FINAL
Preliminary Assessment Report
Tulsa Army Aviation Support Facility #2
Oklahoma

Perfluorooctanesulfonic Acid (PFOS) and Perfluorooctanoic Acid (PFOA) Impacted Sites
ARNG Installations, Nationwide

October 2020

Prepared for:

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

UNCLASSIFIED

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Acronyms and Abbreviations

°F	degrees Fahrenheit
AECOM	AECOM Technical Services, Inc.
AASF	Army Aviation Support Facility
AFFF	aqueous film forming foam
amsl	above mean sea level
ANGB	Air National Guard Base
AOI	area of interest
ARNG	Army National Guard
bgs	below ground surface
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CSM	conceptual site model
EDR™	Environmental Data Resources, Inc.™
FTA	fire training area
HA	Health Advisory
HEMTT	heavy expanded mobility tactical truck
ng/L	nanograms per liter
OKARNG	Oklahoma Army National Guard
OWS	oil/water separator
PA	Preliminary Assessment
PFAS	per- and polyfluoroalkyl substances
PFOA	perfluorooctanoic acid
PFOS	perfluorooctanesulfonic acid
SI	Site Inspection
UCMR3	Unregulated Contaminant Monitoring Rule 3
US	United States
USACE	United States Army Corps of Engineers
USEPA	United States Environmental Protection Agency
VSI	visual site inspection
WWTP	wastewater treatment plant

Executive Summary

The Army National Guard (ARNG) is performing *Preliminary Assessments (PAs) and Site Inspections (Sis) for Perfluorooctanesulfonic acid (PFOS) and Perfluorooctanoic acid (PFOA) impacted Sites at ARNG Facilities Nationwide*. A PA for per- and polyfluoroalkyl substances (PFAS)-containing materials was completed for Tulsa Army Aviation Support Facility (AASF) #2 in Tulsa, Oklahoma to assess potential PFAS release areas and exposure pathways to receptors. The performance of this PA included the following tasks:

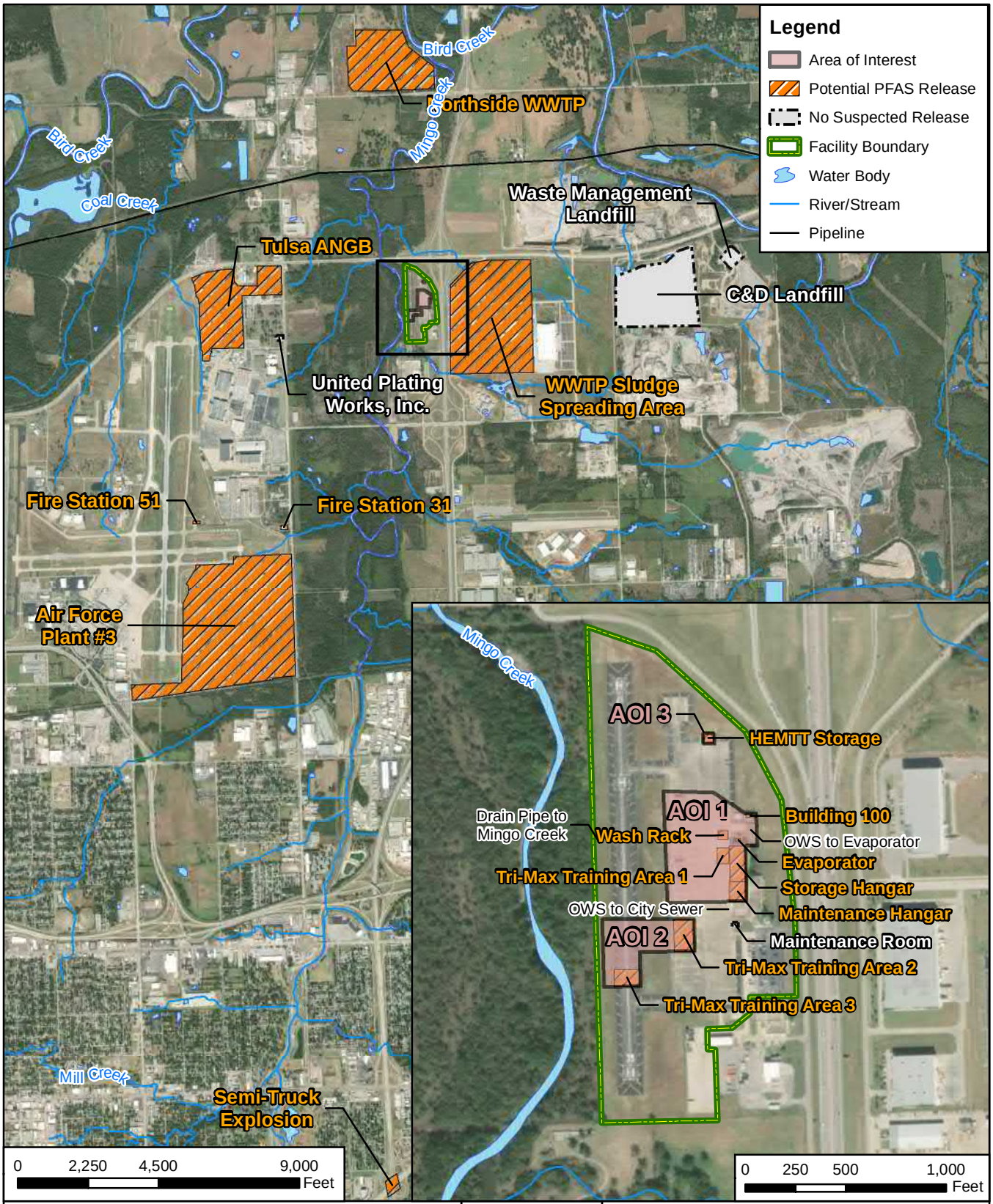
- Reviewed available administrative record documents and Environmental Data Resources, Inc. (EDR)™ report packages to obtain information relevant to potential PFAS releases, such as: drinking water well locations, historical aerial photographs, Sanborn maps, and environmental compliance actions in the area surrounding the facility;
- Conducted a 1-day site visit on 17 October 2019 and completed visual site inspections at locations where PFAS-containing materials were suspected of being stored, used, or disposed;
- Interviewed personnel during the site visit who are associated with AASF #2 activities including the maintenance test pilot, the facility manager, a facility supervisor, a computer assistant, an aircraft mechanic, and one quality control personnel;
- Developed a preliminary conceptual site model (CSM) to outline the potential release, pathway, and receptors of PFAS for the Tulsa AASF #2.

Nine potential PFAS source areas were identified during the PA. These source areas constitute three Areas of Interest (AOIs) identified at the Tulsa AASF #2. The AOIs are shown in **Figure ES-1** and summarized in **Table ES-1**.

Table ES-1: AOIs at Tulsa AASF #2

Area of Interest	Name	Used by	Potential Release Dates
AOI 1	Eastern Release Areas	OKARNG	1990s to 2014
AOI 2	Western FTAs	OKARNG	1990s-early 2000s
AOI 3	HEMTT Storage	OKARNG	1990s-early 2000s

Based on potential PFAS releases at the AOIs, there is potential for exposure to PFAS contamination in media at or near the facility. The preliminary CSM for the AOIs is shown in **Figure ES-2**, which presents the potential receptors and media impacted. Based on the US Environmental Protection Agency (USEPA) Unregulated Contaminant Monitoring Rule 3 (UCMR3) data, it was indicated that no PFAS were detected in a public water system above the USEPA Health Advisory (HA) within 20 miles of the facility. The HA is 70 parts per trillion for PFOS and PFOA, individually or combined. PFAS analyses performed in 2016 had method detection limits that were higher than currently achievable. Thus, it is possible that low concentrations of PFAS were not detected during the UCMR3 but might be detected if analyzed today.



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Base Map: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS,		PM	RG	6/24/2020

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Summary of Findings

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Figure ES-1

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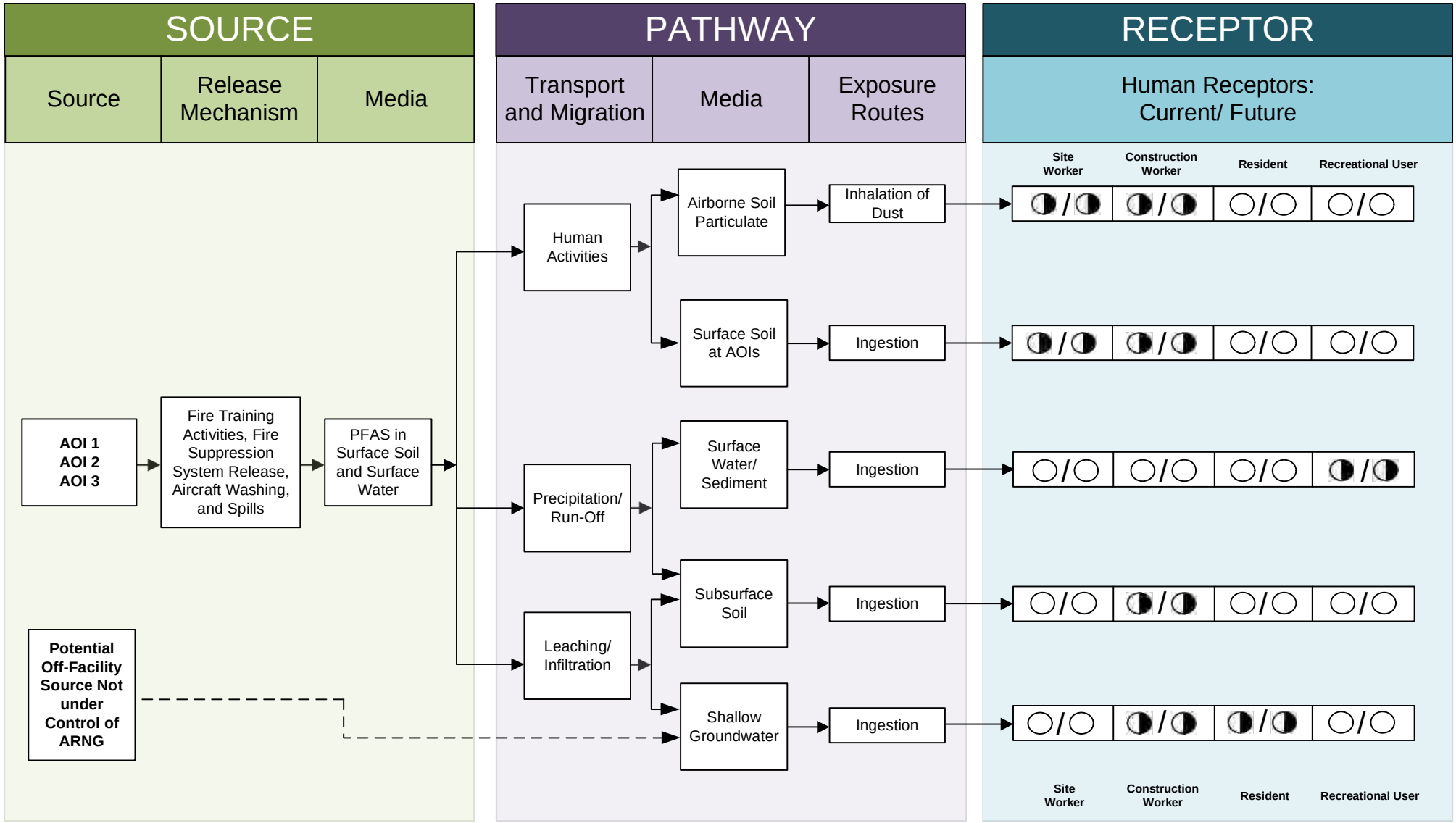


LEGEND

- Flow-Chart Stops
- Flow-Chart Continues
- Partial / Possible Flow
- Incomplete Pathway
- Potentially Complete Pathway
- Complete Pathway

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

Figure ES-2
Preliminary Conceptual Site Model
Tulsa AASF #2

1. Introduction

1.1 Authority and Purpose

The Army National Guard (ARNG) G9 is the lead agency in performing *Preliminary Assessments (PAs) and Site Inspections (Sis) for Perfluorooctanesulfonic acid (PFOS) and Perfluorooctanoic acid (PFOA) Impacted Sites at ARNG Facilities Nationwide*. This work is supported by the United States (US) Army Corps of Engineers (USACE) Baltimore District and their contractor AECOM Technical Services, Inc. (AECOM) under Contract Number W912DR-12-D-0014, Task Order W912DR17F0192, issued 11 August 2017.

The ARNG is assessing potential effects on human health related to processes at their facilities that used per- and polyfluoroalkyl substances (PFAS), primarily in the form of aqueous film forming foam (AFFF) released as part of firefighting activities, although other sources of PFAS are possible. In addition, the ARNG is assessing businesses or operations adjacent to the ARNG facility (not under the control of ARNG) that could potentially be responsible for a PFAS release.

PFAS are classified as emerging environmental contaminants that are garnering increasing regulatory interest due to their potential risks to human health and the environment. PFAS formulations contain highly diverse mixtures of compounds. Thus, the fate of PFAS compounds in the environment varies. The regulatory framework at both federal and state levels continues to evolve. The US Environmental Protection Agency (USEPA) issued Drinking Water Health Advisories (HAs) for PFOA and PFOS in May 2016, but there are currently no promulgated national standards regulating PFAS in drinking water. The HA is 70 parts per trillion for PFOS and PFOA, individually or combined.

This report presents findings of a PA for PFAS at Tulsa Army Aviation Support Facility (AASF) #2 (also referred to as the “facility”) in Tulsa, Oklahoma, in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended, the National Oil and Hazardous Substances Pollution Contingency Plan (40 Code of Federal Regulations Part 300), and Army requirements and guidance.

This PA documents the locations where PFAS-containing materials were historically stored and reportedly released into the environment at Tulsa AASF #2. The term PFAS will be used throughout this report to encompass all PFAS chemicals being evaluated, including PFOS and PFOA, which are key components of AFFF.

1.2 Preliminary Assessment Methods

The performance of this PA included the following tasks:

- Reviewed available administrative record documents and Environmental Data Resources, Inc. (EDR)™ report packages to obtain information relevant to potential PFAS releases, such as: drinking water well locations, historical aerial photographs, Sanborn maps, and environmental compliance actions in the area surrounding the facility;
- Conducted a 1-day site visit on 17 October 2019 and completed visual site inspections (VSIs) at locations where PFAS-containing materials were suspected of being stored, used, or disposed;
- Interviewed personnel during the site visit who are associated with AASF #2 activities including the maintenance test pilot, the facility manager, a facility supervisor, a computer assistant, an aircraft mechanic, and one quality control personnel;

- Developed a preliminary conceptual site model (CSM) to outline the potential release, pathway, and receptors of PFAS for Tulsa AASF #2.

1.3 Report Organization

This report has been prepared in accordance with the USEPA *Guidance for Performing Preliminary Assessments under CERCLA* (USEPA, 1991). The report sections and descriptions of each are as follows:

- **Section 1** – **Introduction:** identifies the project purpose and authority and describes the facility location, environmental setting, and methods used to complete the PA.
- **Section 2** – **Fire Training Areas:** describes the potential or suspected fire training areas (FTAs) at the facility identified during the site visit.
- **Section 3** – **Non-Fire Training Areas:** describes other locations of potential or suspected PFAS releases at the facility identified during the site visit.
- **Section 4** – **Emergency Response Areas:** describes areas of suspected or potential AFFF release at the facility, specifically in response to emergency situations.
- **Section 5** – **Adjacent Sources:** describes sources of PFAS release adjacent to the facility that are not under the control of ARNG.
- **Section 6** – **Preliminary Conceptual Site Model:** describes the pathways of PFAS transport and receptors at the Areas of Interest (AOIs).
- **Section 7** – **Conclusions:** summarizes the data findings and presents the conclusions of the PA.
- **Section 8** – **References:** provides the references used to develop this document.
- **Appendix A** – Data Resources
- **Appendix B** – Preliminary Assessment Documentation
- **Appendix C** – Photographic Log

1.4 Facility Location and Description

The Tulsa AASF #2 encompasses approximately 47 acres of land in Tulsa County, northeast Oklahoma (**Figure 1-1**). The facility is situated at the junction of US Highway 169 and Oklahoma Highway 266 and is northeast of Tulsa International Airport and a mile east of the Tulsa Air National Guard Base (ANGB).

The Tulsa AASF #2 was built in 1987 and the Oklahoma ARNG (OKARNG) moved into the facility in 1989. Prior to construction, the land was previously agricultural or undeveloped land. The mission of the facility is to support aviation equipment and machinery and maintain properly trained and equipped units ready for mobilization and includes a storage hangar, maintenance hangar, heavy expanded mobility tactical truck (HEMTT) storage area, and armory.

1.5 Facility Environmental Setting

The facility is within the geomorphic province of Claremore Cuesta Plains, which is characterized by westward dipping Pennsylvanian-aged sandstones and limestones, which form cuestas between broad shale plains (Tyrl et al., 2007). The topography at the facility is relatively flat with surface elevations ranging from about 600 to 610 feet above mean sea level (amsl).

1.5.1 Geology

The geology at the facility is characterized by Quaternary-aged alluvial deposits and Pennsylvanian-aged rocks, which dip to the west (Miller and Stanley, 2006; Tyrl et al., 2007). The surficial geology near the facility consists of alluvium, located near Mingo Creek, and the Oologah Formation. The alluvium in the Tulsa region is composed of clay, silt, sand, and gravel and ranges in thickness from 0 to 30 feet (Marcher and Bingham, 1971; Miller and Stanley, 2006). The Oologah Formation is a Pennsylvanian-aged grayish limestone with intervals of sandstone or fossiliferous shale ranging up to 110 feet-thick (Marcher and Bingham, 1971; Miller and Stanley, 2006).

The Labette Formation underlies the Oologah Formation and is composed of shale and thin laminations of sandstone and limestone (Marcher and Bingham, 1971; Miller and Stanley, 2006). The thickness of the Labette Formation in the Tulsa region ranges from 220 to 260 feet-thick (Miller and Stanley, 2006). The Fort Scott Formation underlies the Labette Formation and comprises two members: Little Osage Shale and Blackjack Creek Limestone. The thickness of the Fort Scott Formation ranges from 7 to 12 feet (Miller and Stanley, 2006). Underlying the Fort Scott Formation is the Senora Formation, which consists of a silty to sandy shale with thin laminations of sandstone (Marcher and Bingham, 1971; Miller and Stanley, 2006). The Senora Formation is underlain by other Pennsylvanian and older units. Geologic units underlying the facility are displayed on **Figure 1-2**.

1.5.2 Hydrogeology

There is no principal aquifer in the Tulsa area (Johnson, 1983). While groundwater exists in the Pennsylvanian rocks found at the facility, they are not ideal for groundwater resources with most wells yielding an estimated rate of 0.5 gallons per minute. The Oologah Formation, which is stratigraphically the uppermost unit at the facility, yields small quantities of fair to poor quality water (Marcher and Bingham, 1971).

Subsurface investigative work completed at the C&D landfill, located approximately 1 mile east of the facility, indicated groundwater depths vary but are typically at the contact of the Oologah and Labette formations or the first 10 feet of the Labette Formation. The boring logs of this work indicate the contact between limestone and shale occurs around 532 to 565 feet amsl (E&E Engineering and Associates, LLC, 2018). The inferred groundwater flow direction at the facility is northwest. An SI completed in 2018 at the adjacent Tulsa ANGB reported groundwater levels in soil borings and monitoring wells that ranged from 4.78 to 25 feet below ground surface (bgs) with groundwater flow bifurcating from the south to the northwest and east/northeast (Leidos, 2018).

The facility's drinking water is supplied by the City of Tulsa, which acquires its water from Lake Spavinaw, Lake Eucha and Lake Oologah. Lakes Spavinaw and Eucha are located approximately 46 and 52 miles east of the facility, respectively. Lake Oologah is about 17.5 miles northeast of the facility. An EDR™ report conducted a well search for a 1-mile radius surrounding the facility (**Appendix A**). Using additional online resources, such as state and local GIS databases, wells were researched to a 4-mile radius of the facility. Groundwater features in the four-mile radius surrounding the facility are shown in **Figure 1-2**. Within a 2.5-mile radius of the facility there are three domestic wells, whose total depths range from 21 to 197 feet bgs. Additionally, there are numerous monitoring wells to the east and west of the facility at the Tulsa ANGB and two landfills. Most of these wells have total depths ranging from 10 to 60 feet bgs (Oklahoma Water Resource Board, 2020).Consequently, groundwater in the water table aquifer may be expected at a similar depth.

Based on USEPA's Unregulated Contaminant Monitoring Rule 3 (UCMR3) data, it was indicated that no PFAS were detected in a public water system above the HA within 20 miles of the facility.

The HA is 70 parts per trillion for PFOS and PFOA, individually or combined. PFAS analyses performed in 2016 had method detection limits that were higher than currently achievable. Thus, it is possible that low concentrations of PFAS were not detected during the UCMR3 but might be detected if analyzed today.

1.5.3 Hydrology

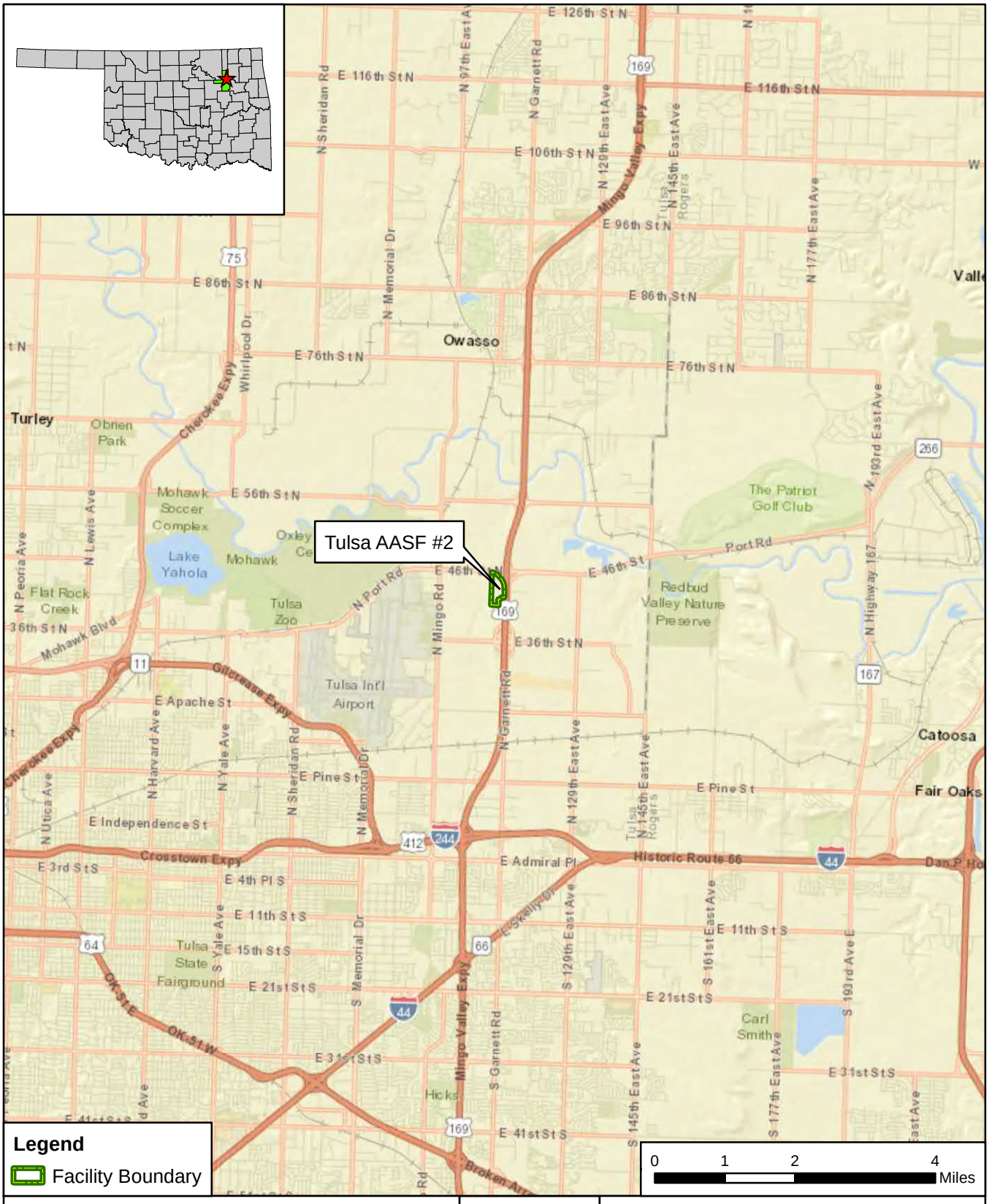
Surface water near the facility includes Mingo Creek to the west. Mingo Creek flows northward into Bird Creek, which is a tributary of the Verdigris River. The inferred overland flow direction at the facility is to the northwest and eventually drains into Mingo Creek. Surface water features surrounding the facility are shown in **Figure 1-3**.

1.5.4 Climate

The facility is in the City of Tulsa. The average temperature of Tulsa is 60.7 degrees Fahrenheit (°F). Seasonally, temperatures vary from a summer average monthly high of 93 °F to a winter average monthly low of 28 °F. Average precipitation in Tulsa is 40.91 inches (World Climate, 2020).

1.5.5 Current and Future Land Use

The facility currently includes a storage hangar, maintenance hangar, HEMTT storage area, and armory. Reasonably anticipated future land use is not expected to change from the current land use.



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SCALE	1:126,720	CHK BY	JH	4/23/2020
Base Map: Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI,		PM	RG	4/23/2020

Facility Location

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Figure 1-1

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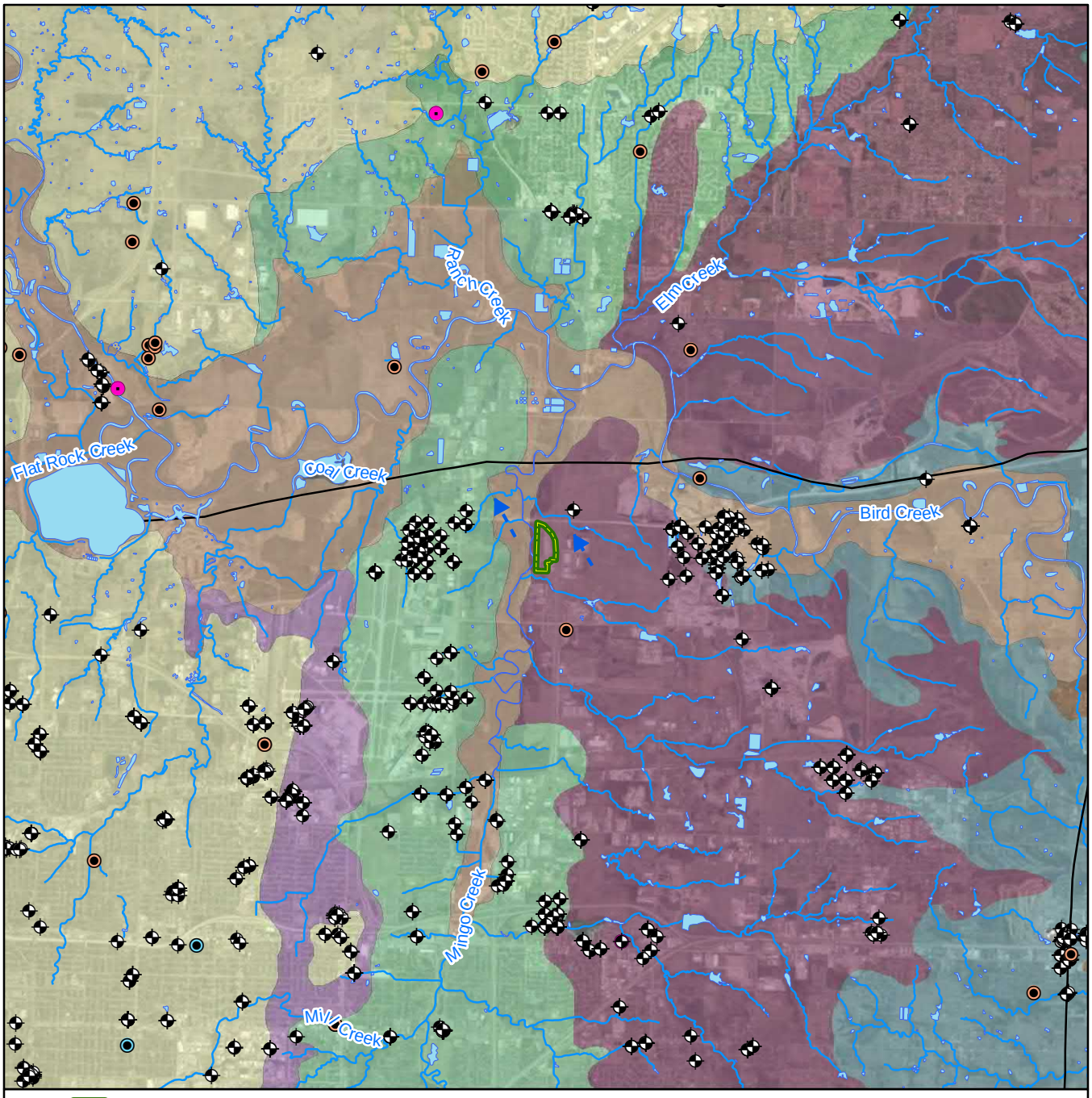

Facility Boundary
River/Stream
Pipeline
Water Body
Wetland
Inferred Groundwater Flow Direction

Geology
Alluvium
Seminole Formation
Holdenville and Lenapah Formations
Nowata Formation
Oologah Formation
Labette Formation
Senora Formation

Wells
Agriculture Well
Commercial
Domestic Well
Observation/Monitoring Well

0 0.75 1.5 3 Miles

CLIENT	ARNG			
NOTES	Preliminary Assessment for PFAS at Tulsa AASF #2, OK			
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Groundwater Features

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Figure 1-2

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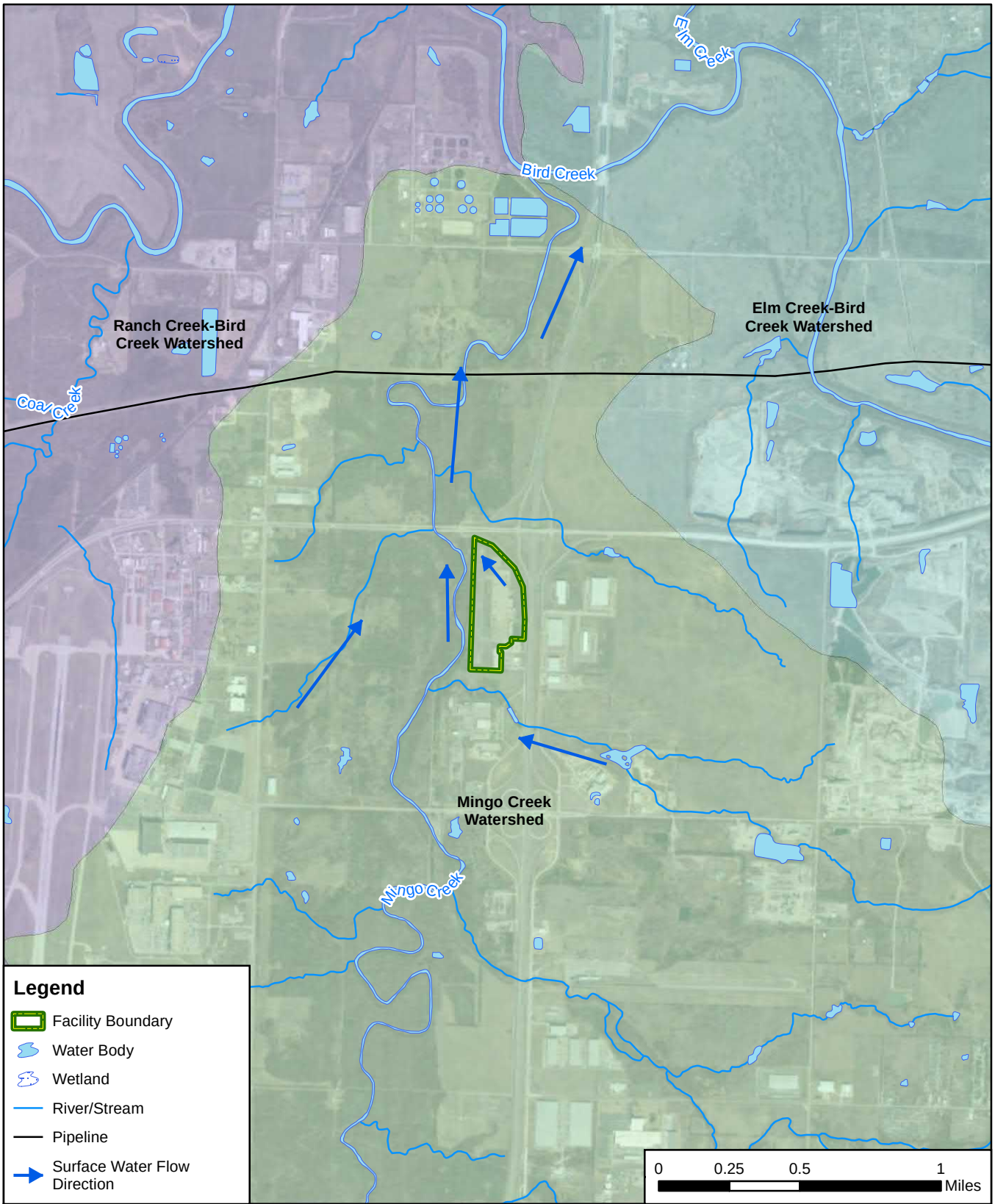

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Surface Water Features

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Figure 1-3

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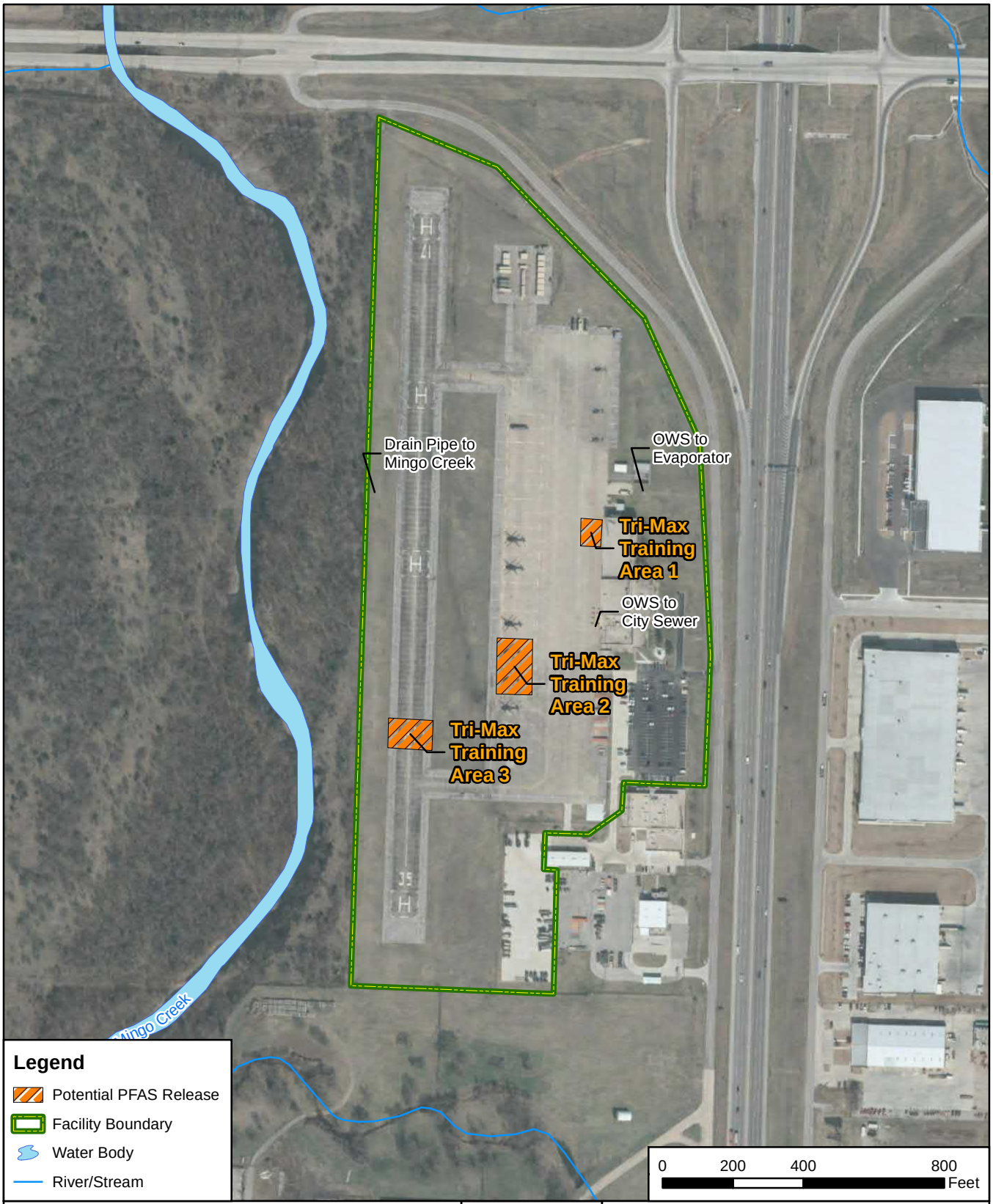
2. Fire Training Areas

Three FTAs were identified at the Tulsa AASF #2 during the PA. The FTAs are described below and shown on **Figure 2-1**.

2.1 Tri-Max Training Areas 1, 2, and 3

The facility obtained eight Tri-Max™ extinguishers in the 1990s and trained with the units on three occasions. One extinguisher was completely discharged during each training event. The training events occurred in three different locations, designated as Tri-Max Training Area 1, 2, and 3. The geographic coordinates of Tri-Max Training Areas 1, 2, and 3 are 36°13’00.8”N, 95°51’12.6”W; 36°12’57.0”N, 95°51’14.7”W; and 36°12’55.1”N, 95°51’18.2”W; respectively. A few extinguishers were located at the HEMTT Storage but the locations of the remaining units are unknown. No information was provided regarding the dates of the training events. The Tri-Max™ extinguishers were subsequently removed from use in the early 2000s. In 2011 the Tri-Max™ extinguishers were shipped to the US Property and Fiscal Office for Oklahoma.



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Fire Training Areas

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Figure 2-1

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3. Non-Fire Training Areas

In addition to FTAs, the PA evaluated areas where PFAS-containing materials may have been broadly used, stored, or disposed. This may include buildings with fire suppression systems, paint booths, AFFF storage areas, and areas of compliance demonstrations. Information on these features obtained during the PA are included in **Appendices A** and **B**. Seven non-FTAs where AFFF was stored and/or potentially released were identified during the PA. A description of each non-FTA is presented below and shown on **Figure 3-1**.

3.1 Storage Hangar

The Storage Hangar is located between the Maintenance Hangar and the Evaporator. The geographic coordinates are 36°13'00.4"N; 95°51'11.3"W. The Storage Hangar houses two 300-gallon foam tanks, located along the northern wall, and three 36-gallon manual AFFF tanks, located along the north, east, and south walls, that were obtained in 2013. The 300-gallon foam tanks are filled with 2.2% Buckeye Hi-Ex foam. Foam is replaced by contractors based in Houston, Texas. No information was provided on the disposal of AFFF and Buckeye Hi-Ex after it leaves the facility or when this occurred.

In 2014, a fire suppression system was installed, which conveys Buckeye Hi-Ex foam to three overhead sprayers in the Storage Hangar and two overhead sprayers in the Maintenance Hangar. The system was tested twice after installation. During both tests, plastic was placed around both the Storage Hangar and the Maintenance Hangar to prevent foam from leaving the hangars. The first test failed because not enough foam was produced by the system and only a small area of hangars was filled with foam. No information was provided on the type of foam used in the first test. Consequently, 2.2% Buckeye Hi-Ex foam was acquired, and a second test was conducted. The second test was meant to test whether both hangars would be adequately covered by the fire suppression system. The hangars were taped up in order to seal them so foam would not leak out of the hangars. The second test was successful, and the hangars filled up with 8 or 9 feet of foam. Only an estimated 5-10 gallons of Buckeye Hi-Ex foam were released during the second test. After both tests, the facility personnel let the foam settle and pushed it down to the trench drain, which transports wastewater to an oil/water separator (OWS), then to the City of Tulsa sanitary sewer, and, eventually, to the Northside Wastewater Treatment Plant (WWTP).

In August 2014, the fire suppression system was accidentally triggered, and one of the 300-gallon foam tanks released into the Storage Hangar. Buckeye Hi-Ex foam spilled out through the Storage Hangar doors into the Maintenance Hangar and onto the ramp. Videos of the aftermath show up to around 4 feet of foam, which spread approximately 300 feet northward on the ramp and into the grassy area just north of the Storage Hangar and approximately 350 feet westward into the grassy area between the ramp and the runway. Facility personnel allowed the foam to settle and evaporate. The helicopters on the ramp that were covered by foam were washed at the Wash Rack. It is estimated that 300 gallons of Buckeye Hi-Ex foam was released during the accidental triggering of the fire suppression system.

3.2 Maintenance Hangar

The Maintenance Hangar is located south of the Storage Hangar and north of the Maintenance Room. The geographic coordinates are 36°12'59.1"N; 95°51'11.3"W. Two 36-gallon AFFF tanks were obtained in 2013 and are stored in the Maintenance Hangar, one on the north side of the hangar, and one on the south side. Buckeye Hi-Ex foam filled the Maintenance Hangar during the second testing of the fire suppression system, to 8 or 9 feet. Only an estimated 5-10 gallons of foam were released during the second test. Additionally, an unknown amount of Buckeye Hi-Ex foam spilled into the Maintenance Hangar during the August 2014 accidental fire suppression

system release event. Any PFAS releases in the Maintenance Hangar would flow to the trench drain, then to the OWS and, eventually, to the Northside WWTP via the sanitary sewer.

3.3 HEMTT Storage

The HEMTT Storage area is located north of the ramp. The geographic coordinates are 36°13’06.7”N; 95°51’12.8”W. The HEMTTs are used as mobile refuelers at the facility. Tri-Max™ extinguishers were located at the HEMTT Storage from the 1990s to the early 2000s when the extinguishers were removed from the facility. There are no reported releases of AFFF at this location.

3.4 Wash Rack

The Wash Rack is located 50 feet northwest of the Storage Hangar and west of the Evaporator. The geographic coordinates of the Wash Rack are 36°13’01.9”N; 95°51’12.1”W. The Wash Rack was used to wash the Buckeye Hi-Ex foam off the helicopters after the accidental fire suppression release event. The Wash Rack effluent drains to an OWS and is then conveyed to a holding tank. Water in the holding tank is reused by the facility to wash aircraft. The excess water is burned off at the evaporator.

Multiple types of OWS have been used at the facility, the previous OWS system included a defoamer, which conveyed the wastewater to Mingo Creek and a system that had a filter in the Petroleum, Oil, and Lubricant Storage building with an underground plate system. The current OWS is a recycle system with an evaporator and was installed in 2010. A valve on the system allows water to be discharged to nearby Mingo Creek, but this only occurs after a large rain event and once the water has been checked for a sheen. However, prior to 2010, water was discharged more frequently to the creek. Historically, foam has been observed in the creek, although it is unknown whether this was related to a release of AFFF.

3.5 Evaporator

The Evaporator is located just north of the Storage Hangar. The geographic coordinates are 36°13’01.6”N; 95°51’11.2”W. The Wash Rack effluent drains to an OWS and then to a holding tank. Any excess water is burned off at the Water Maze® Evaporator, which was installed in 2010. AFFF or Buckeye Hi-Ex foam discharged at the Wash Rack could be conveyed to the Evaporator. Solids from the wash water evaporation process are removed and disposed of by a contractor on routine basis. No information was available regarding the offsite disposal of the solid waste.

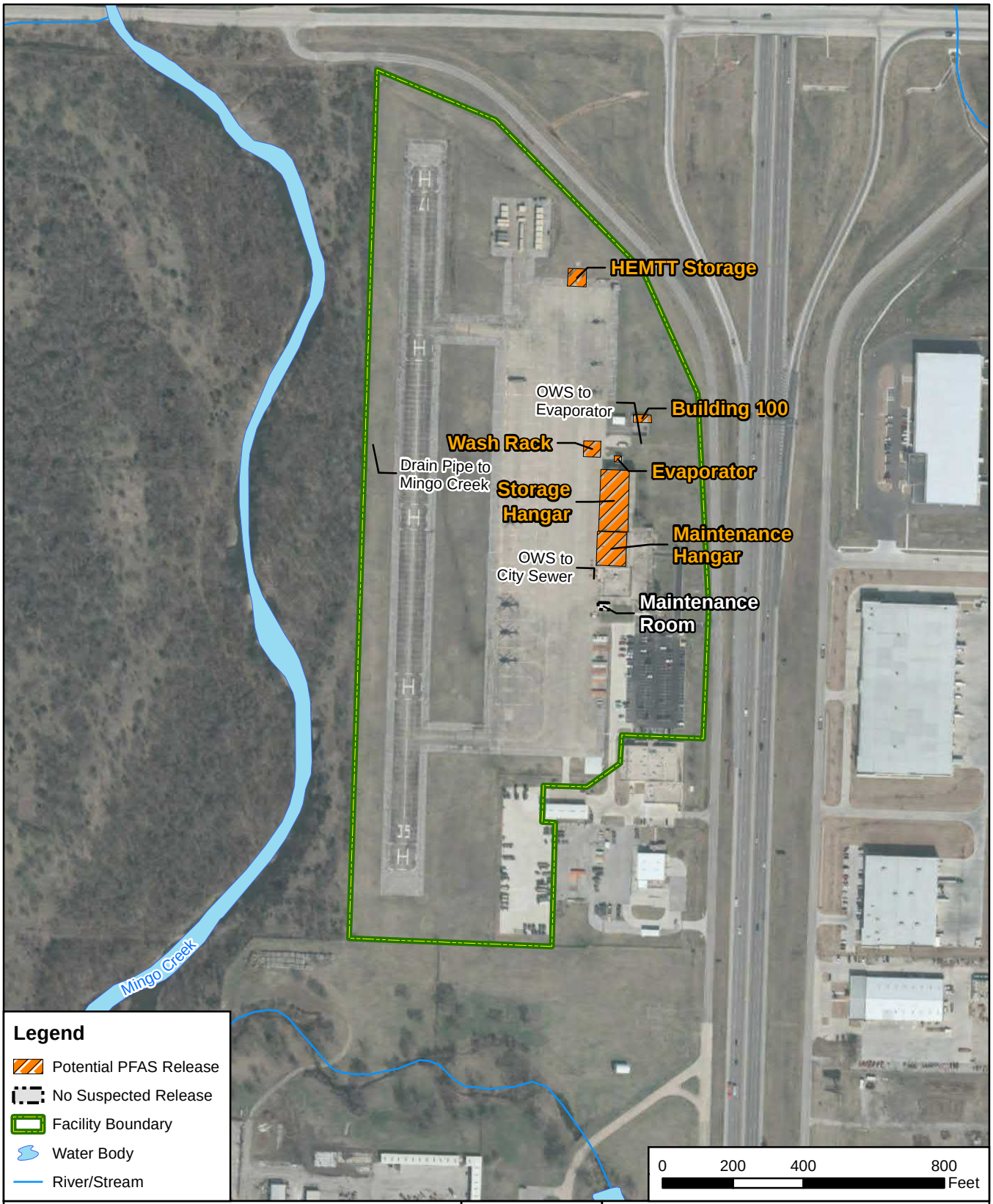
3.6 Building 100

Building 100 is located east of the ramp and approximately 100 feet northeast of the evaporator. The geographic coordinates are 36°13’02.8”N; 95°51’10.4”W. Historically, 25 five-gallon buckets of AFFF were stored at this location. The buckets were donated to a local fire station at an unknown date. No information was available on the concentration or type of AFFF stored in the buckets. No leaks or spills were reported. No AFFF is currently stored in Building 100.

3.7 Maintenance Room

The Maintenance Room is located south of the Maintenance Hangar. The geographic coordinates of the Maintenance Room are 36°12’57.5”N; 95°51’11.6”W. The Maintenance Hangar previously housed the facility firetruck; however, the truck was not equipped with AFFF. Interviewees

indicated firefighting vehicles and helicopters are equipped with Purple-K. No information was available regarding the dates the firetruck arrived or removed from the facility.



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SCALE	1:4,800	CHK BY	JH	4/23/2020
Base Map: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS,		PM	RG	4/23/2020

Non-Fire Training Areas

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Figure 3-1

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4. Emergency Response Areas

During the PA no historic emergency responses were identified at the facility. Emergency response at the facility is provided by the Tulsa Fire Department located at the Tulsa International Airport. Interviewees had no recollection of the city fire department training at the Tulsa AASF #2.

5. Adjacent Sources

Eight adjacent sources of potential PFAS, not under the control of OKARNG were identified. These off-facility sources include: Tulsa ANGB, Air Force Plant #3, two landfills, Northside WWTP, WWTP Sludge Spreading Area, two fire stations, and United Plating Works, Inc. **Figure 5-1** displays the adjacent sources described in this section.

5.1 Tulsa ANGB

The Tulsa ANGB is less than a mile to the west of the facility. An SI report dated November 2018 identified multiple areas where AFFF was discharged. PFAS was confirmed in soil and groundwater. PFOA and PFOS exceeded the USEPA HA (70 nanograms per liter [ng/L]) for groundwater with PFOA+PFOS reaching concentrations as high as 47,400 ng/L (Leidos, 2018).

5.2 Air Force Plant #3

The Air Force Plant #3 is approximately 1.5 miles to the southwest of the facility, near the Tulsa International Airport. An SI report dated August 2018 focused on AFFF discharges in surface soil. The report detected PFAS in soil and groundwater and PFOA and/or PFOS above the USEPA HA in groundwater with PFOA+PFOS reaching concentrations as high as 436 ng/L (Oneida Total Integrated Enterprises, 2018).

5.3 Landfills

There are two landfills approximately a mile east of the facility, C&D Landfill and the Waste Management Landfill. Landfills are not usually a primary release area of PFAS, but materials disposed in landfills may create a secondary source of contamination. Such materials may include sludge from a WWTP that processes PFAS-laden water, used AFFF storage containers, or products associated with waterproofing uniforms or boots. However, no information obtained indicates PFAS-related materials were disposed of at these landfills.

5.4 Northside WWTP

Northside WWTP is approximately 1 mile north of the facility. The WWTP was constructed in 1958 and treats the local wastewater conveyed from the Tulsa AASF #2 and the wastewater from adjacent potential PFAS source areas, such as the Tulsa ANGB and Air Force Plant #3. Little information was available on the disposal of the sludge generated at the WWTP.

5.5 WWTP Sludge Spreading Area

The WTTP Sludge Spreading Area is located to the east, directly adjacent to the facility and across Mingo Valley Expressway (Highway 169). The Northside WWTP historically spread sludge at the WWTP Sludge Spreading Area. Information on when the sludge spreading practice was started is unclear, but development in the area began approximately in 2012; therefore, the spreading process may have ceased prior to 2012.

5.6 Fire Stations 31 & 51

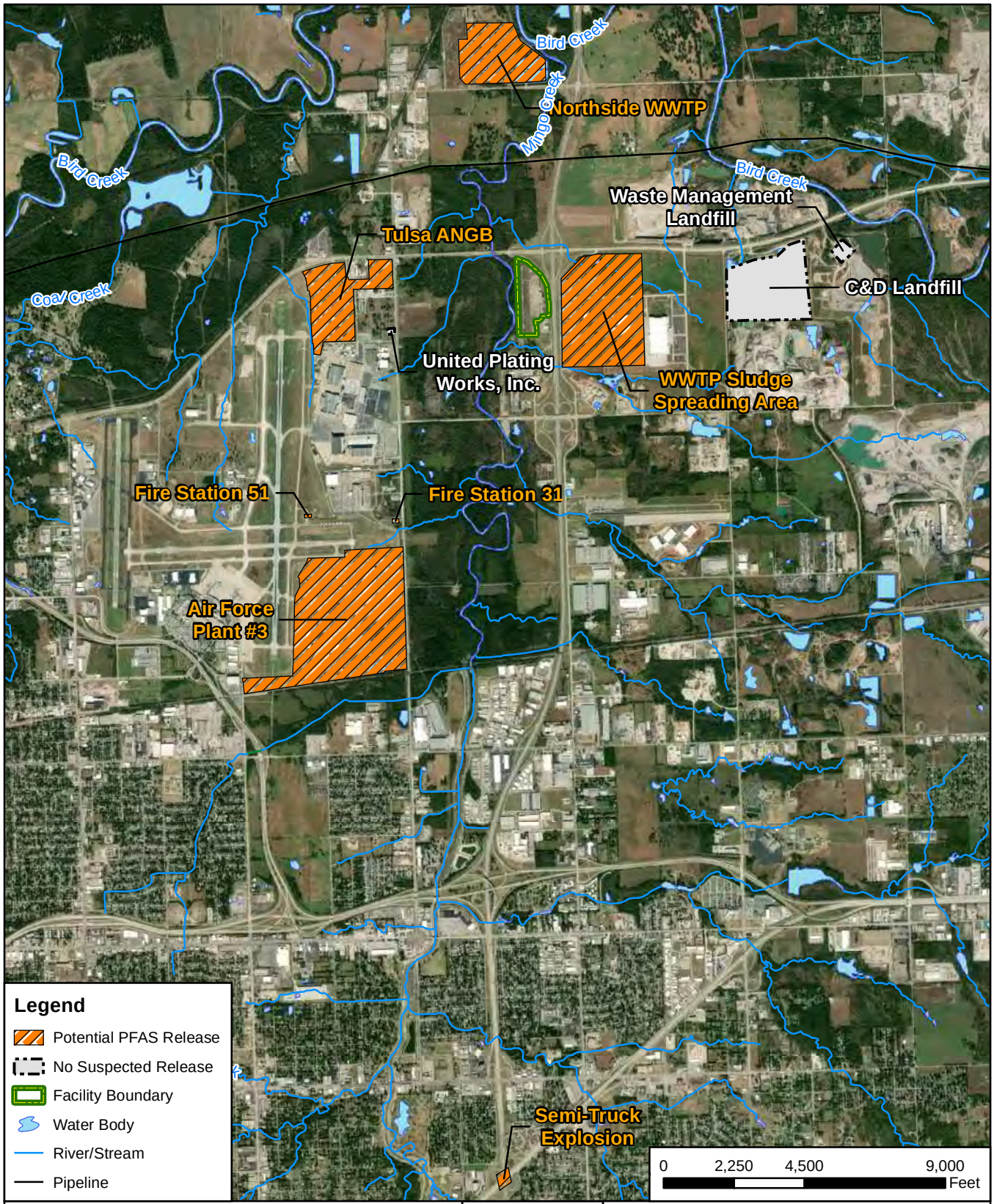
Fire Station 31 is located on the eastern side of the Tulsa International Airport and Fire Station 51 is located in the center of the airport. These fire stations received 25 five-gallon buckets of AFFF from the OKARNG. The storage and use of the AFFF by the fire stations are unknown.

5.7 United Plating Works, Inc.

United Plating Works, Inc. is approximately 1.5 miles southwest of the facility, just north of Air Force Plant #3. United Plating Works, Inc. provides various metal plating services, including chrome plating. Metal plating often involves the use of PFAS for mist suppression; however, no information could be obtained regarding the use of PFAS at this location. Interviewees also indicated that the United Plating, Inc. was formerly located further south of the facility at the intersection of E Pine Street and Mingo Express Highway.

5.8 Semi-Truck Explosion

In June 2019, a semi-truck collision resulted in an explosion. The explosion occurred approximately 4.5 miles south of the facility at the junction of I-44 and Highway 169. The Tulsa Fire Department responded to the emergency and discharged firefighting foam in unknown quantities to put out the fire (Fox 23 News, 2019).



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Base Map: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS,		PM	RG	6/22/2020

N

Adjacent Sources

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Figure 5-1

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6. Preliminary Conceptual Site Model

Based on the PA findings, three AOIs were identified at the Tulsa AASF #2: AOI 1 Eastern Release Areas, AOI 2 Western FTAs, and AOI 3 HEMTT Storage. Locations of the AOIs are shown on **Figure 6-1**. The preliminary CSM for AOIs 1, 2, and 3 is shown on **Figure 6-2**. The following sections describe the CSM components and the specific preliminary CSMs developed for each AOI. The CSM identifies the three components necessary for a potentially complete exposure pathway: (1) source, (2) pathway, (3) receptor. If any of these elements are missing, the pathway is considered incomplete.

6.1 Pathways

In general, the potential PFAS exposure pathways are ingestion and inhalation. Human exposure via the dermal contact pathway may occur, and current risk practice suggests it is an insignificant pathway compared to ingestion; however, exposure data for dermal pathways are sparse and continue to be the subject of PFAS toxicological study (National Ground Water Association, 2018).

Known and potential AFFF releases identified at the Tulsa AASF #2 occurred on both surface soil and paved surfaces. Releases to the paved surfaces could have migrated a short distance onto the surrounding surface soil. Ground-disturbing activities in the surface soils as well as beneath the pavement may result in potential exposure to surface soils via ingestion and inhalation of dust particles. AFFF releases to the paved surfaces could have infiltrated the subsurface via cracks in the pavement or joints between areas that are paved with different materials. Ground-disturbing activities may result in potential exposure to subsurface soils and groundwater via ingestion.

PFAS are water soluble and can migrate readily from soil to groundwater via leaching; however, drinking water at the Tulsa AASF #2 is provided by the City of Tulsa, which is sourced from three lakes located 17 to 52 miles northeast and east of the facility. Within a 2.5-mile radius of the facility, there are three domestic wells (Oklahoma Water Resource Board, 2020). It is possible that unregistered, private, domestic wells exist downgradient of the facility. Wells downgradient of the facility may result in potential exposure via ingestion of groundwater.

Surface water runoff at the facility appears to drain northwest toward Mingo Creek. Additionally, drainage ditches in grassy areas convey runoff northwest into Mingo Creek. The current OWS system has a valve that allows water to be discharged to Mingo Creek, but this only occurs after a large rain event and once the water has been checked for a sheen. However, prior to 2010, water was discharged more frequently to the creek. Mingo Creek flows northward into Bird Creek, which is a tributary of the Verdigris River, and may result in potential exposure via ingestion of surface water and sediment.

6.2 Receptors

Receptors at the Tulsa AASF #2 include site workers, construction workers, off-facility recreational users, and off-facility residents. These receptors, as they pertain to the facility, are described below:

- Site workers typically work at or use the site and may come into contact with the surface soils.
- Construction workers are considered workers who represent a utility worker or other worker who would be exposed to surface and/or subsurface conditions through ground-disturbing activities.
- Off-facility recreational users typically identify a person who may recreationally use an off-facility area that may be affected by a PFAS release from the facility. Off-facility recreational users could be exposed to sediment and surface water during recreational use.

- Off-facility residents identify receptors who occupy properties outside of the Tulsa AASF #2. Off-facility residents may come into contact with groundwater using private or domestic wells.

The preliminary CSMs for the Tulsa AASF #2 indicate which specific receptors could potentially be exposed to PFAS. The preliminary CSM for AOIs 1, 2, and 3 is shown on **Figure 6-2**.

6.3 AOI 1: Eastern Release Areas

AOI 1 encompasses Tri-Max Training Area 1, Storage Hangar, Maintenance Hangar, Wash Rack, Evaporator, and Building 100. Fire training activities occurred at Tri-Max Training Area 1 as early as the 1990s to as late as the early 2000s when the Tri-Max™ extinguishers were removed from use. The Tri-Max™ extinguishers were removed from the facility in 2011. In 2014, the fire suppression system was tested twice, resulting in PFAS draining from the Storage and Maintenance Hangars via the trench drain. In August 2014, the fire suppression system was accidentally triggered, resulting in Buckeye Hi-Ex foam on the ramp and grassy areas.

Releases at AOI 1 have occurred on both paved areas and grassy surfaces. Some PFAS releases may have occurred directly onto surface soil but may also have infiltrated subsurface soil via cracks in pavement or joints between areas that are paved with different materials. PFAS are water soluble and can migrate readily from soil to groundwater via leaching. Overland surface water flow would result in the transport of PFAS from these release locations to Mingo Creek, west of the facility. Mingo Creek flows into Bird Creek north of the Tulsa AASF #2. Potential PFAS exposure pathways resulting from releases at AOI 1 are described in **Table 6-1**.

Table 6-1: Exposure Pathways at the AOIs

Pathway	Receptor
Surface Soil	Considered a potentially complete pathway to site workers and construction workers via ingestion or inhalation of dust
Subsurface Soil	Considered a potentially complete pathway to construction workers via ingestion or inhalation of dust
Surface Water and Sediment	Considered a potentially complete pathway to off-facility recreational users via ingestion
Groundwater	Considered a potentially complete pathway to construction workers and off-facility residents via ingestion

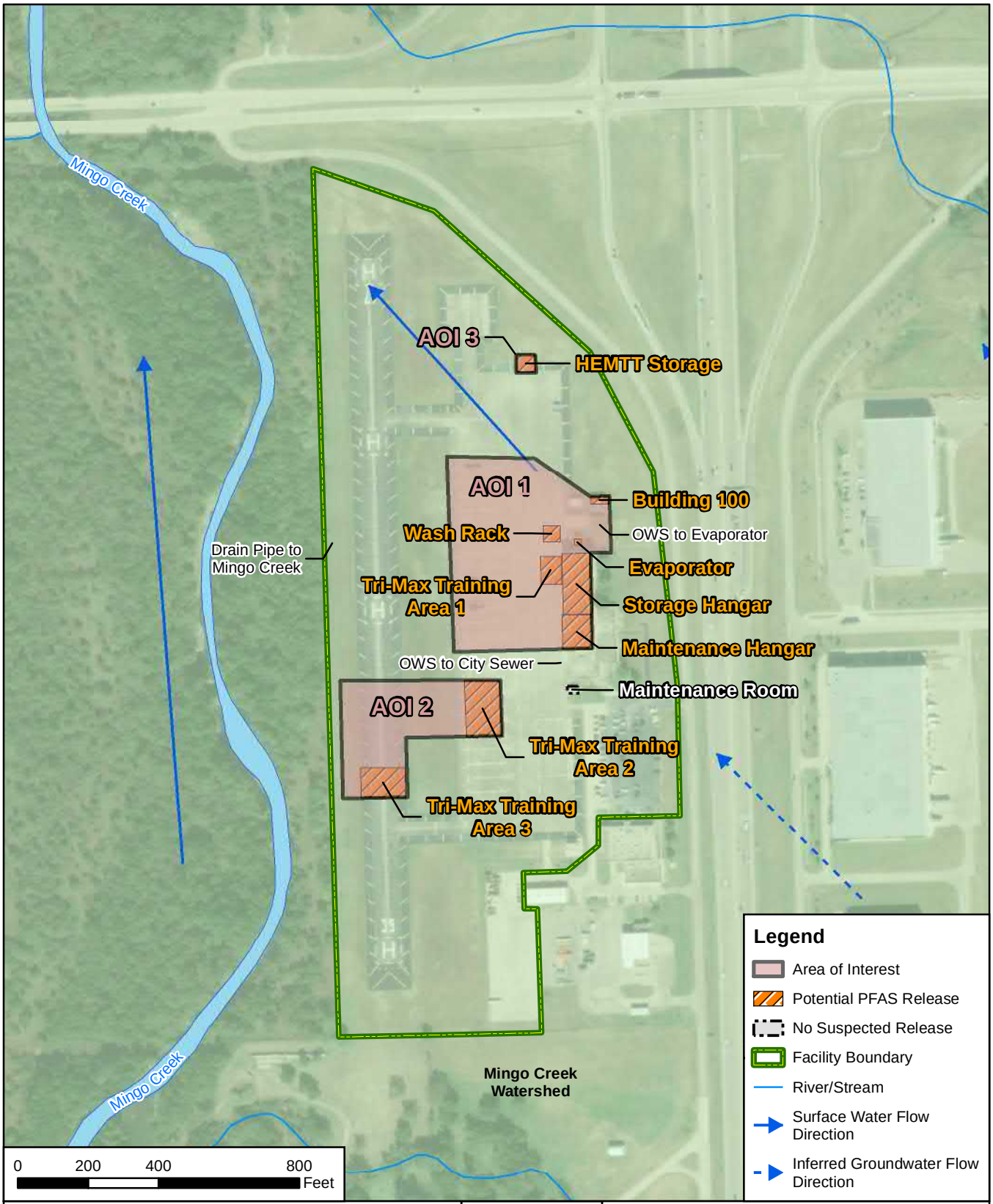
6.4 AOI 2: Western FTAs

AOI 2 encompasses Tri-Max Training Area 2 and Tri-Max Training Area 3 along the ramp and landing pad. Between the 1990s and the early 2000s, Tri-Max™ extinguishers were used for fire training activities at these locations. One training activity occurred at each location and involved the use of one extinguisher.

Releases at AOI 2 occurred on paved surfaces. AFFF releases would flow northwestward, off the pavement toward Mingo Creek, potentially impacting surface soil. Additionally, AFFF may also have infiltrated subsurface soil via cracks in pavement or joints between areas that are paved with different materials. PFAS are water soluble and can migrate readily from soil to groundwater via leaching. Potential PFAS exposure pathways resulting from releases at AOI 2 are described in **Table 6-1**.

6.5 AOI 3: HEMTT Storage

AOI 3 encompasses HEMTT Storage, which is a concrete-covered area that is located north of the ramp. Historically, Tri-Max™ units were stored in this location. No known or recorded leaks or spills occurred at AOI 3. Any AFFF releases would flow northwestward, off the concrete and potentially impacting surface soil. PFAS are water soluble and can migrate readily from soil to groundwater via leaching. Surface water flows to Mingo Creek. Potential PFAS exposure pathways resulting from releases at AOI 3 are described in **Table 6-1**.



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Base Map: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS,		PM	RG	6/24/2020

Areas of Interest

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Figure 6-1

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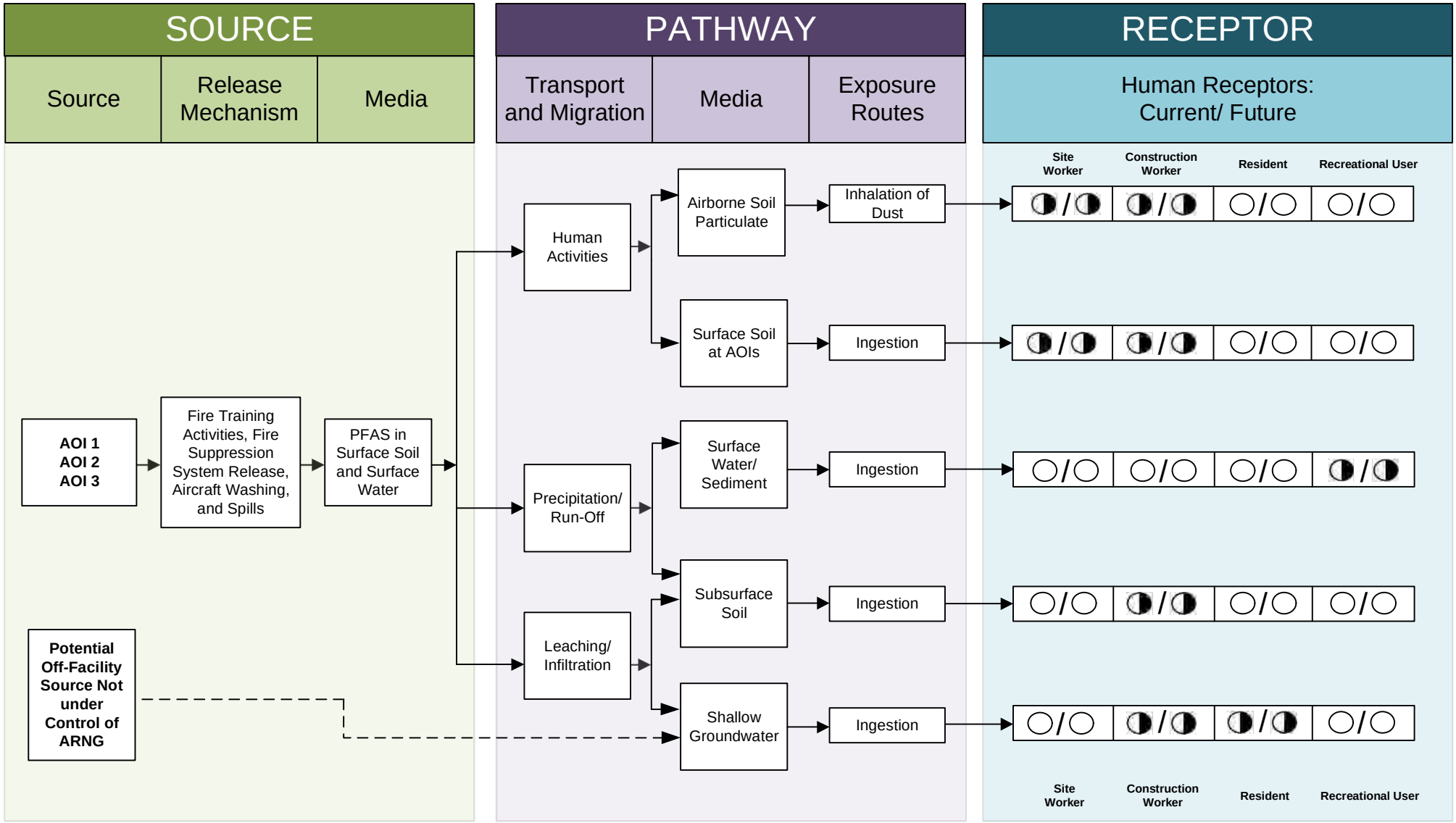


LEGEND

- Flow-Chart Stops
- Flow-Chart Continues
- Partial / Possible Flow
- Incomplete Pathway
- Potentially Complete Pathway
- Complete Pathway

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

Figure 6-2
Preliminary Conceptual Site Model
AOI 1 Eastern Release Areas, AOI 2, Western FTAs, and AOI 3 HEMTT Storage

7. Conclusions

This report presents a summary of available information gathered during the PA with respect to the use of AFFF and other PFAS-related activities at the Tulsa AASF #2. The PA findings are based on the information presented in **Appendix A** and **Appendix B**.

7.1 Findings

Three AOIs related to potential PFAS releases were identified during the PA. A summary of the AOIs is shown in **Table 7-1** and their location on **Figure 7-1**.

Table 7-1: AOIs at Tulsa AASF #2

Area of Interest	Name	Used by	Potential Release Dates
AOI 1	Eastern Release Areas	OKARNG	1990s to 2014
AOI 2	Western FTAs	OKARNG	1990s to early 2000s
AOI 3	HEMTT Storage	OKARNG	1990s to early 2000s

Based on potential PFAS releases at the AOIs, there is potential for exposure to PFAS contamination in media at or near the facility. The preliminary CSM for the AOIs, which presents the potential receptors and media impacted, is shown in **Figure 6-2**.

The following area discussed in **Section 3** was determined to have no suspected PFAS releases (**Table 7-2**):

Table 7-2: No Suspected Release Areas

No Suspected Release Area	Used by	Rationale for No Suspected Release Determination
Maintenance Room	OKARNG	No known or recorded instances of AFFF storage. Maintenance Hangar housed the firetruck, which was not equipped with AFFF.

7.2 Uncertainties

Available information sources were investigated during this PA to determine the potential for PFAS-containing materials to have been present, used, or released at the facility. Historically, documentation of PFAS use was not required because PFAS were considered benign. Therefore, records were not typically kept or historically maintained by the facility or available during the PA with respect to the use of PFAS in training, firefighting, or other non-traditional activities, or its disposal.

The conclusions of this PA are based on all available information, including: previous environmental reports, EDRs™, observations made during the VSI, and interviews. Interviews of personnel with direct knowledge of a facility generally provided the most useful insights regarding a facility's historical and current PFAS-containing materials. Sometimes the provided information was vague or conflicted with other sources. Gathered information has a degree of uncertainty due to the absence of written documentation, the limited number of personnel with direct knowledge due to staffing changes, the time passed since PFAS was first used (1969 to present), and a reliance on personal recollection. Inaccuracies may arise in potential PFAS release locations, dates of release, volume of releases, and the concentration of AFFF used. There is also a

possibility the PA has missed a source of PFAS, as the science of how PFAS may enter the environment continually evolves.

In order to minimize the level of uncertainty, readily available data regarding the use and storage of PFAS were reviewed, current personnel were interviewed, multiple persons were interviewed for the same potential source area, and potential source areas were visually inspected. **Table 7-3** summarizes the uncertainties associated with the PA:

Table 7-3: Uncertainties

Area of Interest	Source of Uncertainty
AOI 1	The dates at which the 25 five-gallon buckets of AFFF stored in Building 100 were obtained and donated are unknown.
AOIs 1 and 2	The dates of training with the Tri-Max™ extinguishers and the concentrations of AFFF in the extinguishers are unknown.
Tulsa AASF #2	The storage location of most of the Tri-Max™ extinguishers and the concentrations of AFFF in the extinguishers are unknown.

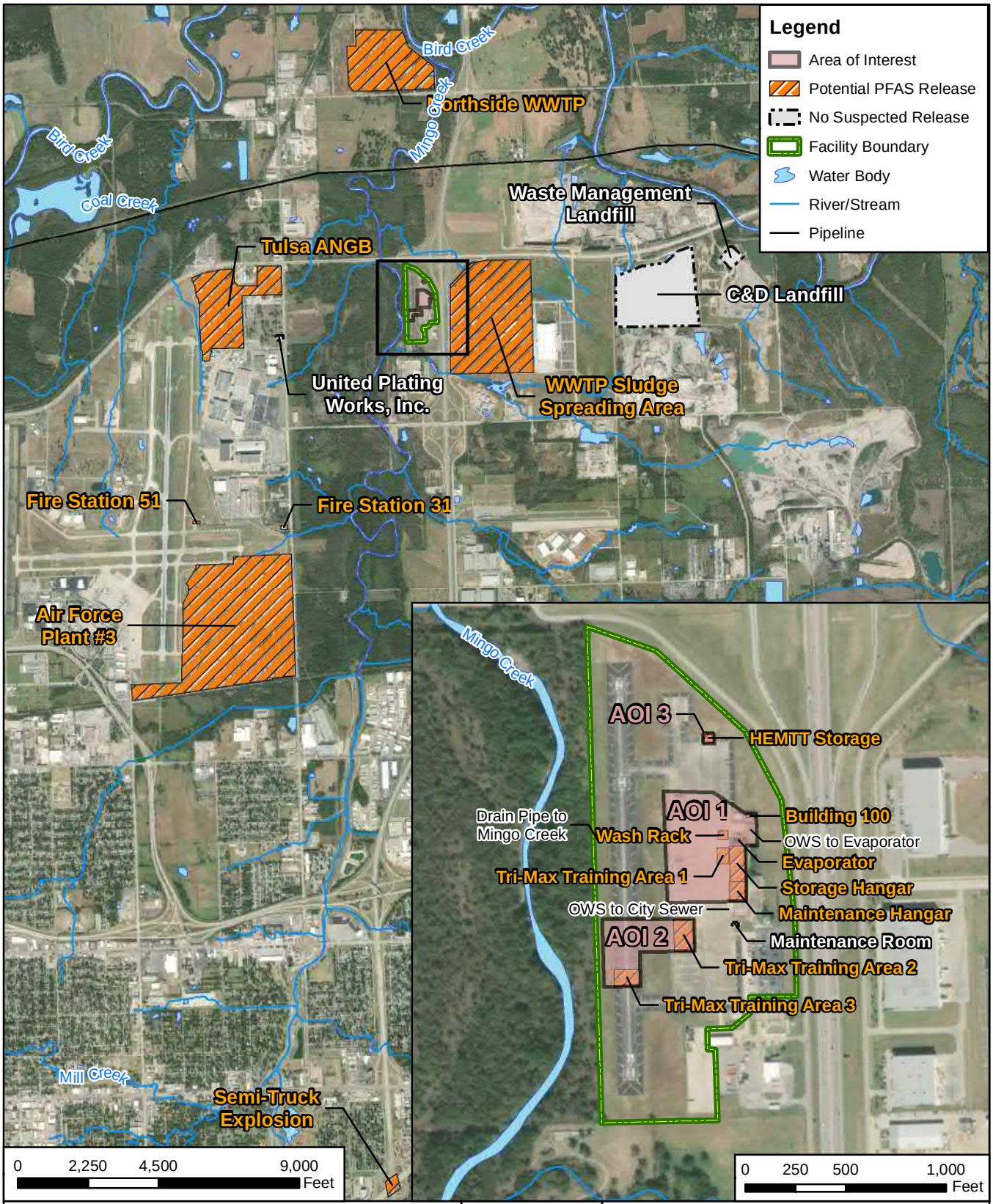
7.3 Potential Future Actions

Interviews and records (covering 1989 to present) indicate that current or former ARNG activities may have resulted in potential PFAS releases at the three AOIs identified during the PA. Based on the preliminary CSMs developed for the AOIs, there is potential for receptors to be exposed to PFAS contamination in soil, groundwater, surface water, and sediment. **Table 7-4** summarizes the rationale used to determine if the AOIs should be considered for further investigation under the CERCLA process and undergo an SI.

ARNG will evaluate the need for an SI at the AASF based on the potential receptors, the potential migration of PFAS contamination off the facility, and the availability of resources.

Table 7-4: PA Findings Summary

Area of Interest	AOI Location	Rationale	Potential Future Action
AOI 1: Eastern Release Areas	36°13'00.3"N; 95°51'11.2"W	Releases of AFFF to concrete during fire training activities from the 1990s to the early 2000s. Buckeye Hi-Ex foam released to concrete and surface soil during accidental triggering of the fire suppression system in 2014.	Proceed to an SI, focus on soil and shallow groundwater
AOI 2: Western FTAs	36°12'56.4"N; 95°51'17.5"W	Releases of AFFF to concrete and surface soil during fire training activities from the 1990s to the early 2000s.	Proceed to an SI, focus on soil and shallow groundwater
AOI 3: HEMTT Storage	36°13'06.7"N; 95°51'12.8"W	AFFF was historically stored at AOI 3 from the 1990s to the early 2000s.	Proceed to an SI, focus on soil and shallow groundwater



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SCALE	1:54,000	CHK BY	JH	6/24/2020
Base Map: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS,		PM	RG	6/24/2020

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Summary of Findings

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Figure 7-1

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Appendix A
Data Resources

Appendix B
Preliminary Assessment Documentation

Appendix B.1
Interview Records

PA Interview Questionnaire - Other

Facility: Tulsa AASF #2
Interviewer: [redacted]
Date/Time: 10/17/19 0900

Interviewee: See Sign-in Sheet **Title:** " **Phone Number:** " **Email:** "	Can your name/role be used in the PA Report? (Y) or N Can you recommend anyone we can interview? Y or N _____

Roles or activities with the Facility/Years working at the Facility:

[redacted] in OKC for the day
[redacted] Environmental Officer Chief
[redacted] OMD - Maintenance

PFAS Use: Identify accidental/intentional release locations, time frame of release, frequency of releases, storage container size (maintenance, fire training, firefighting, buildings with suppression systems (as builts), fueling stations, crash sites, pest management, recreational, dining facilities, metals plating, or waterproofing). How are materials ordered/purchased/disposed/shared with others?

	Known Uses
Chrome plating nearby (car parts)	
AASF built in 1984 - moved in 1989	Use
[redacted] doesn't recall a fire truck, but there is a fire station	Procurement
AFFF fire suppression system installed in 2014	Disposition
August 2014: accidental triggering of the system	Storage (Mixed)
In 2014 they initially tested the system - not enough foam	Storage (Solution)
Put plastic around both hangars during testing	Inventory, Off-Spec
Came back and tested 2nd time with new foam	Containment
Taped hangar - tested to 8-9 feet	SOP on Filling
First test: small area tested	Leaking Vehicles
2nd test: whole area tested - let it settle, pushed it down the trench drain	Nozzle and Suppression System Testing
Trench drain → OWS → sanitary sewer → Tulsa WWTP	Dining Facilities
Same trench drains when system triggered	Vehicle Washing
	Ramp Washing
	Fuel Spill Washing and Fueling Stations
	Chrome Plating or Waterproofing

PA Interview Questionnaire - Other

Facility: Tulsa AASF #2
Interviewer: [redacted]
Date/Time: 10/17/19 0900

Gaskets replaced on small tanks
2 tanks in Hangar
1 tank released during accidental triggering
During 2nd testing, released between 5-10 gallons AFFF
During accidental triggering AFFF reached ramp and part of nearby grassy area. Let settle and evaporate. Washed off helicopters at wash rack.
Wash rack → holding tank → evaporator
No bulk AFFF storage
Contractor out of Houston replaces AFFF solution
Fire protection is provided by City of Tulsa
The facility is on city water
No recollection of training with city fire department
Chrome plating at 46th and Mingo
AFFF Tri-Max training every 2 years (occurred twice)
Old fire truck in maintenance room
Tulsa Fire Department is located at Tulsa Airport
Tanker explosion at 44 & 169 (3 or 4 miles away) occurred a few months ago
Bird Creek leads to Arkansas River
Decoster recalled no spray foam from 1993-1995
No AFFF in truck
Close proximity to Tulsa Airport and City of Tulsa FD
Tri-Max units used 1990s to early 2000s
8-10 Tri-Max units, all turned in
Maintained onsite by [redacted] (retired last month)
~3 training events (1 unit used)
Building 100 stored 5-gallon bulk AFFF (25 buckets, given to local fire department)
HMTTs for fuel, no fuel farm
Same wash rack location
Three types of OWS over the years
- Filter in POL building - underground plate system
- Straight to creek with defoamer

PA Interview Questionnaire - Other

Facility: Tulsa AASF #2
Interviewer: [redacted]
Date/Time: 10/17/19 0980

- Currently use recycle system - burn off (installed in 2010)
Water is discharged to either creek or city sewer (valve)
Only discharges to creek after a large rain event, once water has been checked for sheen
No burn barrel used
Old chrome plating shop was at Pine and Mingo, has moved to 45th / 46th and Mingo

Preliminary Assessment Sign-In Sheet

Tulsa AASF #2
10/17/19

Name	Position	Years at the Facility	Phone Number/Email	May AECOM use your name in the PA Report?
[redacted]	MAINTENANCE TEST PILOT	30	[redacted]	YES
	FACILITY MANAGER	20		yes
	Supervisor	30		yes
	Computer Assistat	19		yes
	Quality Control	23		yes
	State Haz Waste Manager OMO - ENV	6 months		yes
	MECHANIC, AIRCRAFT	21		yes.

Appendix B.2
Visual Site Inspection Checklists

Facility ST
Visual Survey Inspection Log

Recorded by: [redacted]
ARNG Contact:
Date: 10/17/19 0900

Site Name / Area Name / Unique ID: Tulsa AASF #2
Site / Area Acreage: ~47 acres
Historic Site Use (Brief Description): Previously may have been agricultural or undeveloped land

Current Site Use (Brief Description): Supports aviation equipment and machinery and maintains properly trained and equipped units ready for mobilization.

1. Was AFFF used at the site/area? (Y) N
   3a. If yes, document how AFFF was used and usage time (e.g., *fire fighting training 2001 to 2014*) Fire training from 1990s to early 2000s, AFFF suppression system installed in 2014.
2. Has usage been documented? Y / (N)
   2a. If yes, keep a record (place electronic files on a disk)

Significant Topographical Features:

1. Has the infrastructure changed at the site/area? Y (N)
   1a. If so, please describe change: (*ex. Structures structures longer exist.*) No substantial structural changes over time.
2. Is the site/area vegetated? (Y) N
   2a. If not vegetated, briefly describe the site/area composition: Grassy areas surround the flight line and buildings
3. Does the site or area exhibit evidence of erosion? Y / (N)
   3a. If yes, describe the location and extent of the erosion : Site is relatively flat
4. Does the site/area exhibit any areas of ponding or standing water? Y / (N)
   4a. If yes, describe the location and extent of the ponding : Water does collect at the wash rack during large rain events, as well as the grassy area near the flight line.

Migration Potential:

1. Does site/area drainage flow off installation? (Y) N
   1a. If so, please note observation and location: Drainage flows to the west to Mingo Creek
2. Is there standing water or drainage issues within the site/area? (Y) N
   2a. If so, please note observation and location: During heavy rain there is sometimes flooding of the flight line/grassy areas.
3. Is there channelized flow within the site/area? (Y) / N
   3a. If so, please note observation and location: Drainage ditches in grassy area take water NW offsite to Mingo Creek.
4. Have man-made drainage channels been constructed within the site/area? Y / (N)
   4a. If so, please note the location of the channel:

Additional Notes

Appendix B.3
Conceptual Site Model Information

Preliminary Assessment – Conceptual Site Model Information

Site Name: Tulsa AASF #2

Why has this location been identified as a site?

Historic Tri-Max use and accidental triggering of the AFFF suppression system.

Are there any other activities nearby that could also impact this location?

American Airlines (0.8 mi WSW), Landfill (1.5 mi E), ~~Atro Steel (1130 ft E)~~ United Plating Works (4600 ft W), WWTP (1.6 mi N), Air National Guard (1.2 mi W)

Training Events

Have any training events with AFFF occurred at this site? Yes

If so, how often? Approximately twice / three times at 3 locations with 1 unit

How much material was used? Is it documented? Not documented

Identify Potential Pathways: Do we have enough information to fully understand over land surface water flow, groundwater flow, and geological formations on and around the facility? Any direct pathways to larger water bodies?

Surface Water:

Surface water flow direction? NW, to Bird Creek

Average rainfall? 38.7 inches

Any flooding during rainy season? Yes

Direct or indirect pathway to ditches? Indirect pathway over flight line

Direct or indirect pathway to larger bodies of water? Direct pathway to Bird Creek then to Arkansas River

Does surface water pond any place on site? In grassy areas & at wash rack

Any impoundment areas or retention ponds? No

Any NPDES location points near the site? Unknown

How does surface water drain on and around the flight line? To ditch in grassy area and then NW offsite

Preliminary Assessment – Conceptual Site Model Information

Groundwater:

Groundwater flow direction? Unknown

Depth to groundwater? Unknown Depth to water: 12 ft bgs

Uses (agricultural, drinking water, irrigation)? 1 domestic well SSE 1/2-1 mile

Any groundwater treatment systems? No

Any groundwater monitoring well locations near the site? Yes

Is groundwater used for drinking water? 1 domestic well (facility is on city water)

Are there drinking water supply wells on installation? No

Do they serve off-post populations? No

Are there off-post drinking water wells downgradient Groundwater flow direction is unknown.

Waste Water Treatment Plant:

Has the installation ever had a WWTP, past or present? No

If so, do we understand the process and which water is/was treated at the plant? N/A

Do we understand the fate of sludge waste? N/A

Is surface water from potential contaminated sites treated? N/A

Equipment Rinse Water

1. Is firefighting equipment washed? Where does the rinse water go?

Unknown

2. Are nozzles tested? How often are nozzles tested? Where are nozzles tested? Are nozzles cleaned after use? Where does the rinse water flow after cleaning nozzles?

Unknown

3. Other?

Preliminary Assessment – Conceptual Site Model Information

Identify Potential Receptors:

Site Worker Yes

Construction Worker Yes

Recreational User No

Residential Potentially affected water supply

Child "

Ecological Surface drainage runs off to Bird Creek

Note what is located near by the site (e.g. daycare, schools, hospitals, churches, agricultural, livestock)?

Industrial, airport

Documentation

Ask for Engineering drawings (if applicable). SPCC plans

Has there been a reconstruction or changes to the drainage system? When did that occur?

3 types of OWS

-Filter in POL building - underground plate system

-Straight to creek with defoamer

- Currently use recycle system - burn off (installed in 2010)

Appendix C
Photographic Log

APPENDIX C – Photographic Log

Army National Guard, Preliminary Assessment for PFAS	Tulsa AASF #2 (October 17, 2019)	Tulsa, Oklahoma

Photograph No. 1

Description:

Photo facing north of oil/water separator that is located on the west side of the facility. This OWS receives wastewater from the trench drains in the hangars.

Photograph No. 2

Description:

Photo facing west of the flight line. Helicopters and mobile firefighting units (Purple-K) shown. Location of historic Tri-Max™ Training Area 1.

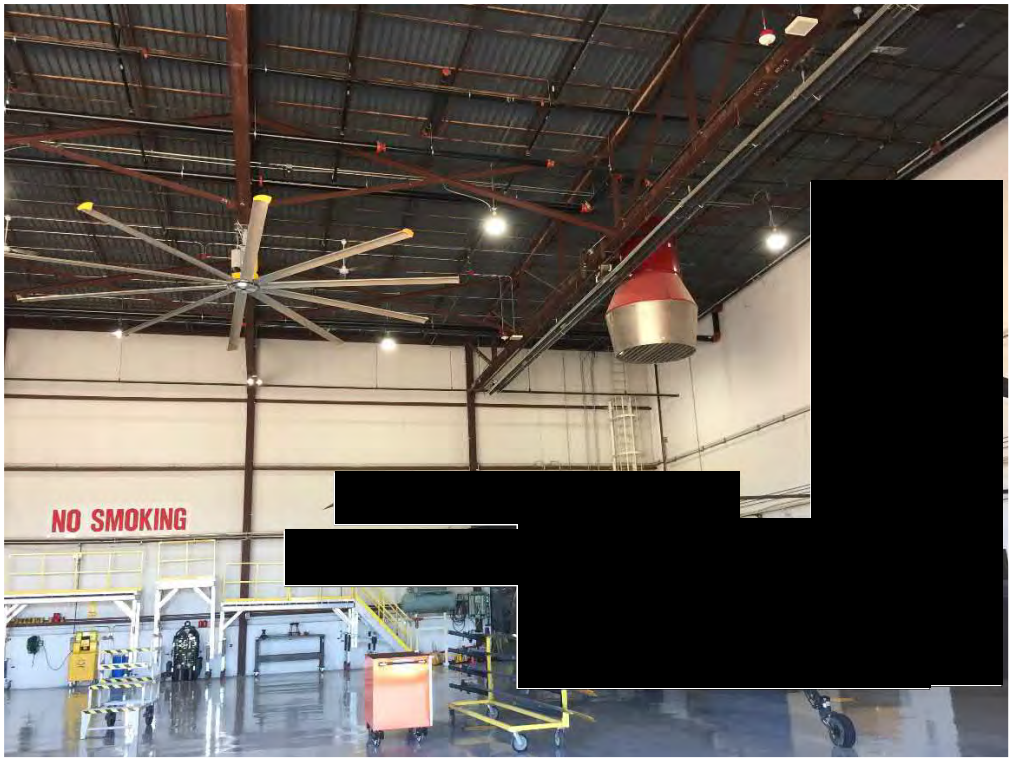
APPENDIX C – Photographic Log

Army National Guard, Preliminary Assessment for PFAS	Tulsa AASF #2 (October 17, 2019)	Tulsa, Oklahoma

Photograph No. 3

Description:

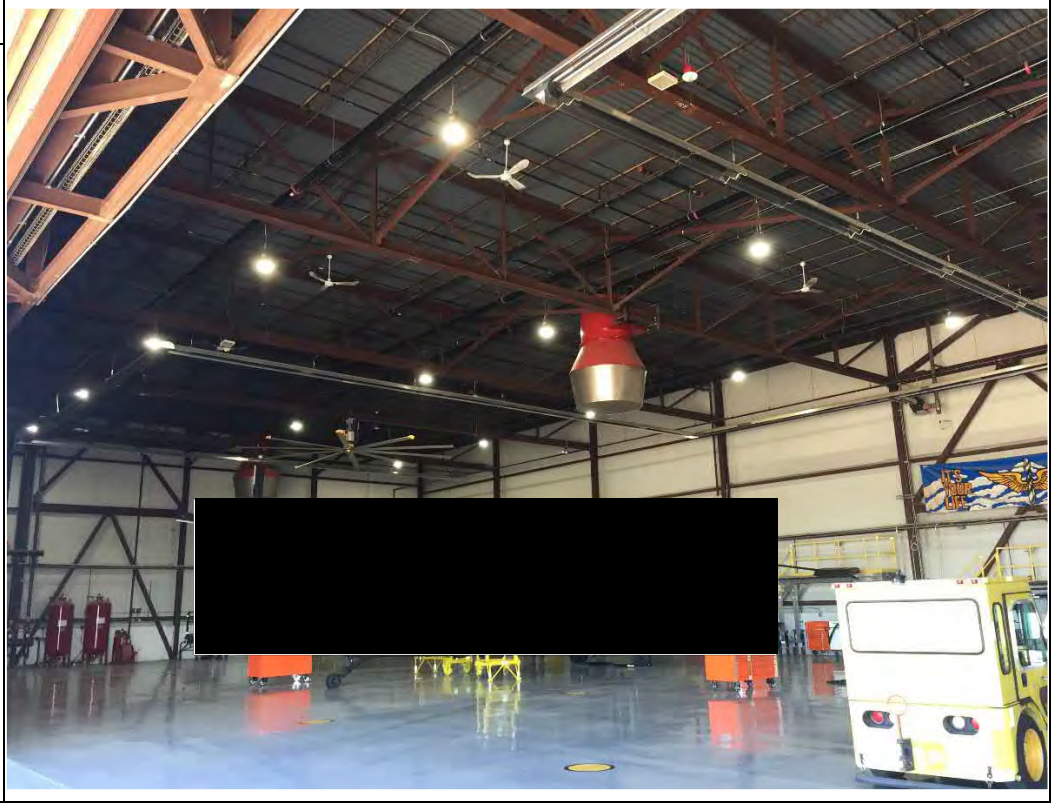
Photo facing east of Storage Hangar. This hangar has a fire suppression system and three overhead foam sprayers (red unit attached to the ceiling on right side of photo). This is the location of the 2014 accidental triggering of the fire suppression system.



Photograph No. 4

Description:

View of the Storage Hangar facing northeast. Two foam ceiling spray nozzles are visible, as well as the two 300-gallon foam tanks and one 36-gallon manual AFFF tank along the north wall.



APPENDIX C – Photographic Log

Army National Guard, Preliminary Assessment for PFAS	Tulsa AASF #2 (October 17, 2019)	Tulsa, Oklahoma

Photograph No. 5

Description:

Photo facing north of the historic Tri-Max™ Training Area 1 located west of the Storage Hangar.

Photograph No. 6

Description:

Photo facing west of the historic and current wash rack.

APPENDIX C – Photographic Log

Army National Guard, Preliminary Assessment for PFAS	Tulsa AASF #2 (October 17, 2019)	Tulsa, Oklahoma

Photograph No. 7

Description:

Photo facing north of valve and OWS that is connected to the wash rack.

Photograph No. 8

Description:

Photo of the Water Maze® Evaporator; used to burn off excess wastewater from the wash rack.

APPENDIX C – Photographic Log

Army National Guard, Preliminary Assessment for PFAS	Tulsa AASF #2 (October 17, 2019)	Tulsa, Oklahoma

Photograph No. 9

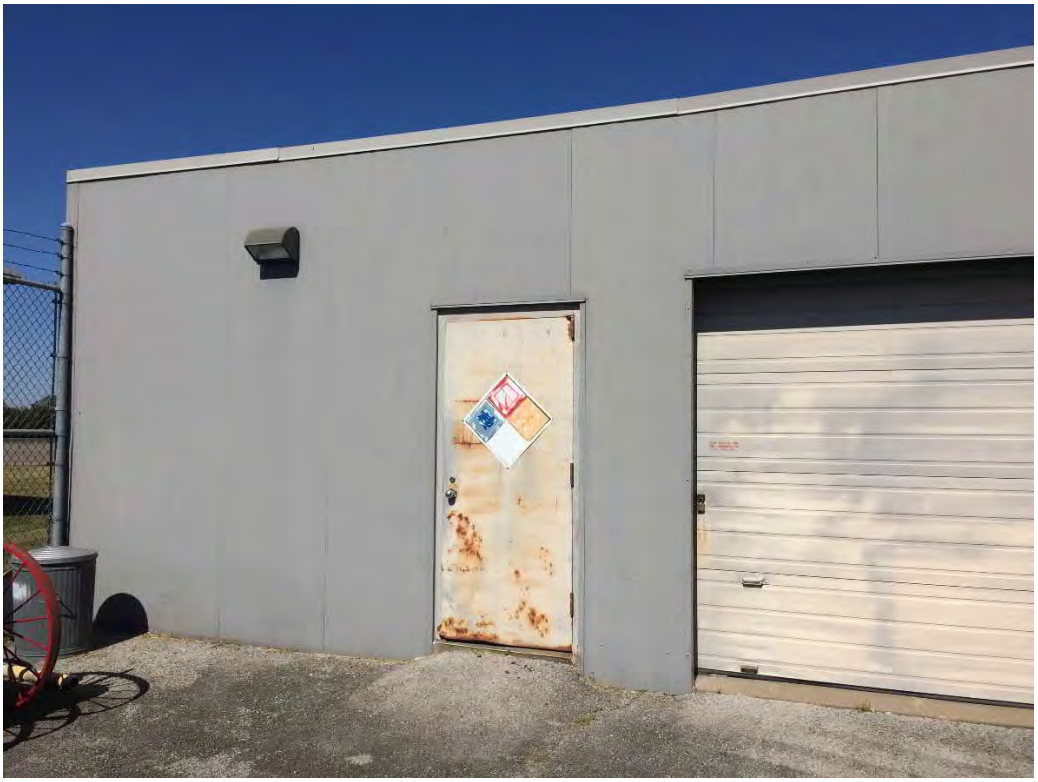
Description:

Photo facing west of the holding tanks that are located between the OWS and the Water Maze® evaporator.

Photograph No. 10

Description:

Photo facing north of Building 100. This is the location where historically 25 5-gallon buckets of AFFF were stored.



APPENDIX C – Photographic Log

Army National Guard, Preliminary Assessment for PFAS	Tulsa AASF #2 (October 17, 2019)	Tulsa, Oklahoma

Photograph No. 11

Description:

Inside of Building 100, where historically 25 5-gallon buckets of AFFF were stored.

Photograph No. 12

Description:

Photo facing north toward HEMTT storage area.

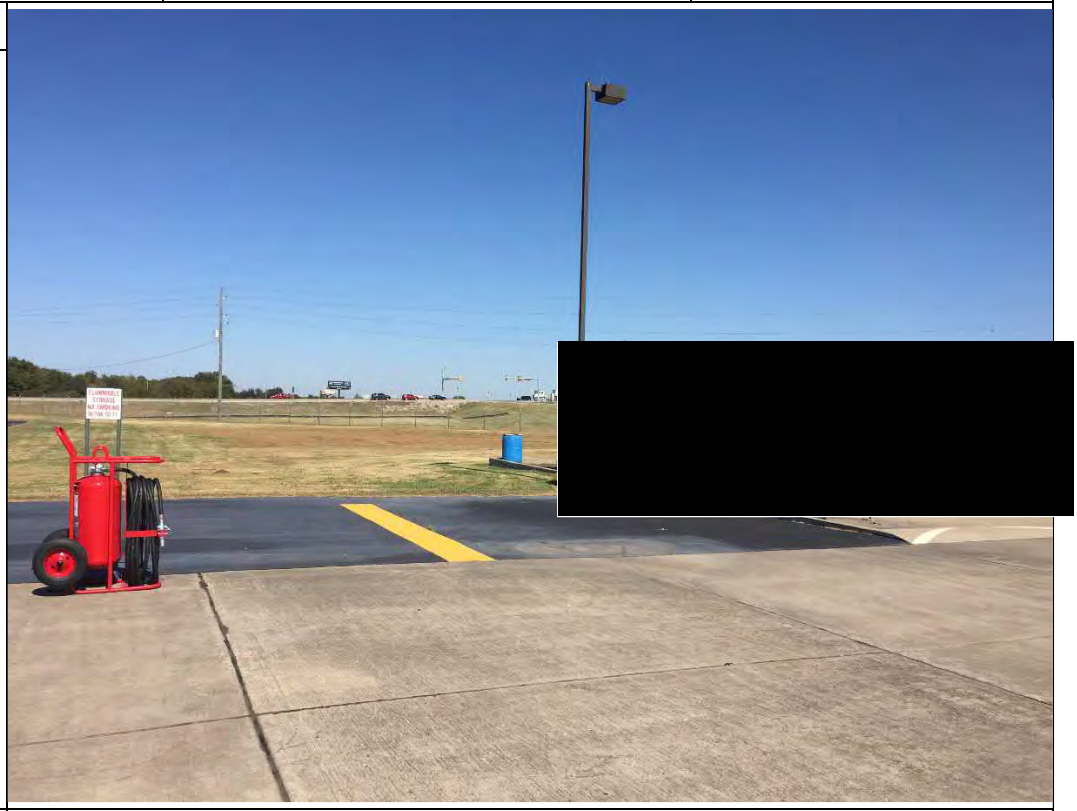
APPENDIX C – Photographic Log

Army National Guard, Preliminary Assessment for PFAS	Tulsa AASF #2 (October 17, 2019)	Tulsa, Oklahoma

Photograph No. 13

Description:

HEMTT fueling area with mobile fire extinguisher.



Photograph No. 14

Description:

Photo near the northwest part of the flightline. Photo is facing northwest, toward the drainage ditch where stormwater flows off the facility.

APPENDIX C – Photographic Log

Army National Guard, Preliminary Assessment for PFAS	Tulsa AASF #2 (October 17, 2019)	Tulsa, Oklahoma

Photograph No. 15

Description:

Ditch along the east side of the flightline.

Photograph No. 16

Description:

Photo facing west. Drainage from the OWS to Mingo Creek.

APPENDIX C – Photographic Log

Army National Guard, Preliminary Assessment for PFAS	Tulsa AASF #2 (October 17, 2019)	Tulsa, Oklahoma

Photograph No. 17

Description:

Photo facing east. Photo of historic Tri-Max™ Training Area 3, which is located on the western flight line.

Photograph No. 18

Description:

Photo facing northeast of location of historic Tri-Max™ Training Area 2.

APPENDIX C – Photographic Log

Army National Guard, Preliminary Assessment for PFAS	Tulsa AASF #2 (October 17, 2019)	Tulsa, Oklahoma

Photograph No. 19

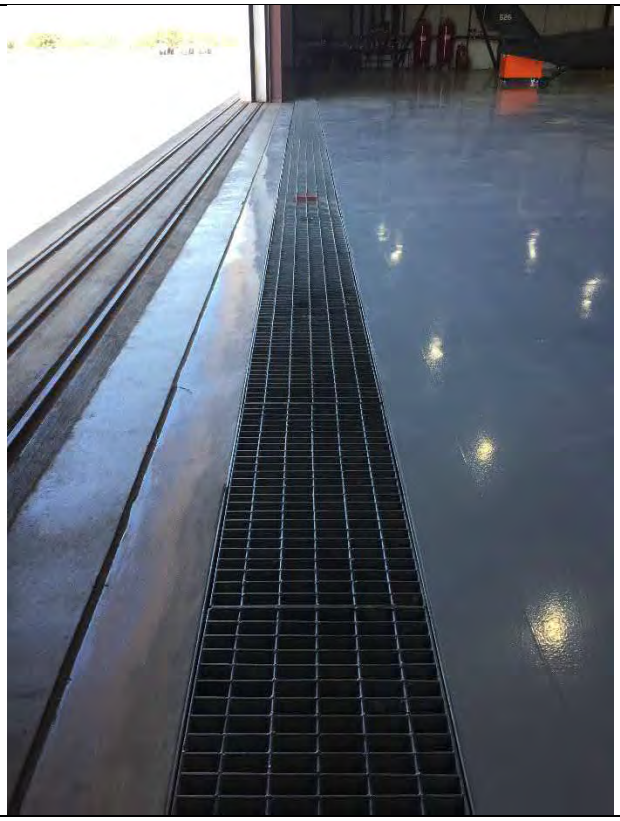
Description:

Historic firetruck location, facing south.

Photograph No. 20

Description:

Trench drain along west side of Storage Hangar and Maintenance Hangar.



APPENDIX C – Photographic Log

Army National Guard, Preliminary Assessment for PFAS	Tulsa AASF #2 (October 17, 2019)	Tulsa, Oklahoma

Photograph No. 21

Description:

36-gallon AFFF tank (built in 2013) for manual fire fighting in the hangars. Three of these tanks located in the Storage Hangar, and two are located in the Maintenance Hangar.

Photograph No. 22

Description:

Chemical data information listed on the two 300-gallon AFFF tanks located in the Storage Hangar.