pathways would be limited to the site and the potential targets would include commercial workers and construction workers that may be working near the source area.

Figure 2-1: Site Location

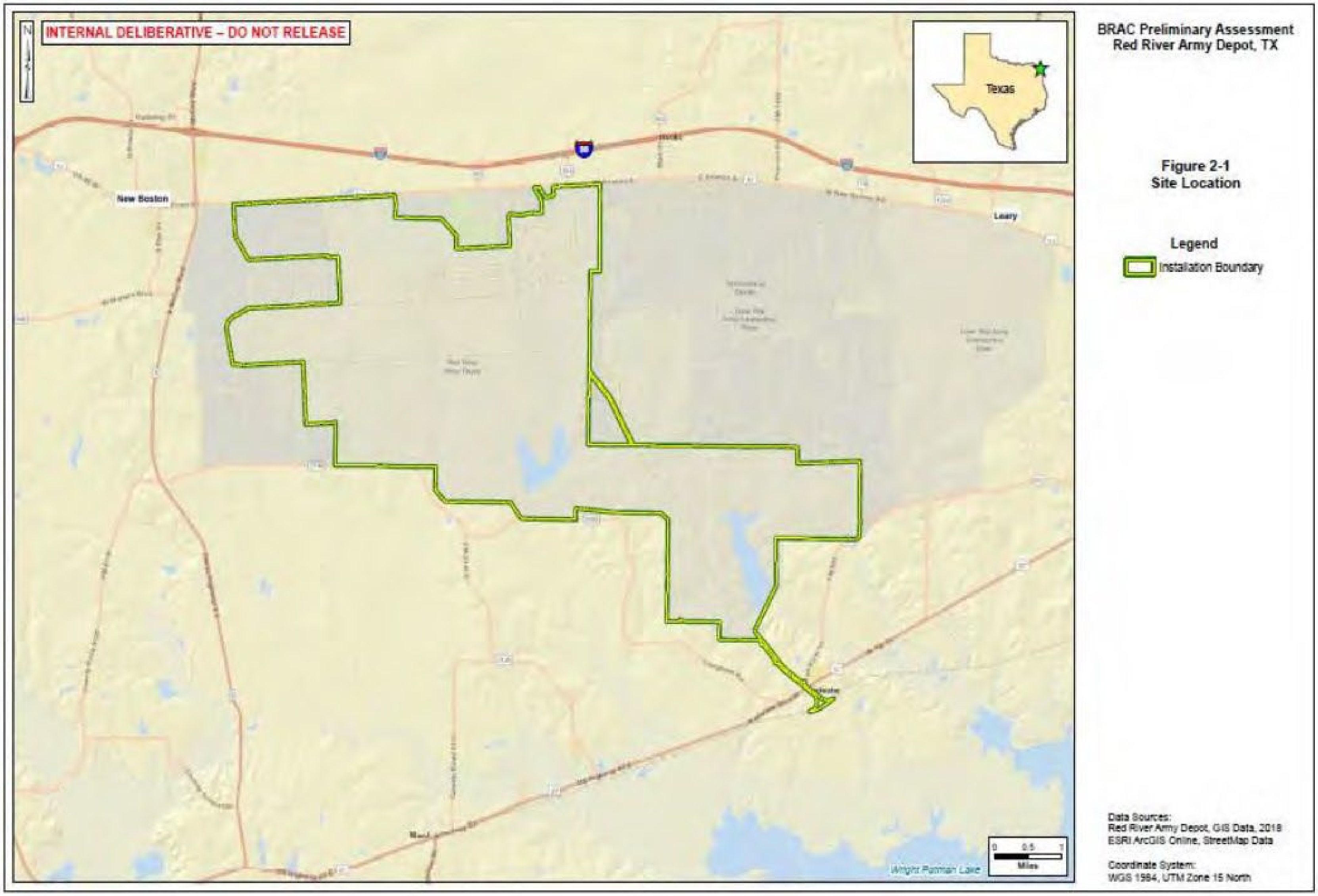


Figure 2-2: Site Layout

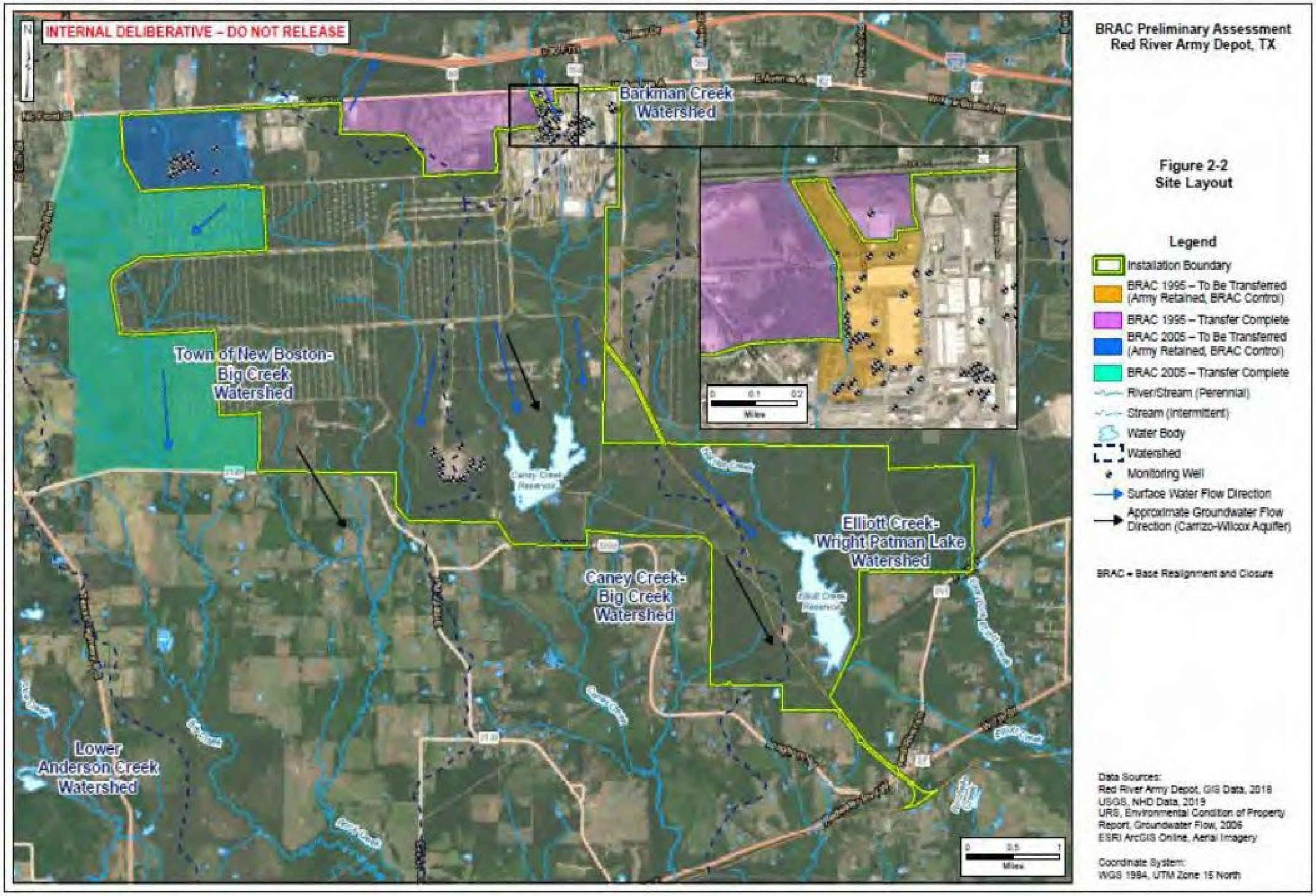


Figure 2-3: Site Topographic Map

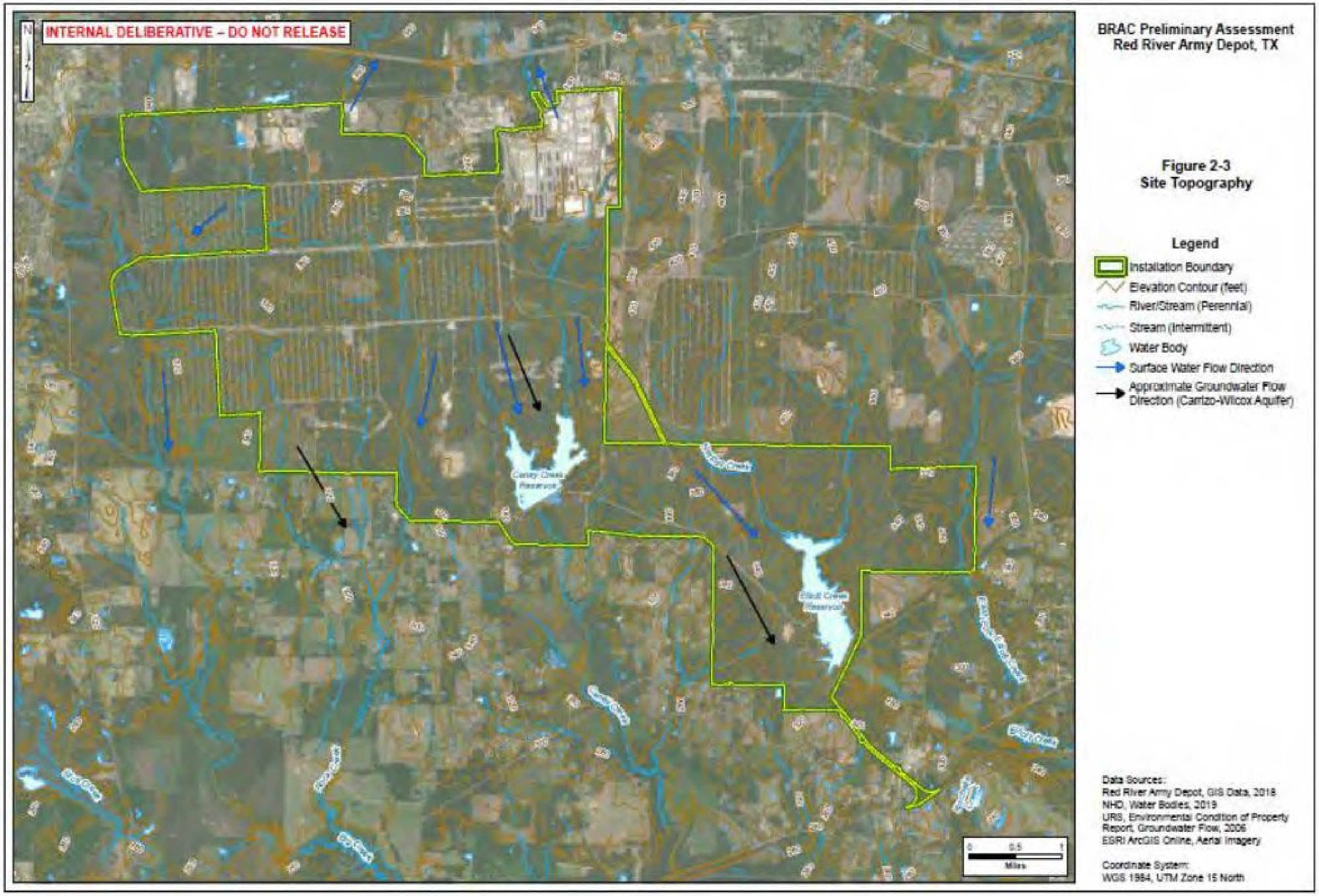
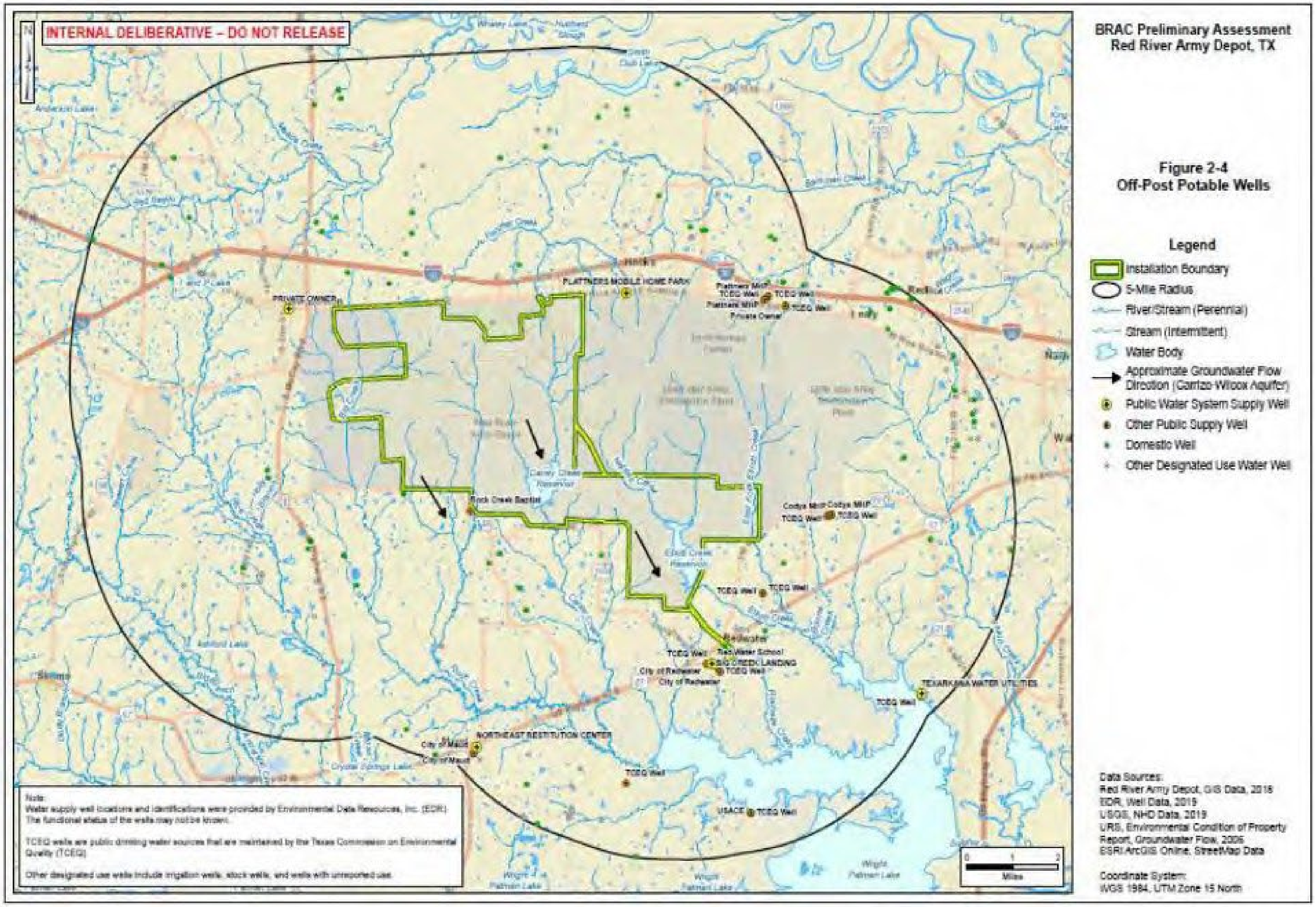


Figure 2-4: Off-Post Potable Wells



3.0 SUMMARY OF PA ACTIVITIES

To document areas where any potential current and/or historical PFAS-containing materials were used, stored and/or disposed at RRAD, data were collected from three principal sources of information:

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

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

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, RRAD fire department documents and GIS files. Internet searches were also conducted to identify publicly available and other relevant information. A list of the specific documents reviewed for RRAD is provided in ***Appendix E***.

3.2 Personnel Interviews

Interviews were conducted during the PA site visit. The list of roles for the installation personnel interviewed during the PA process for RRAD is presented below (affiliation is with RRAD unless otherwise noted).

- RWRD Contractor
- Fire Chief
- Assistant Chief of Operations
- Chief of Prevention
- Chief of Environmental Division
- Natural Resources Manager and Installation Test Management Coordinator

Additionally, interviews with a RRAD fire inspector from July 2018 as part of a PA for the active Army portion of RRAD were also referenced for this BRAC PA. The compiled interview logs provided in ***Appendix F***.

3.3 Site Reconnaissance

Site reconnaissance and visual surveys were conducted at the preliminary locations identified at RRAD during the records review process, the installation in-briefing, and/or during the installation personnel interviews. A photo log from the site reconnaissance is provided in ***Appendix G***; photos were used to assist in verification of qualitative data collected in the field. The compiled site reconnaissance logs are provided in ***Appendix H***.

Access to existing groundwater monitoring wells, if present, were also noted during the site reconnaissance in case the monitoring wells could be proposed for future sampling. Much of the installation's infrastructure was left in disrepair before the recommendation for transfer and was later demolished.

Preliminary locations of potential use, storage, and/or disposal of PFAS-containing materials were then evaluated in the PA (during records review, personnel interviews, and/or site reconnaissance) 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 E***), installation personnel interviews (***Appendix F)***, and site reconnaissance logs (***Appendix G***) during the PA process for RRAD is presented in **Section 4**. Further discussion regarding rationale for not retaining areas for further investigation is presented in **Section 5.2**.

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

RRAD was evaluated for all potential current and historical use, storage, and/or disposal of PFAS-containing materials. There are a variety of PFAS-containing materials used in relation to current and historical Army operations. However, the use, storage, and/or disposal of AFFF is the most prevalent potential source of PFAS chemicals at DoD facilities. As such, this section is organized to summarize the 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 percent (%) hydrocarbon surfactants, and 1 to 3% PFAS (Interstate Technology Regulatory Council 2020). AFFF concentrate is designed to be diluted with water to become a 1, 3, or 6% foam. AFFF releases at 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.

As described in **Section 3.2**, interviewees with recollection of historical site activities like fire responses, AFFF use, and general firefighter activities prior to the 1995 and 2005 BRAC determinations of excess were not accessible during this 2022 PA. However, an interview conducted as part of a 2018 PA for the active Army portion of RRAD is included with this report as the interviewee provided details regarding AFFF storage and use at the BRAC portion of the site. Historical records detailing the use of AFFF as part of pre-BRAC fire responses are not typically retained and were not available for review. RRAD personnel recalled electronic firefighter response records only describing fire responses after 2003; none of which related to surplus BRAC properties. However, interviews do indicate that AFFF was utilized at RRAD by firefighting personnel and the timeline of firefighting activities, the types of firefighting activities, and commonly known firefighting behaviors provide contextual insight on the types of foam being utilized.

Firefighting fleet vehicles were washed and maintained at Fire Station 1. Any residual AFFF remaining on the fleet would be washed off and collected in the sump system underneath the building. AFFF was reportedly stored here, although in less overall quantity than what was stored in fire stations on Army retained property.

For emergency preparedness, fire department personnel may be trained to performed nozzle testing with AFFF to ensure optimal flow and use of the AFFF mixture. Nozzle testing involved spraying AFFF through fire equipment. Fire equipment training also can include arc training to maximize the arc, reach, and distance covered by AFFF in an emergency response. Nozzle testing would be conducted at Fire Station 1 Flushing Area at an interval ranging somewhere between weekly and monthly. Whenever AFFF would be taken off fire trucks, the trucks would be flushed wherever it had been used. Flushing would be also conducted if valves were stuck or if the AFFF concentrate container being used was empty.

Firefighter training did not occur on areas that were determined to be on the BRAC property.

Firefighter response records were available going back to 2003. Firefighter response records covered only area retained by the Army. However, records did indicate that AFFF would be utilized in response to hydrocarbon spills, as a vapor suppression technique. Firefighters responded to hydrocarbon spills utilizing AFFF on property retained by the Army.

The Fire Truck Service Extension was utilized for the refurbishing of trucks, including firefighting vehicles. Firefighting vehicles with capacity to carry AFFF would have housed, at minimum, residual quantities. When washed and refurbished, this residual AFFF would have flowed towards the Current IWTP.

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

Following document research, personnel interviews, and site reconnaissance at RRAD, two functional test ranges, one landfill (formerly a wastewater treatment plant), two additional wastewater treatment plants, one photograph processing building, one pesticide storage facility, and one pesticide disposal pit, were identified and reviewed as potential PFAS use, storage, and/or disposal areas. A summary of information gathered in the PA for each of these preliminary locations is described below. Specific discussion regarding areas retained as AOPIs is presented in **Section 5.1** and specific discussion regarding areas not retained for further investigation is presented in **Section 5.2**. PFAS-containing materials may be involved in the production and processing of munitions. However, the availability of documentation regarding the use of PFAS containing materials as part of the munitions manufacturing process at RRAD prior to the BRAC event is limited as described below.

Pesticides

Sulfluramid, flursulamid, novaluron, nifluiridide, and lithium PFOS are PFAS ingredients known to be used in some pesticides. PFOS-containing insecticides (i.e., Sulfluramid in an ant bait) were identified in a 2006 Environmental Condition of Property Report for the site, which had been listed as “perfluro octanes” with a USEPA registration number of 499-459. This USEPA registration number is associated with the Whitemire Micro-Gen Ant Reactor and contains Sulfluramid (USEPA 1999). Sulfluramid was not identified on any pesticide list prior to 2004 and was generally not utilized in insecticides prior to 1991. The ant bait traps containing Sulfluramid were delivered in sealed packaging and were unsealed and placed at the use location on an as needed and sporadic basis (i.e., no widespread or repeated uses).

The Former Pesticide Building and related Pesticide Disposal Pit were reviewed as potential sources of PFAS. The Former Pesticide Building was demolished in 1993, and the Pesticide Disposal Pit was used from 1967 to 1972, prior to the use of Sulfluramid in insecticides.

Further discussion regarding areas not retained for further investigation is presented in **Section 5.2**.

Enamel

Enamels containing PTFE have been used in military operations (Armed Services Technical Information Agency 1961). Further, they are used in metal coatings to promote flow of coatings, prevent cracks in the coating during drying, and can serve as a corrosion inhibitor on steel. Surface coating and painting has occurred within the Western Industrial Area. On May 05, 1970, patent US3511682A of the US Department of Navy was published. US3511682A patents a process of applying Teflon® films. This patent details a green, PTFE-containing enamel produced by DuPont, known as the One Coat Enamel (US Department of Navy 1970). This enamel was not identified in any chemical lists reviewed during the PA process.

Metal Plating Waste Disposal

Potential PFAS use associated with metal plating activities may also be relevant to Army installations. During metal plating operations, a metal surface may be treated with a layer of electrochemically deposited metals in an acid bath. PFAS, specifically PFOS, have been used in metal plating operations as surface tension-reducing wetting agents to mitigate the release of aerosolized chemicals into a working environment. Historically, it was common for spent plating baths from metal plating operations to be disposed of in a lined or unlined pit or into a sanitary or storm sewer. Therefore, PFAS present in mist suppressants during the metal plating process could be released to the environment. Metal plating has been conducted on property retained by the Army, but waste streams from these operations are taken to BRAC property.

The Ordnance Training Center (OTC) Landfill was first used as a sewage treatment plant during the 1940s to service a large troop encampment. Waste discharges were made through vitrified clay pipe. The waste treatment area was in what is currently known as the Dunbar filter bed location. The primary and secondary treatment areas for the sewer treatment areas were located to the south and east of these filter beds. Wastes passed through a chlorinator. The use of the sewage treatment plant concluded in the 1950s (USACE, Fort Worth 1992). The OTC Landfill was used again as a sewer plant for industrial batch treatment processes. This treatment included transporting hexavalent chromium and cadmium-bearing wastewaters by tank truck from a metal plating facility to a sewer settling tank here. Treated wastewater was discharged into a tributary of Big Creek. The use of the sewage treatment plant as an IWTP concluded in the early 1970s (USACE, Fort Worth 1992). The area was then used as a drum storage area, and shortly thereafter, a landfill. Hazardous and non-hazardous wastes were disposed within the OTC Landfill.

Wastewater generated by metal plating facilities also went to the Hayes Batch Treatment Plant from 1961 to 1978, during its time of operation. Spent chemicals used in vats for metal plating operations were profiled (usually as hazardous waste) and were disposed offsite. However, any rinse-water and overflow from the vats was discharged into the industrial wastewater system.

Sludge from the Hayes Batch Treatment Plant was disposed of at the OTC Landfill (RRAD 1996).

Wastewater from metal plating operations was routed to the Current IWTP after it began accepting metal plating waste in 1978. Effluent generated from the Current IWTP discharges into Panther Creek. Between 1978 and 1982, sludge from the Current IWTP was containerized and buried at the OTC Landfill. A RCRA cap was installed over the site in 1985. Spills were reported to occur in the unloading process as well as releases from deteriorated containers. The OTC Landfill was determined excess as part of BRAC 2005 but has not yet been transferred. The property is managed by BRAC.

As described in **Section 2.13**, samples were collected from groundwater wells within the Current IWTP and exceeded OSD risk screening levels for PFOS and/or PFOA at three of the four sampled monitoring wells. Although the land comprising the Current IWTP has been retained by the Army and is under BRAC control as it continues environmental cleanup operations as part of the Western Industrial Area, the IWTP building and infrastructure was transferred to TAC in furtherance of conveyance and the facility is operated by RWRD under their own permit (Lawson 2021; RRAD 2021).

Film Processing

Fluorinated surfactants have been used as antifoaming agents in silver halide photographic processing solutions in order to eliminate air bubbles that can cause failure in image transfer (Gluege et al. 2020). The Communication Center housed a photography laboratory, where photo processing waste was inadvertently disposed of on the ground rather than to an aboveground storage tank. The amount of waste released and the length of time that waste was released for was unknown. Analytical samples from the area did not indicate hazardous soil conditions for non-PFAS constituents (Woodward Clyde 1998), , and therefore there is reason to believe that there was no release.

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 RRAD) is not part of the PA. However, potential off-post PFAS sources within a five-mile radius of the installation that were identified during the records search and PA site visit are described below.

As identified during the record search, the following sites are listed as nearby Superfund, Archived Superfund, or Brownfield sites (in addition to a site within the installation itself):

- RRAD BRAC-associated property
- LSAAP, adjacent to and east
- Tedder Aviation Corp, four miles west
- Texarkana Mill, over five miles southeast
- Hooks Truck Stop, one mile northeast

The full EDR report is included as ***Appendix D***.

These sites are or were under environmental investigations for contaminants other than PFAS (the presence or absence of PFAS as a contaminant at these sites is not known). With the exception of the BRAC-related RRAD properties, documentation of PFAS use at these locations was not obtained.

Nearby community fire departments such as Redwater Volunteer Fire Department, New Boston Volunteer Fire Department, Hooks Fire Department, Red Lick/Leary Volunteer Fire Department, and Lone Star Fire Station could potentially be off-post PFAS sources near RRAD if the departments have used AFFF within 5 miles of the installation.

Nearby airfields include the Ashford Field and Cranfill Airfield, which are within 5 miles of RRAD and could potentially be off-post PFAS sources if the airfields have used AFFF.

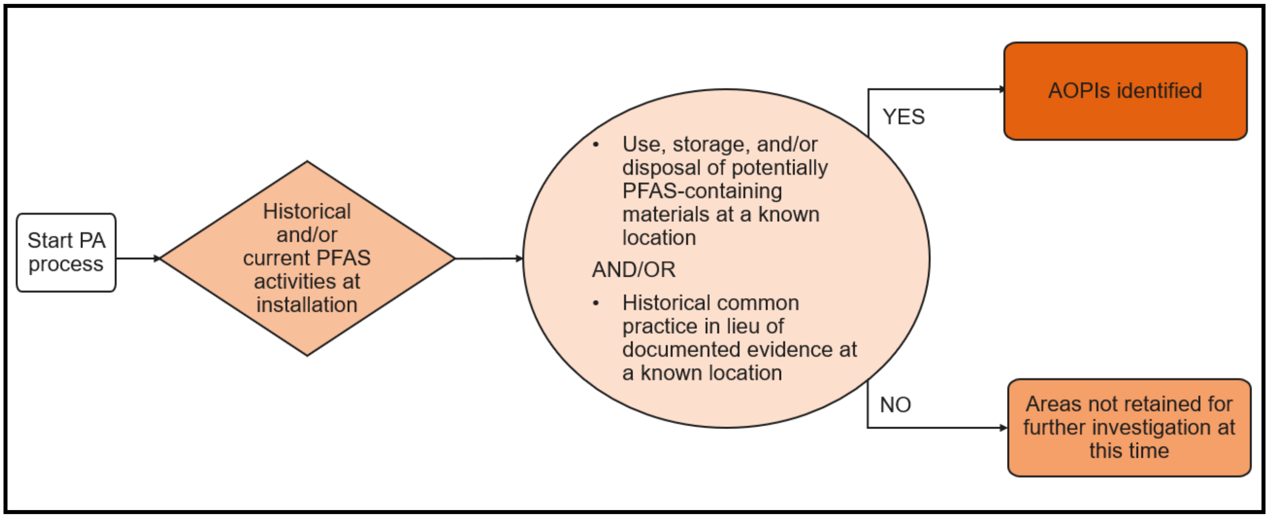
PFAS is known to be used in specific industries. The USEPA has identified sectors under the North American Industry Classification System (NAICS) and Standard Industrial Classification (SIC) system which are associated with PFAS in their operations. Facilities within 5 miles of RRAD that are categorized under these industrial classification sectors have been identified below. These facilities may be primary or secondary sources of PFAS based on their historical operations.

The Martin Nash Facility is an active facility which manufactures chemicals (SIC code 2869: Industrial Organic Chemicals). It is located one and a half miles west of the former RRAD boundary. The New Boston LLC Red River Biodiesel Plant is an active plant used for the manufacture of chemicals (SIC code 2869: Industrial Organic Chemicals and NAICS code 325199: All other Basic Organic Chemical Manufacturing). It is located less than one mile west of the former RRAD boundary.

5.0 SUMMARY AND DISCUSSION OF PA RESULTS

The preliminary locations evaluated for potential use, storage, and/or disposal of PFAS-containing materials at RRAD, 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, 6 areas have been identified as AOPIs on ***Figure 5-1***, below.

Figure 5-1: AOPI Decision Flowchart



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

Data limitations for this PA at RRAD are presented in **Section 6**.

5.1 AOPIs

Overviews for each of the six AOPIs identified during the PA process are presented in this section. The AOPI locations are shown on ***Figure 5-2***. Aerial photographs of each AOPI that also show the approximate extent of AFFF use (if applicable) are presented on ***Figures 5-3*** through ***Figures 5-7***.

5.1.1 Fire Station 1

The Fire Station 1 is identified as an AOPI following records research, personnel interviews, and site reconnaissance. This location is an active building owned by TAC that is being leased back to the Army. The Fire Station 1 serves to store, wash, and maintain firefighting fleet vehicles. Additionally, small volumes of AFFF were reportedly stored at Fire Station 1 with more AFFF stored at other locations (e.g., Fire Station 2) located the active Army property. The RRAD Fire Department formerly used AFFF for their operations, so the firefighting fleet vehicles had the potential to hold AFFF. Therefore, during washing and maintenance practices, there was the potential for AFFF residual to leak or wash off the fleet vehicles and enter the stormwater or sanitary sewers. During interviews, the firefighters stated that routine nozzle testing was not a practice for them. Although, the firefighters would flush out their systems when AFFF buckets became empty or if a valve was stuck. The RRAD Fire Department no longer uses AFFF; however, continued pressure testing of hoses and tank cleanouts does occur.

An aerial photograph of the Fire Station 1 is provided on ***Figure 5-3***. Fire Station 1 is located in the administrative area. Runoff flows west and east towards the stormwater drains running along the streets and continues to flow south.

This area was transferred to TAC with no restrictions apply.

5.1.2 Fire Station 1 Flushing Area

The Fire Station 1 Flushing Area is identified as an AOPI following records research and site reconnaissance. The Fire Station 1 Flushing Area is located east of Fire Station 1 and is owned by TAC. The Flushing Area was used by firefighting fleet vehicles to conduct routine (weekly and/or monthly) hose flushing. Because firefighting fleet vehicles use to carry AFFF, there was the potential for AFFF residual to enter the stormwater system. The volume of AFFF released is unknown.

An aerial photograph of the Fire Station 1 Flushing Area is provided on ***Figure 5-3***. The area is located west of Fire Station 1, adjacent to a track field. The area reportedly used for the flushing activities is located on the southern side of the track field. The Flushing Area had two fire hydrants and two stormwater entry ways located on the southern end. Any flushing would enter directly into the stormwater drain.

This area was transferred to TAC with no restrictions apply.

5.1.3 Fire Truck Service Extension

The Fire Truck Service Extension is identified as an AOPI following records research, personnel interviews, and site reconnaissance. The Fire Truck Service Extension was located in Building 333. The building is owned by TAC and is being leased back to the Army for maintenance operations.

The Fire Truck Service Extension operations serviced and reconditioned fire trucks brought from other installations as part of the Shelf-Life Maintenance Program. Fire trucks sent to the building to be serviced had the potential to arrive with residual foam on board. Operations were later moved to Building 412, but the year of operational change is unknown. The Fire Truck Service Extension featured two hull paint booths, parts booths, and a vapor degreaser. Activities included the disassembly of light tracked vehicles for rebuild, cleaning of hulls and component parts, and the machine and welding of component parts. Cleaning was conducted in acid, caustic, or freon baths.

An aerial photograph of the Fire Truck Service Extension is provided on ***Figure 5-4***. The Fire Truck Service Extension was located on the northeastern part of RRAD in a highly industrialized area. Drainage flowed away from the building towards the stormwater drains. Stormwater drains surrounded the building.

This area was transferred to TAC with no restrictions apply.

5.1.4 Ordnance Training Center (OTC) Landfill

The OTC Landfill is identified as an AOPI following records research, personnel interviews, and site reconnaissance indicating the disposal of metal plating wastes. The OTC Landfill is located on the northwest portion of RRAD and is shown on ***Figure 5-5***. The OTC Landfill is as part of a BRAC event but has not been transferred and remains under Army control. The OTC Landfill served many functions from 1942 to 1982. It was a sewage treatment plant, an industrial waste batch treatment plant, a drum storage area, and a landfill.

From the 1960s until the early 1970s, it served as a batch sewage treatment plant until the Phase II construction of the Current IWTP was completed. Hexavalent chromium and cadmium-bearing wastewaters were transported by truck from metal plating facility to a sewer settling tank at the industrial waste batch treatment plant. Treated wastewater was discharged into a tributary of Big Creek.

Chromate waste sludge from the Former Hayes Batch Treatment Plant and Current IWTP was containerized and buried at the OTC Landfill until 1982. The waste included solvents, pentachlorophenol, and heavy metals and it was distributed through four burial sites. Spills were reported to occur in the unloading process as well as releases from deteriorated containers. A RCRA cap was installed over the site in 1985.

Drainage in the area is affected by groundwater infiltration and surface runoff. Surface runoff is through small tributaries that eventually flow south into Big Creek, which is located outside of the northwest boundary of the OTC Landfill.

5.1.5 Former Hayes Batch Treatment Plant

The Former Hayes Batch Treatment Plant is identified as an AOPI following records review due to the disposal of metal plating wastes having been disposed of here. The former Hayes Batch Treatment plant was an IWTP originally constructed in 1961. It included two Dunbar filter beds, a concrete wet well, a baffled settling basin, above ground steel mixing tanks, and miscellaneous underground piping systems. Located north of the Western Industrial Area (***Figure 5-6***), wastewater generated from metal plating was disposed of here from 1961 to 1978. Sludge from this plant would be disposed of in the OTC Landfill. It was as a temporary facility used to treat wastewater generated from metal plating shops until the establishment of the Current IWTP. Dunbar filter beds at this IWTP that received the metal plating waste were removed between 1988 and 1990. This facility, during operation, would discharge into Panther Creek. For what is described in the 1996 RFI as “short time”, electroplating wastes were pumped via an underground vitrified clay pipe to a wet well for storage. The supernatant from the wet well was pumped into the baffled settling basin and the fed to the Dunbar filter beds. The clay pipe was reportedly in poor condition and demolished at an unknown time. Industrial waste was then hauled by pump trucks to the Batch Plant until the Current IWTP was opened. All generated sludges were containerized and buried at the OTC landfill, and the filtered supernatant was discharged to Panther Creek. The plant ceased operations in 1978.

An aerial photograph of the Former Hayes Batch Treatment Plant is provided on ***Figure 5-6***. It is located on a flat, paved area. Currently, only the Former Deactivation Furnace foundation remains. It is surrounded by vegetated area. This area was transferred to Riverbend Water Resources District with no known restrictions apply.

5.1.6 Current Industrial Wastewater Treatment Plant

In 1968, the Current IWTP was constructed, and its location is shown on ***Figure 5-7***. It began receiving waste from the electroplating shops, as well as from other operations in the Western Industrial Area (USACE, Fort Worth 1992) in 1978. Metal plating and other industrial waste continue to be sent to the Current IWTP for treatment. The Current IWTP discharges into Panther Creek.

Three former Chromate Sludge Drying Beds, located 100 feet southwest of the Current IWTP, were in use between 1978 and 2005. Located within the Western Industrial Area, these easternmost sludge drying beds (10 drying beds total) were put into service in 1978 to handle chromate industrial wastes associated with the addition of the Current IWTP. In 1986, these chromate beds were converted to a waste pile to house industrial chromate and phosphate sludge. A double-lined leachate collection system is reportedly installed beneath the sludge drying beds with associated groundwater monitoring points. Subsequent RCRA investigations indicated no known release of wastes associated with the sludge drying beds or waste pile. These beds were demolished in 2005. The area was determined to be excess as part of BRAC 1995 and is now operated by RWRD; however, the full property transfer is pending completion of environmental cleanup in the Western Industrial Area and is currently under Army BRAC control.

The former Chromate Equalization Lagoons were in service between 1978 and 1997 at the Current IWTP. There were three lagoons which were located directly north and east of the Current IWTP and used as surface impoundments for electroplating wastewater as it was processed through the Current IWTP. The three lagoons were the Effluent Lagoon, Equalization Lagoon, and Final Holding Lagoon. The Equalization Lagoon was installed in 1978. It was 65 feet wide by 95 feet long and held untreated chromium rinse water prior to treatment at the Current IWTP. The Equalization Lagoon and the soil beneath it were removed in 1989. The Effluent Lagoon (also referred to as the "Intermediate Lagoon") was installed sometime between 1991 and 1995. It was approximately 70 feet wide by 70 feet long and held treated wastewater from the Current IWTP. The Final Holding Lagoon (also referred to as the "Final Lagoon") was the third lagoon and was installed sometime between 1978 and 1984. It also held treated wastewater from the Current IWTP and was approximately 200 feet wide and 50 feet long. The Effluent Lagoon and Final Holding Lagoons were demolished in 1997. The land was excavated upon closure and remains open. The area of the former Equalization Lagoon is currently used to support the Current IWTP operations. The area was determined to be excess as part of BRAC 1995 and is now operated by RWRD, the land remains under the control of Army BRAC while environmental cleanup continues.

5.2 Areas Not Retained for Further Investigation

Through the evaluation of information obtained during records review, personnel interviews, and/or site reconnaissance, the areas described below were categorized as areas not retained for further investigation at this time (i.e., non-AOPIs). The locations of the non-AOPIs are shown on ***Figure 5-8***.

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

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

Area Description	Dates of Operation	Relevant Site History	Rationale	Data Gap	Land Ownership
Flammable Materials Storage Facility	Unknown	Building is used to store the flammable materials used in the repair and rebuilding operations. The materials stored in this building include oils, paints, and solvents. This building is designed to store these chemicals inside with adequate spills or release containment; however, materials are routinely stored outside this building where there is minimal spill containment. AFFF can be used for vapor suppression purposes in the event of a hydrocarbon spill.	Firefighting records dating back to 2003 did not report of any spills reported to by the fire department.	Use of AFFF in firefighting responses prior to 2003 could not be verified through documentation or interviews.	TAC: building is leased back to Army for maintenance operations
Pesticide Storage Facility	1990s - BRAC	Building constructed sometime in the 1990s. PFAS can be used in pesticides, one of which (Whitemire Micro-Gen Ant Reactor, which contains sulfluramid) was utilized at RRAD.	Mixing of pesticides was not reported as having occurred here; Ant traps containing of sulfuramid were sealed and opened only upon utilization	--	TAC: building is leased back to Army for maintenance operations
Pesticide Pit and Former Pesticide Building	1967 - 1972	Pesticide Pit was an unlined (4' square by 8' deep) pit was reported to have been used for dumping rinsate containing insecticides from activities in the nearby Former Pesticide Building. Approximately 430 cubic yards of soil were removed in the remediation effort conducted in 2000. PFAS can be used in pesticides.	Pesticide pit was closed prior to the development of sulfuramid in pesticides. Pesticide building was demolished prior to the development of sulfuramid in pesticides.	--	TAC
NWSFTR	1953 – 1966	Used to test pyrotechnics, smoke pots, select grenades, grenade launcher ground signals, trip flares, grenade fuzes, and antipersonnel mines for stockpile reliability.	Physical records did not identify PFAS-containing materials as having	Use of PFAS-containing materials in	TAC

Area Description	Dates of Operation	Relevant Site History	Rationale	Data Gap	Land Ownership
		Specific items tested there include photoflash XM185 2-second delay; handheld position marker PM-4; M2 series anti-personnel mines; simulator, hand grenade, M116. PFAS-containing components can be used in munitions and pyrotechnics. It is possible that PFAS may be released to the environment under high-heat conditions, like detonation.	been used, stored, or disposed.	munitions and pyrotechnic testing could not be verified through documentation or interviews.	
SWSFTR	1948 - 1984	Used to test pyrotechnics, grenade launcher ground signals, grenade fuzes, trip flares, and anti-personnel mines. A mine/grenade stand and a flare/signal stand were identified previously as having existed. The area was used for stationary testing. Specific items tested here include M2 and M16 series anti-personnel mines. PFAS-containing components can be used in munitions and pyrotechnics. It is possible that PFAS may be released to the environment under high-heat conditions, like detonation.	Physical records did not identify PFAS-containing materials as having been used, stored, or disposed.	Use of PFAS-containing materials in munitions and pyrotechnic testing could not be verified through documentation or interviews.	TAC
Communication Center	Unknown	Photo processing waste was inadvertently discharged to the ground rather than the aboveground storage tank it was meant to be disposed in. The amount of waste released and the length of time that waste was released for was unknown. Analytical samples from the area did not indicate hazardous soil conditions. PFAS can be used in industrial processes such as photo film development.	Interviews and physical records did not identify PFAS-containing materials as having been used, stored, or disposed	Use of PFAS-containing materials in the film photograph development process could not be verified through documentation or interviews.	TAC: building is leased back to Army for maintenance operations

Figure 5-2: AOPI Locations

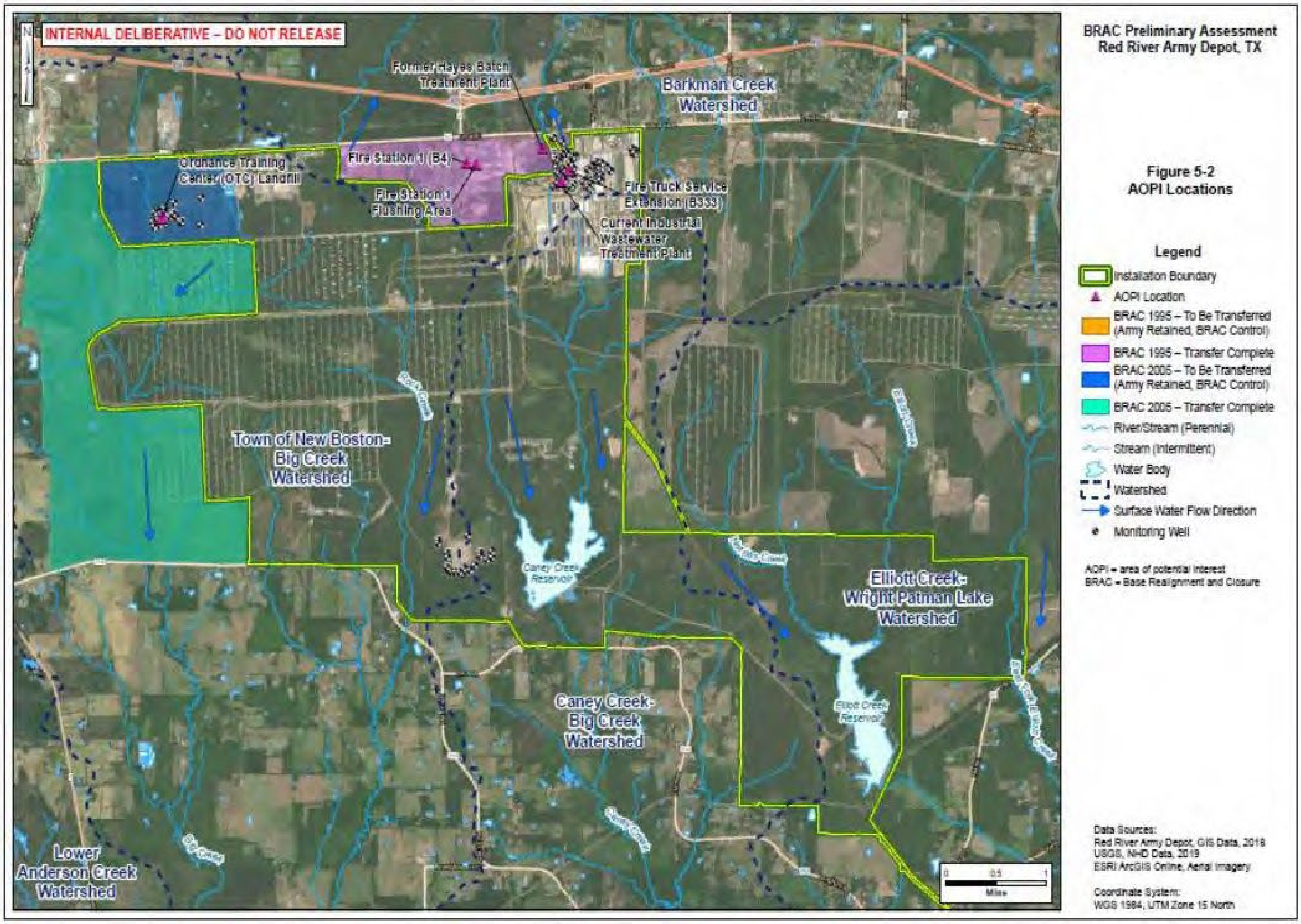


Figure 5-3: Aerial Photo of Fire Station 1 (B4) & Fire Station 1 Flushing Area AOPIs

Figure 5-4: Aerial Photo of Fire Truck Service Extension (B333) AOPI

Figure 5-5: Aerial Photo of OTC Landfill AOPI

Figure 5-6: Aerial Photo of Former Hayes Batch Treatment Plant AOPI

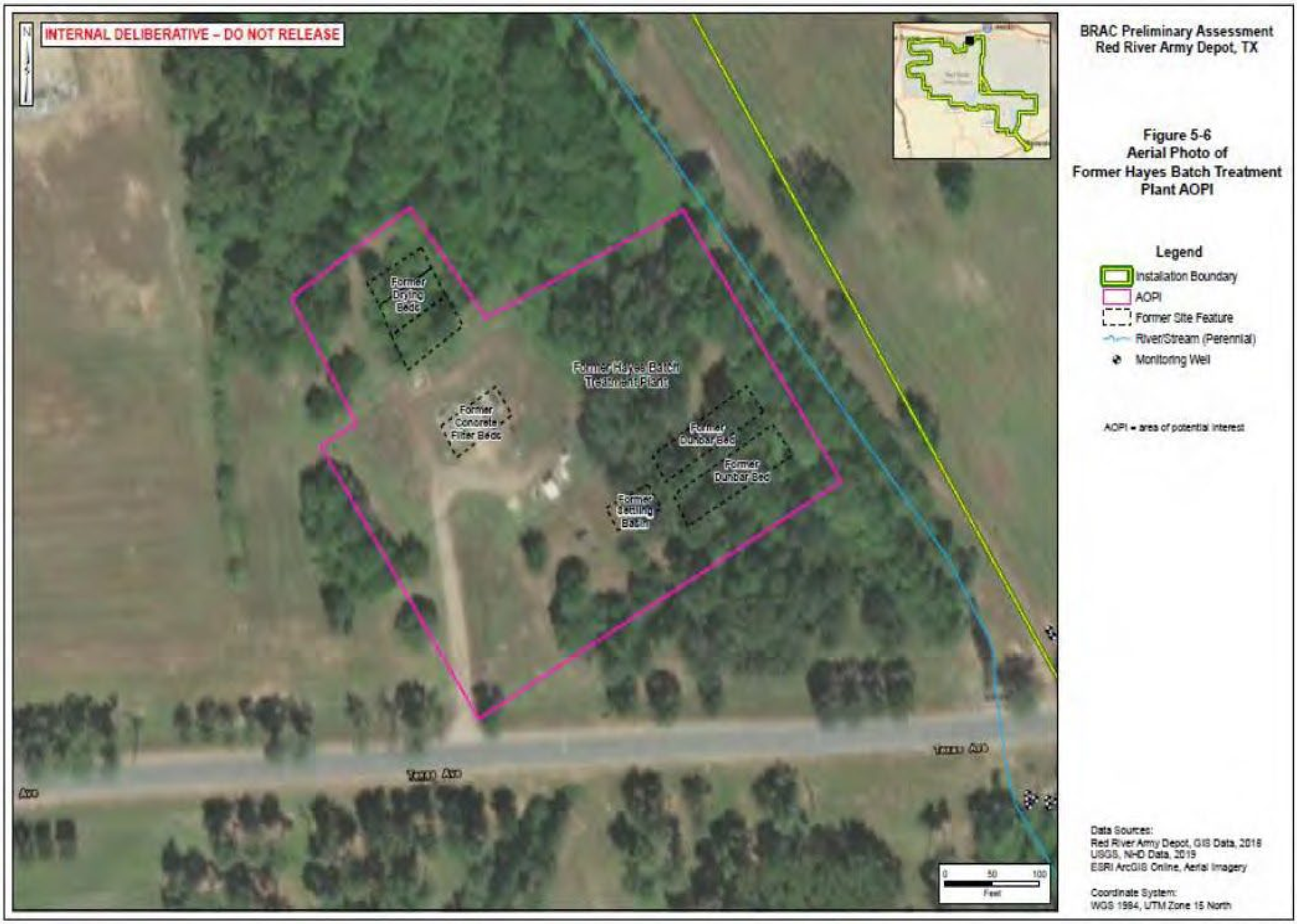


Figure 5-7: Aerial Photo of Current Industrial Wastewater Treatment Plant AOPI

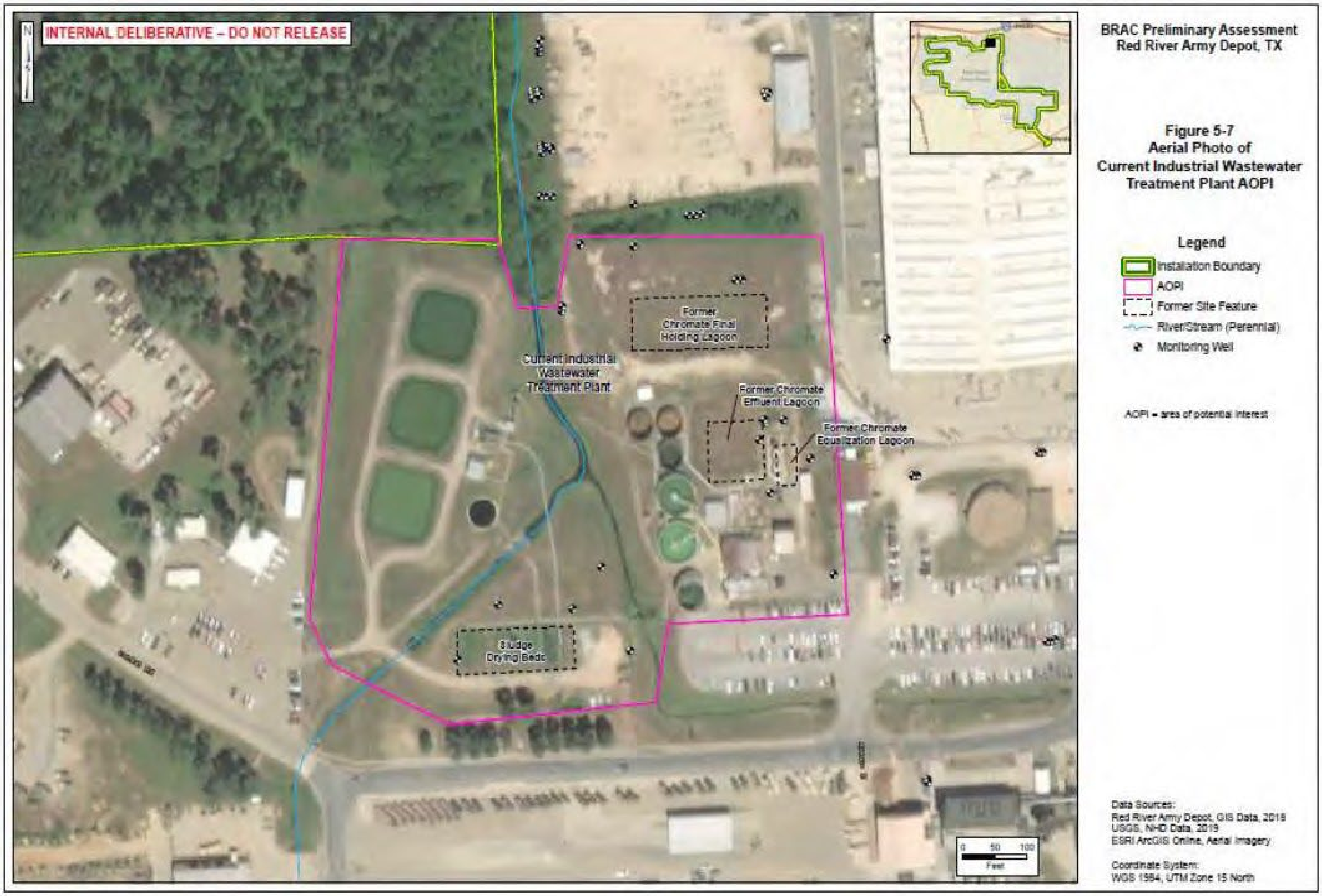
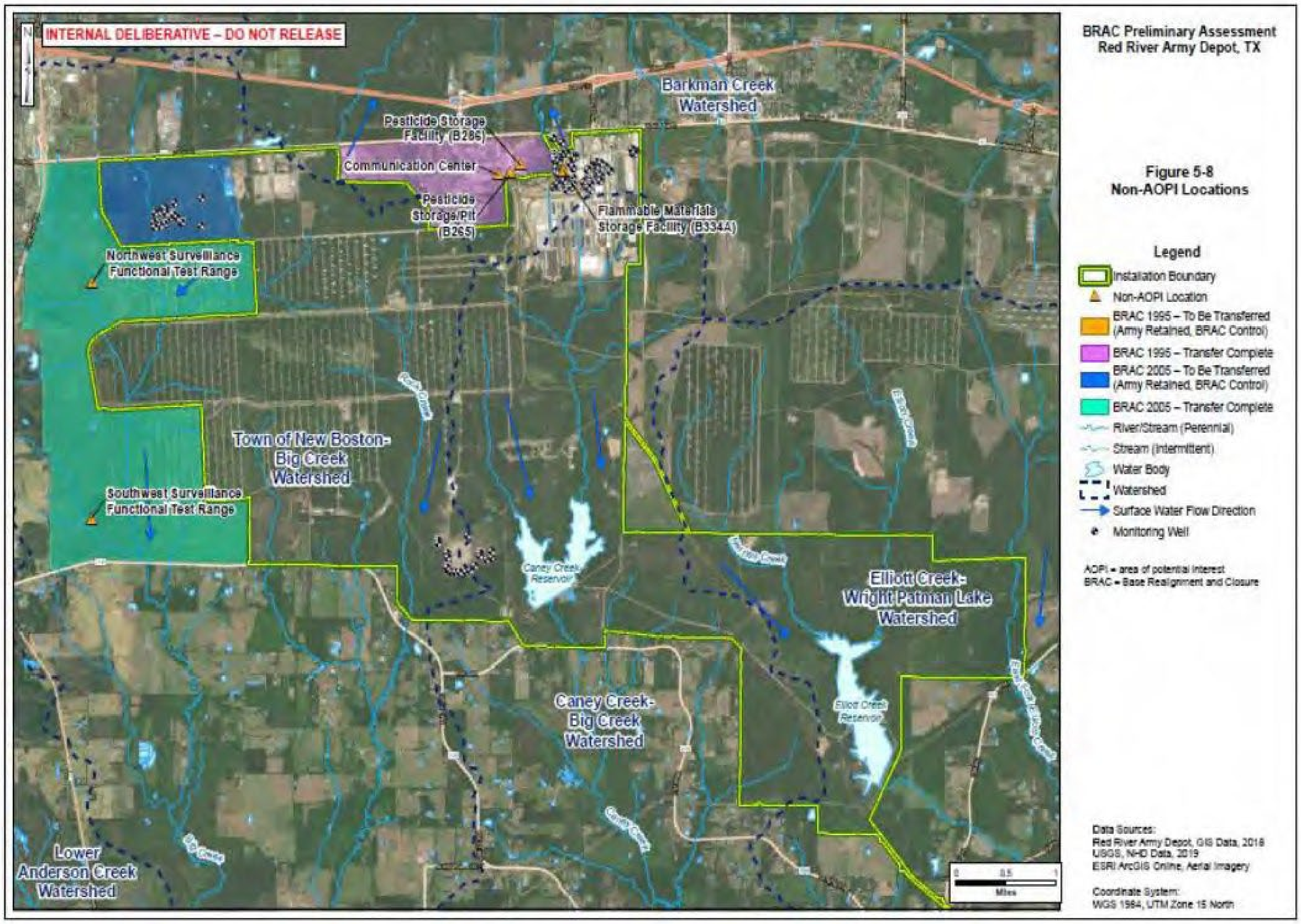


Figure 5-8: Aerial Photo of Non-AOPI Locations



6.0 CONCLUSIONS AND RECOMMENDATIONS

The PFAS PA at RRAD evaluated preliminary locations for the use, storage, and/or disposal of PFAS-containing materials, in accordance with the 2018 Army Guidance for Addressing Releases of PFAS (Army 2018). A combination of document review, internet searches, interviews with installation personnel, and an installation site visit were used to identify preliminary locations (potential AOPIs) of suspected use, storage, and/or disposal of PFAS-containing materials at RRAD.

Based on the results of the PA for the entire installation, 6 AOPIs were identified. Therefore, further investigation for PFAS at RRAD is warranted at this time. ***Table 6-1*** below summarizes the AOPIs identified at RRAD as well as sampling recommendations for each AOPI.

Table 6-1: Summary of Locations Identified During the PA, Recommendations & Rationale

Location Name	Identifier	AOPI	Recommendation	Rationale
Fire Station 1	--	Yes	Further study in SI	Storage of AFFF at location reported in interview, and likely also stored on fire fighting vehicles at this location
Fire Station 1 Flushing Area	--	Yes	Further study in SI	Reported flushing of AFFF charged hoses and tanks at this location
Fire Truck Service Extension	--	Yes	Further study in SI	Vehicles being serviced carried AFFF or AFFF residue, which may have been discharged as part of vehicle rehabilitation process
OTC Landfill	RRAD-04	Yes	Further study in SI	Waste from treatment plants placed into landfill may have contained PFAS containing material from electroplating shops
Former Hayes Batch Treatment Plant	--	Yes	Further study in SI	Suspected accumulation of PFAS-containing material from electroplating shops through wastewater system and settling ponds
Current IWTP		Yes	Further study in SI	Suspected accumulation of PFAS-containing material from electroplating shops and PFAS-containing lubricants
Flammable Materials Storage Facility		No	No action at this time	No records of fire responses at this location. Use of AFFF in firefighting responses prior to 2003 could not be verified through documentation or interviews
Pesticide Storage Facility		No	No action at this time	Mixing of pesticides was not reported as having occurred here; Ant traps containing of sulfuramid were sealed and opened only upon utilization
Pesticide Pit and Former Pesticide Building		No	No action at this time	Pesticide pit was closed prior to the development of sulfuramid
NWSFTR	RRAD-10	No	No action at this time	Use of PFAS-containing materials in munitions and pyrotechnic testing could not be verified through documentation or interviews
Southwest Surveillance Functional Test Range	RRAD-09	No	No action at this time	Use of PFAS-containing materials in munitions and pyrotechnic testing could not be verified through documentation or interviews
Communication Center	--	No	No action at this time	Use of PFAS-containing materials in the film photograph development process could not be verified through documentation or interviews

Data collected during the PA (**Sections 3** through **5**) were sufficient to draw conclusions and recommendations summarized above. The data limitations relevant to the development of this PA at RRAD are discussed below.

Many DoD personnel associated with the Active Army operation at RRAD prior to the BRAC transfer events are no longer available for interviews (e.g., have transferred to alternate assignments, have retired, and/or have passed away.) Therefore, interviewees with recollections of historical site activities were typically unavailable. Additionally, many Active Army records from RRAD were transferred to other DoD facilities and many pre-BRAC environmental records were not available.

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, and PFBS use) were limited to available installation personnel, whose knowledge of AFFF use may have been restricted by their time spent at the installation or previous roles held that limited their relevant knowledge of potential AFFF (or other PFAS-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 E***).

The searches for ecological receptors and off-post PFAS sources were not exhaustive and were limited to easily identifiable and readily available information evaluated during the relevant records review, installation personnel interviews, and site reconnaissance.

Following the PA evaluation, six AOPIs were identified. Therefore, further investigation of potential PFAS impacts as part of a SI at RRAD is warranted at this time.

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