FINAL
Site Inspection Report
Shelbyville AASF,
Shelbyville, Indiana

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

March 2022

Prepared for:

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

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Acronyms and Abbreviations

6:2 FTS	6:2 Fluorotelomer sulfonic acid
8:2 FTS	8:2 Fluorotelomer sulfonic acid
µg/kg	micrograms per kilogram
°F	degrees Fahrenheit
%	percent
AASF	Army Aviation Support Facility
AECOM	AECOM Technical Services, Inc.
AFFF	aqueous film forming foam
AOI	Area of Interest
ARNG	Army National Guard
bgs	below ground surface
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CoC	chain of custody
CSM	conceptual site model
DA	Department of the Army
DoD	Department of Defense
DQI	data quality indicator
DQO	data quality objective
DUA	data usability assessment
DVR	data validation report
EDR™	Environmental Data Resources, Inc.™
EIS	extraction internal standards
ELAP	Environmental Laboratory Accreditation Program
EM	Engineer Manual
FedEx	Federal Express
FRB	Field Reagent Blank
FTA	Fire Training Area
gpm	gallons per minute
GPRS	Ground Penetrating Radar Services, LLC
HA	Health Advisory
HDPE	high-density polyethylene
IDEM	Indiana Department of Environmental Management
IDW	investigation-derived waste
IIS	injection internal standards
INARNG	Indiana Army National Guard
IDNR	Indiana Department of Natural Resources
ITRC	Interstate Technology Regulatory Council
LC/MS/MS	liquid chromatography with tandem mass spectrometry
LCS	laboratory control spike
LCSD	laboratory control spike duplicate
LOQ	limit of quantitation
MDL	method detection limit
MS	matrix spike
MSD	matrix spike duplicate

NELAP	National Environmental Laboratory Accreditation Program
NEtFOSAA	N-ethyl perfluorooctanesulfonamidoacetic acid
ng/L	nanograms per liter
NMeFOSAA	N-methyl perfluorooctanesulfonamidoacetic acid
OSD	Office of the Secretary of Defense
PA	Preliminary Assessment
PFAS	per- and polyfluoroalkyl substances
PFBA	perfluorobutyrate
PFBS	perfluorobutanesulfonic acid
PFCs	perfluorinated compounds
PFDA	perfluorodecanoic acid
PFDoA	perfluorododecanoic acid
PFHpA	perfluoroheptanoic acid
PFHxA	perfluorohexanoic acid
PFHxS	perfluorohexanesulfonic acid
PFNA	perfluorononanoic acid
PFOA	perfluorooctanoic acid
PFOS	perfluorooctanesulfonic acid
PFPeA	perfluoropentanoic acid
PFTeDA	perfluorotetradecanoic acid
PFTrDA	perfluorotridecanoic acid
PFUdA	perfluoroundecanoic acid
PID	photoionization detector
PQAPP	Programmatic UFP-QAPP
QA	quality assurance
QAPP	Quality Assurance Project Plan
QC	quality control
QSM	Quality Systems Manual
RI	Remedial Investigation
RPD	relative percent differences
SI	Site Inspection
SL	screening level
SOP	standard operating procedure
TOC	total organic carbon
TPP	Technical Project Planning
UCMR3	Unregulated Contaminant Monitoring Rule 3
UFP	Uniform Federal Policy
US	United States
USACE	United States Army Corps of Engineers
USCS	Unified Soil Classification System
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service

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Executive Summary

The Army National Guard (ARNG) G9 is performing Preliminary Assessments (PAs) and Site Inspections (SIs) at per- and polyfluoroalkyl substances (PFAS)-impacted sites at ARNG facilities nationwide. The objective of the SI at each facility is to identify whether there has been a release to the environment from the Areas of Interest (AOIs) identified in the PA and determine the presence or absence of perfluorooctanoic acid (PFOA), perfluorooctanesulfonic acid (PFOS), and perfluorobutanesulfonic acid (PFBS) at or above screening levels (SLs). An SI was completed at the Shelbyville Army Aviation Support Facility (AASF) in Shelbyville, Indiana. Shelbyville AASF will be referred to as the "facility" throughout this document.

The Shelbyville AASF is located off North Michigan Road, approximately 4.5 miles north-northwest of the Town of Shelbyville, in Shelby County, Indiana. The AASF is relatively small facility, at approximately 45-acres, that was originally constructed in 1972 and is owned and operated by Indiana ARNG for the operation, maintenance, and repair of rotary-winged aircraft. The PA identified two potential PFAS release areas based on the use and storage of aqueous film forming foam (AFFF). The two release areas were made into AOIs: AOI 1: Northern Drainage Ditch and AOI 2: Flight Ramp (AECOM, 2020). After the completion of the PA, AOI 2 was amended to include the Storage Tents, and an additional AOI, AOI 3: AFFF Storage Area, was added. These additions reflect the programmatic decision to conservatively include AFFF storage sites without known releases as AOIs. Each of the AOIs were investigated during the SI field activities conducted from 5 April to 9 April 2021.

To fulfill the project Data Quality Objectives set forth in the approved SI Quality Assurance Project Plan Addendum (AECOM, 2021a), samples were collected and analyzed for a subset of 18 PFAS by liquid chromatography with tandem mass spectrometry compliant with Quality Systems Manual 5.3 Table B-15. The 18 PFAS analyzed as part of the ARNG SI program are specified in **Section 5.9** of this Report.

The Department of Defense (DoD) has adopted a policy to retain facilities in the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) process based on risk-based SLs for soil and groundwater, as described in a memorandum from the Office of the Secretary of Defense dated 15 September 2021 (Assistant Secretary of Defense, 2021). The ARNG PFAS SIs follow this DoD policy and, should the maximum site concentration for sampled media exceed the SLs, the AOI will proceed to a Remedial Investigation (RI), the next phase under CERCLA. The SLs apply to three compounds, PFOA, PFOS, and PFBS, for both soil and groundwater, as presented in **Table ES-1**. All other results presented in this report are considered informational in nature and serve as an indication as to whether soil, groundwater, and sediment contain or do not contain the 18 PFAS analyzed within the boundaries of the facility.

Sample chemical analytical concentrations were compared against the project SLs as described in **Table ES-1**. A summary of the results of the SI data relative to the SLs is as follows:

- PFOS in surface soil at AOI 3: AFFF Storage Area exceeded the SL of 130 micrograms per kilogram (µg/kg), with a concentration of 2,680 µg/kg at location AOI03-01. Based on the results of the SI, further evaluation of AOI 3 is warranted in the RI. The detected concentrations of PFOA, PFOS, and PFBS in soil samples collected from all other AOIs were below the SLs.
- PFOA and PFOS were not detected in any groundwater samples collected. PFBS was detected in a single groundwater sample, at a concentration below the SL. While the groundwater concentrations did not exceed the SLs for the samples collected as part of the SI at the facility, the observed groundwater flow direction suggests that groundwater was not adequately characterized. Additional data collected during the RI would improve the understanding of groundwater conditions at the facility.

- It is further recommended that the AOIs are combined and move forward collectively to the RI phase. This determination was based on the proximity of the release areas within the AASF and on the connectivity between these release areas, as it relates to overlapping transport and migration pathways (e.g., combined drainage features).

Table ES-2 summarizes the SI results for soil and groundwater. Based on the conceptual site models (CSMs) developed and revised in light of the SI findings, there is potential for exposure to on-facility and off-facility receptors caused by DoD activities at the facility.

Table ES-3 summarizes the rationale used to determine if an AOI should be considered for further investigation under CERCLA and undergo an RI. Based on the results of this SI, further evaluation under an RI is warranted at Shelbyville AASF. It is recommended that the release areas be combined into a single AOI and investigated collectively. This recommendation is made on the basis that the release areas are closely interconnected and that further evaluation can be adequately addressed recognizing a single AOI.

Table ES- 1 Screening Levels (Soil and Groundwater)

Analyte	Residential (Soil) (µg/kg)[a] 0-2 feet bgs	Industrial/ Commercial Composite Worker (Soil) (µg/kg)[a] 2-15 feet bgs	Tap Water (Groundwater) (ng/L)[a]
PFOA	130	1,600	40
PFOS	130	1,600	40
PFBS	1,900	25,000	600

Notes:

a.) Assistant Secretary of Defense, 2021. Risk Based Screening Levels Calculated for PFOS, PFOA, PFBS in Groundwater and Soil using United States Environmental Protection Agency's (USEPA's) Regional Screening Level Calculator. Hazard Quotient (HQ) = 0.1. 15 September 2021.

ng/L= nanograms per liter

Table ES- 2 Summary of Site Inspection Findings

AOI	Potential PFAS Release Area	Soil – Source Area	Groundwater – Source Area	Groundwater – Facility Boundary
1	Northern Drainage Ditch	N/A[1]	N/A[2]	N/A[2]
2	Flight Line & Storage Tents	◐	N/A[2]	N/A[2]
3	AFFF Storage Area	●	N/A[2]	N/A[2]
Sitewide Locations[3]	Unknown	◐	N/A[2]	◐

Legend:

N/A = Not applicable

1) Due to the nature of AOI 1, only sediment samples were collected.

2) Groundwater was assessed sitewide at the facility boundary. Results are not associated with a specific AOI. See Section 6.6 "Sitewide Locations".

3) Sitewide locations are not considered source areas.

● = detected; exceedance of the screening levels

◐ = detected; no exceedance of the screening levels

○ = not detected

Table ES- 3 Site Inspection Recommendations

AOI	Description	Rationale	Future Action
1	Northern Drainage Ditch	Detections in sediment. No groundwater or soil samples collected. Groundwater was assessed at the facility boundary; however, downgradient well control was not achieved.	Group AOI 1 with the other two AOIs based on proximity and relation. Proceed to RI collectively based on the soil exceedance at AOI 3.
2	Flight Line & Storage Tents	Detections in soil but no exceedances of SLs. No groundwater sample collected at the AOI. Groundwater was assessed at the facility boundary; however, downgradient well control was not achieved.	Group AOI 2 with the other two AOIs based on proximity and relation. Proceed to RI collectively based on the soil exceedance at AOI 3.
3	AFFF Storage Area	Exceedance of PFOS SL in soil. No groundwater sample collected at the AOI. Groundwater was assessed at the facility boundary; however, downgradient well control was not achieved.	Group AOI 3 with the other two AOIs based on proximity and relation. Proceed to RI.
Sitewide Locations	Facility Boundary	Detections in soil and groundwater but no exceedances of SLs. Downgradient well control was not achieved.	Collect additional groundwater data at the up- and downgradient facility boundaries during the RI

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1. Introduction

1.1 Project Authorization

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) at Impacted Sites, ARNG Installations, 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 performed this SI at Shelbyville Army Aviation Support Facility (AASF) in Shelbyville, Indiana. The AASF is also referred to as the "facility" throughout this document.

The SI project elements were performed in compliance with Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA; US Environmental Protection Agency [USEPA], 1980), as amended, the National Oil and Hazardous Substances Pollution Contingency Plan (40 Code of Federal Regulations Part 300; USEPA, 1994), and in compliance with US Department of the Army (DA) requirements and guidance for field investigations including specific requirements for sampling for PFOA, PFOS, and perfluorobutanesulfonic acid (PFBS), and the group of related compounds known in the industry as per- and polyfluoroalkyl substances (PFAS). The term PFAS is used throughout this report to encompass all PFAS chemicals being evaluated, including PFOA, PFOS, and PFBS, which are the key components of the suspected releases being evaluated, and the other 15 related compounds listed in the task order.

1.2 SI Purpose

A PA was performed at Shelbyville AASF (AECOM, 2020) that identified two potential PFAS release areas that were each made into an Area of Interest (AOI). One additional potential PFAS release area was added as an AOI following the PA. The objective of the SI is to identify whether there has been a release to the environment from the AOIs and determine the presence or absence of PFOA, PFOS, and PFBS at or above screening levels (SLs).

As stated in the *Federal Facilities Remedial Site Inspection Summary Guide* (USEPA, 2005), an SI has five goals:

1. Develop information to potentially eliminate a release from further consideration because it is determined that it poses no significant threat to human health or the environment;
2. Determine the potential need for a removal action;
3. Collect or develop data to evaluate potential release;
4. Collect data to better characterize the release for more effective and rapid initiation of a Remedial Investigation (RI), if determined necessary; and
5. Collect data to determine whether the release is more than likely the result of activities associated with the Department of Defense (DoD).

In addition to the USEPA-identified goals of an SI, the ARNG SI also identifies whether there are potential off-facility PFAS sources.

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2. Facility Background

2.1 Facility Location and Description

The Shelbyville AASF is located off North Michigan Road (which parallels Interstate-74), approximately 4.5 miles north-northwest of the Town of Shelbyville, in Shelby County, Indiana (**Figure 2-1**). Shelby County is a sparsely populated county of about 44,000 people, with approximately 108 people per square mile. The original footprint of the AASF comprised two parcels of land totaling 20.26 acres that were purchased from residents of the area in 1970. Two additional parcels of 7.5 acres and 17.6 acres of land were added to the footprint in 1973 and 1997, respectively. The now 45.36-acre property has been state-owned since its purchase and is used for the operation, maintenance, and repair of rotary-winged aircraft.

The AASF was originally constructed in 1972, shortly after purchase, and currently consists of an aircraft hangar, ground power shop, flight line, fuel farm, containment pad, onsite package wastewater treatment plant, administrative offices, chemical storage sheds, personally-owned vehicle parking areas, storage hangars, and a 6-acre flight line. The AASF is bordered to the north by a casino and horse track, an industrial manufacturer, and a wood floor refinishing outfit; agricultural land is located to the east, south, and west.

2.2 Facility Environmental Setting

Shelbyville AASF is located in the New Castle Till Plains and Drainageways unit of the Central Till Plain physiographic region (Gray, 2001). This unit is characterized by low-relief till plains crosscut by major tunnel-valleys (areas where glacial meltwater tunneled underneath the glacier leaving behind deposits of till and stratified drift) up to 1 mile wide and 20 miles long (Franzmeier et al., 2004). Shelby County is within the maximum glacial extent of the Wisconsin glaciation. The area surrounding the AASF is primarily rural agricultural land, with some recreational and industrial land uses close-by. The topography of Shelbyville AASF is shown in **Figure 2-2**.

2.2.1 Geology

The bedrock underlying the facility comprises middle Devonian carbonates of the Muscatatuck Group, except where erosion has exposed underlying Silurian carbonates (Schrader, 2005). These carbonates range from lime to dolostone and are separated by the Waldron Shale into an upper and lower sequence. The upper Devonian New Albany Shale that covers most of west-central and western Indiana has been completely eroded at the facility location (Fenelon et al., 1994). Structurally, Shelby County lies on the western limb of the Cincinnati Arch, a regional anticline composed of Paleozoic rocks whose extent reaches from Ohio to eastern Indiana and northern Kentucky. The complimentary syncline to the west of the Cincinnati Arch is the Illinois Basin, which consists of of Silurian to Pennsylvanian rocks on whose rising limb Shelby County sits. This limb dips gently southwest at 10 to 20 feet per mile (Fenelon et al., 1994).

The bedrock is unconformably overlain by Pleistocene deposits of the Trafalgar Formation that are approximately 50 to 100 feet thick (Environmental Data Resources, Inc.™ [EDR]™, 2018; Wayne, 1963). These unconsolidated till deposits were deposited by melting glaciers, leaving behind complex strata of clay, silt, sand, and gravel. Often characterized by a compact, but uncemented, silty, sandy matrix containing abundant pebbles and cobbles, the Trafalgar Formation maintains relatively low permeability with the exception of the interbedded sands and gravels found through. Typically, a thin loess deposit about 10 feet thick overlies the glacial till, often acting as an aquitard.

2.2.2 Hydrogeology

The facility is underlain by Pleistocene glacial deposits, specifically the New Castle Till aquifer system (**Figure 2-3**). This system is characterized by thinner intra-till sand and gravel layers that differ from the northern and western parts of the county that are hydrologically separated from meteoric and surface infiltration by the overlying till. According to the Indiana Department of Natural Resources (IDNR), unconsolidated deposits range in thickness from about 40 feet to more than 100 feet where glacial deposits have filled bedrock valleys (IDNR, 2005). These horizontal layers of varying depth and thickness often cross surface drainage basin boundaries subterraneously (Fenelon et al., 1994). The potential aquifer materials (sand and gravel) typically range from 4 to 15 feet thick and are generally overlain by 30 to 50 feet of till. System recharge is generally from groundwater in overlying till layers, though recharge is limited, as these till layers typically inhibit groundwater infiltration. Wells constructed in the unit are generally 40 to 65 feet deep, with static water levels commonly 10 to 25 feet below ground surface (bgs). Groundwater flow in the unconsolidated aquifer system near the facility is generally to the southwest, towards major surface drainages in the area, as determined by past studies (IDNR, 2012). However, localized groundwater flow directions may vary based on site conditions. Site-specific groundwater elevation and flow data at Shelbyville AASF were not available prior to this SI. Depths to groundwater measured in permanent wells during the SI ranged from 4.77 feet bgs to 10.92 feet bgs. Groundwater elevations and contours from the SI are presented on **Figure 2-4** and indicate that the on-facility groundwater flow direction is to the northwest.

Underlying the New Castle Till aquifer system is the Silurian-Devonian aquifer system, which is composed of the aforementioned carbonates. These carbonates are divided into an upper and lower aquifer sequence and are marked by the presence of the Waldron Shale. Because limestone and dolostone are not considered to have a high primary porosity, the productivity of these aquifers depends on their secondary porosity achieved through jointing and fracturing. The lower sequence, composed entirely of Silurian age rocks, is generally lower in secondary porosity. The Salamonie dolomite is a typical member of this lower sequence, and its siliceous cap renders the aquifer unproductive in some places (Greeman, 1981). Overlying the lower sequence is the Waldron Shale, which acts as an aquitard between the lower sequence and the much more prolific upper aquifer sequence composed of upper Silurian through Devonian Muscatatuck group carbonates. This upper sequence is the primary bedrock aquifer system in much of the East Fork White River Basin and in southern Shelby County due to its higher secondary porosity. The total thickness of both aquifer sequences ranges from 50 to over 250 feet thick.

Top of bedrock in the area is found at an average of 100 feet bgs, and groundwater wells in the area are typically 50 to 150 feet deep, drawing variously from both the unconsolidated and bedrock aquifers. Static water levels in wells within one eighth of a mile of the AASF are at an average of 20 feet bgs (EDR™, 2018). Well pump rates in the area can theoretically reach 250 gallons per minute (gpm) (Bruns and Uhl, 1976) but are more commonly found in the 10 to 60 gpm range, with an average of 15 gpm (EDR™, 2018). Groundwater flow in the vicinity of Shelbyville AASF has generally been described as southwest (IDNR, 2012), although the direction may vary locally. Shelbyville AASF obtains its drinking water from an on-facility well that is centrally located within the facility. This well was sampled for PFAS in 2017 by the National Guard Bureau; PFOA, PFOS, and PFBS were not detected in any sample.

Based on the USEPA Unregulated Contaminant Monitoring Rule 3 (UCMR3) data, it was indicated that no PFAS were detected in a public water system that serves the City of Shelbyville (approximately 4 miles southeast of the facility) above the USEPA Health Advisory (HA) level (USEPA 2017a).

2.2.3 Hydrology

Shelby County is situated in the East Fork White River Basin, a large catchment encompassing southeastern Indiana. The closest major river system is the Big Blue River, which flows southwest

through Shelbyville. This river is used for recreation (e.g., fishing) but not for drinking water. The nearest natural surface water features to Shelbyville AASF are the Hankins Ditch/Ed Clark Ditch and Brandywine Creek, both of which are tributaries to the Big Blue River. The gradient of these streams, which trends in a northeast – southwest direction, averages about 5 feet per mile (Bruns and Uhl, 1976). Surface water features surrounding the facility are shown in **Figure 2-5**.

Natural lakes do not occur in Shelby County, but gravel pits, farm ponds, and artificial lakes are quite common (Bruns and Uhl, 1976). The casino and horse track to the north of Shelbyville AASF has three artificial ponds, including one at the center of the horse track. There is an additional triangular pond west of the site, across Interstate-74, and a medium drainage pond on the grounds of a previous temporary military structure, present in historical imagery from 2008 to 2013. Groundwater levels in this particular area are quite shallow, reaching as low as 3 feet bgs (EDR™, 2018).

Flooding from the Big Blue River has impacted the City of Shelbyville and the surrounding area in 2005, 2011, and 2013 (Fowler, 2017).

Drainage ditches onsite run northwest and parallel to North Michigan Road, northwest and parallel to the fuel farm, east-west and parallel to the vehicle depot onsite, and ring around the helicopter storage hangars. Surface water runoff from these improved areas of the AASF, particularly the paved areas, flows overland or is conveyed by surface drains into the ditches. Drainage from these ditches is directed to two outfalls that ultimately flow west to Hankins Ditch and Brandywine Creek.

2.2.4 Climate

Shelbyville AASF lies in southeastern Indiana, an area categorized as hot-summer humid continental. Average climate data for the past 5 years were found for Shelbyville Municipal Airport, which abuts the facility. The average annual temperature at Shelbyville Municipal Airport is 54.6 degrees Fahrenheit (°F). Summer has an average maximum temperature of 84.4 °F, with June, July, and August having relatively equal temperatures throughout. Winter has an average minimum temperature of 24.1 °F, with January being the coldest month. Total annual rainfall is 42.5 inches. Rainfall is fairly evenly distributed throughout the year, with an average annual rainfall of 3.5 inches per month. The wettest month, June, receives 5.7 inches of rain, and the driest month, February, receives 2.4 inches of rain. Snow data for the area were unavailable, but the area likely receives snowfall typical for Indiana (National Oceanic and Atmospheric Administration, 2018).

2.2.5 Current and Future Land Use

The Shelbyville AASF is currently owned and operated by the Indiana ARNG (INARNG) and is used for the operation, maintenance, and repair of rotary-winged aircraft. The land surrounding the facility is used for recreation (i.e., casino and horse track), industrial complexes, and agriculture. The Shelbyville Municipal Airport is located to the east, adjacent to the facility. About 1 mile off-facility, there are recreational uses at Brandywine Creek and Hankins Ditch (e.g., fishing and swimming). Reasonably anticipated future land use is not expected to change from the current land use.

2.2.6 Critical Habitat and Threatened/ Endangered Species

The following species are federally endangered, threatened, proposed, and/ or are listed as candidate species in Shelby County, Indiana. No critical habitat is identified in the vicinity of the AASF (US Fish and Wildlife Service [USFWS], 2021).

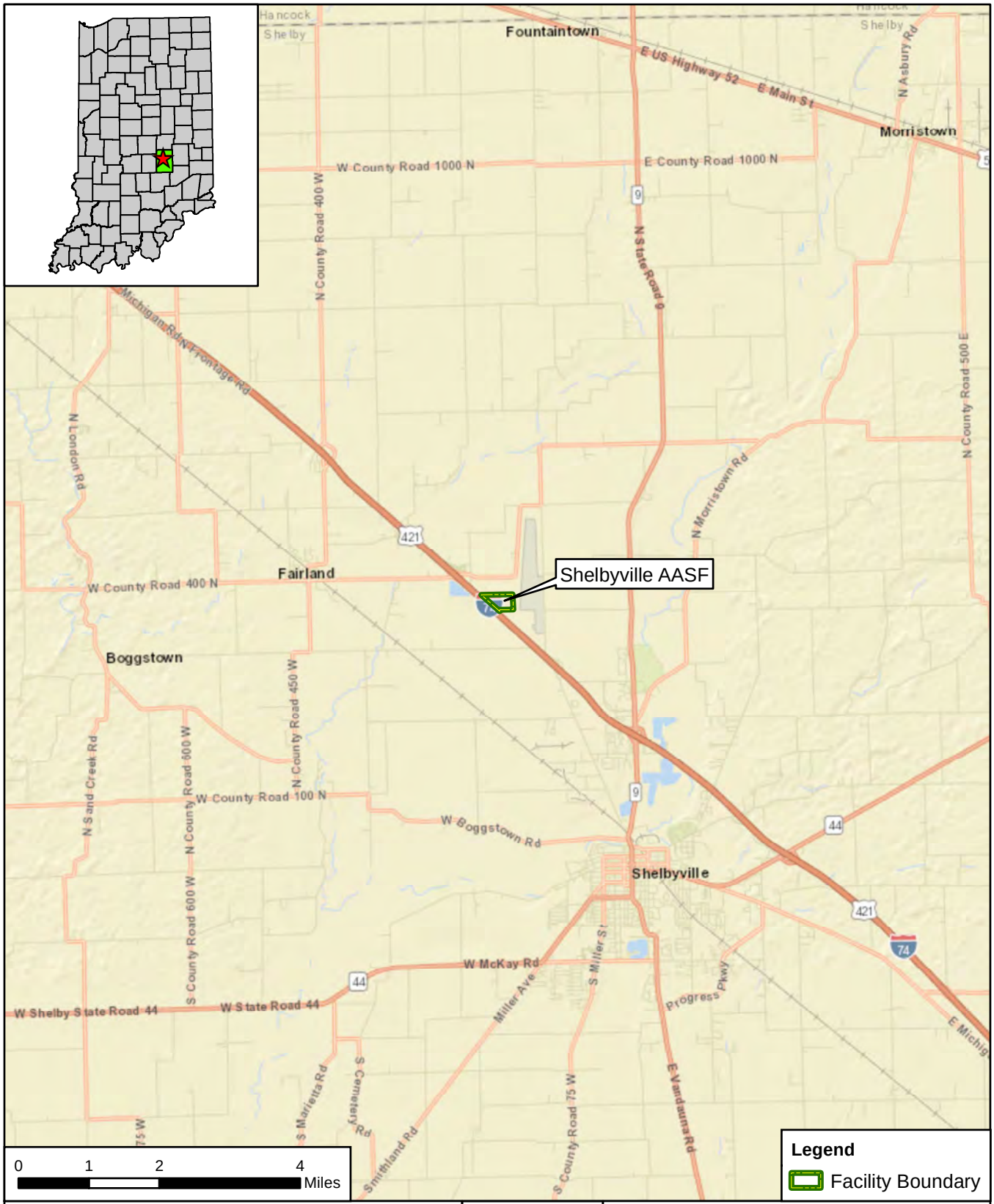
- **Insects:** Monarch butterfly, *Danaus plexippus* (candidate)

- **Clams:** Snuffbox mussel, *Epioblasma triquetra* (endangered)
- **Mammals**: Northern Long-Eared Bat, *Myotis septentrionalis* (threatened); Indiana bat, *Myotis sodalist* (endangered)

2.3 History of PFAS Use

Two potential PFAS releases areas were identified at Shelbyville AASF during the PA at locations where aqueous film forming foam (AFFF) may have been used or released historically (AECOM, 2020). Two additional potential release areas were later added when AFFF storage areas began to be adopted as potential release areas. The known use of AFFF at the facility dates back to 2003, when the first recorded hydrostatic testing of the Tri-Max™ mobile fire extinguisher units resulted in the known release of PFAS to the environment, though typical maintenance schedules suggest that the Tri-Max™ units may have been present at least as early as 1998. No further use or release of AFFF is known to have occurred; however, the Tri-Max™ units were maintained at the facility, where they were staged on the flight ramp or in storage, until they were relocated to another INARNG facility in 2015. At the time of the SI, AFFF was only noted in bulk storage vessels kept within secondary containment.

The potential PFAS release areas were grouped into three AOIs based on proximity to one another and presumed groundwater flow. A detailed description of each AOI is presented in **Section 3**.



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Facility Location

AECOM
12420 Milestone Center Drive
Germantown, MD 20876

Figure 2-1

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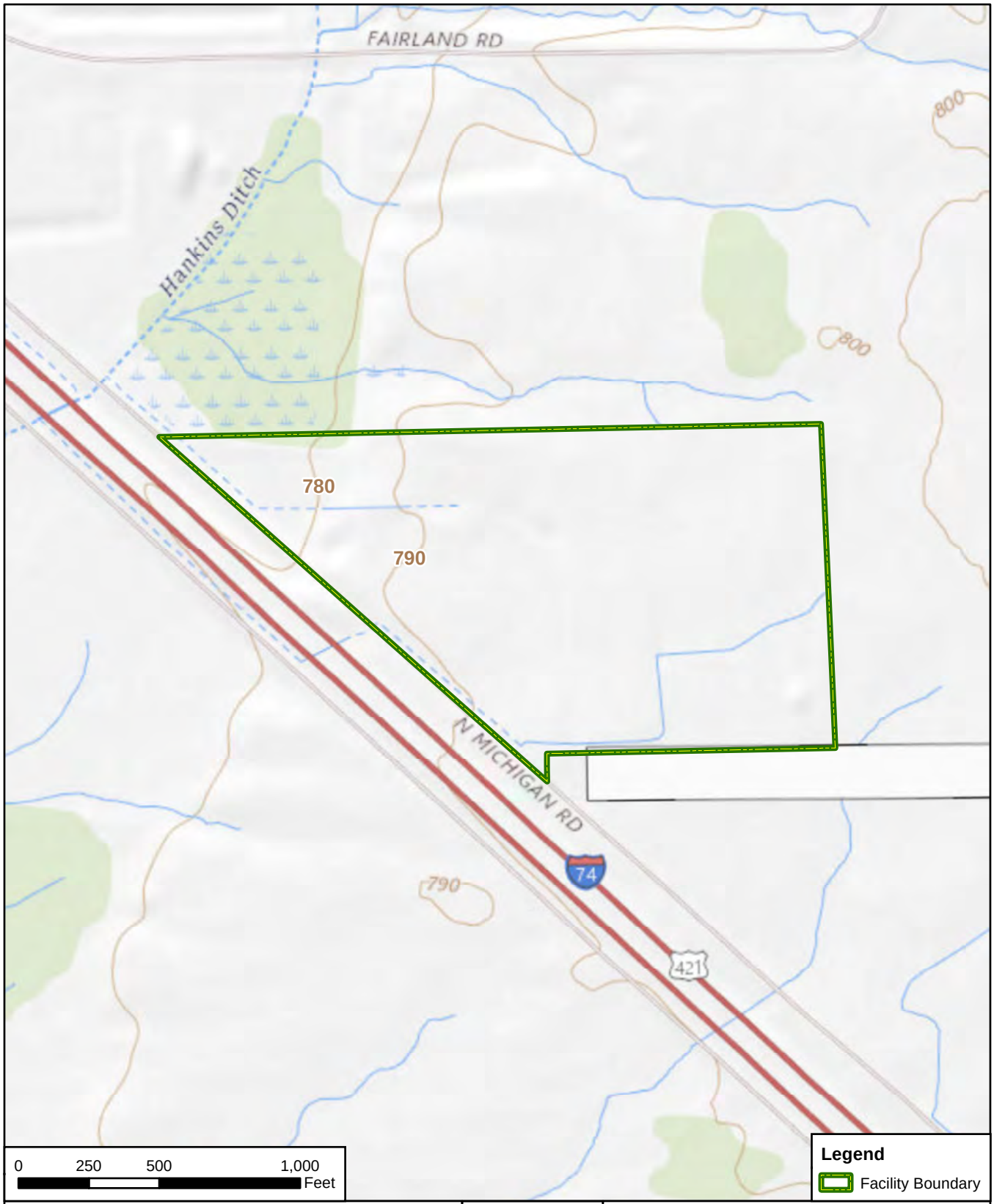

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Shelbyville Topographic Features

AECOM
12420 Milestone Center Drive
Germantown, MD 20876

Figure 2-2

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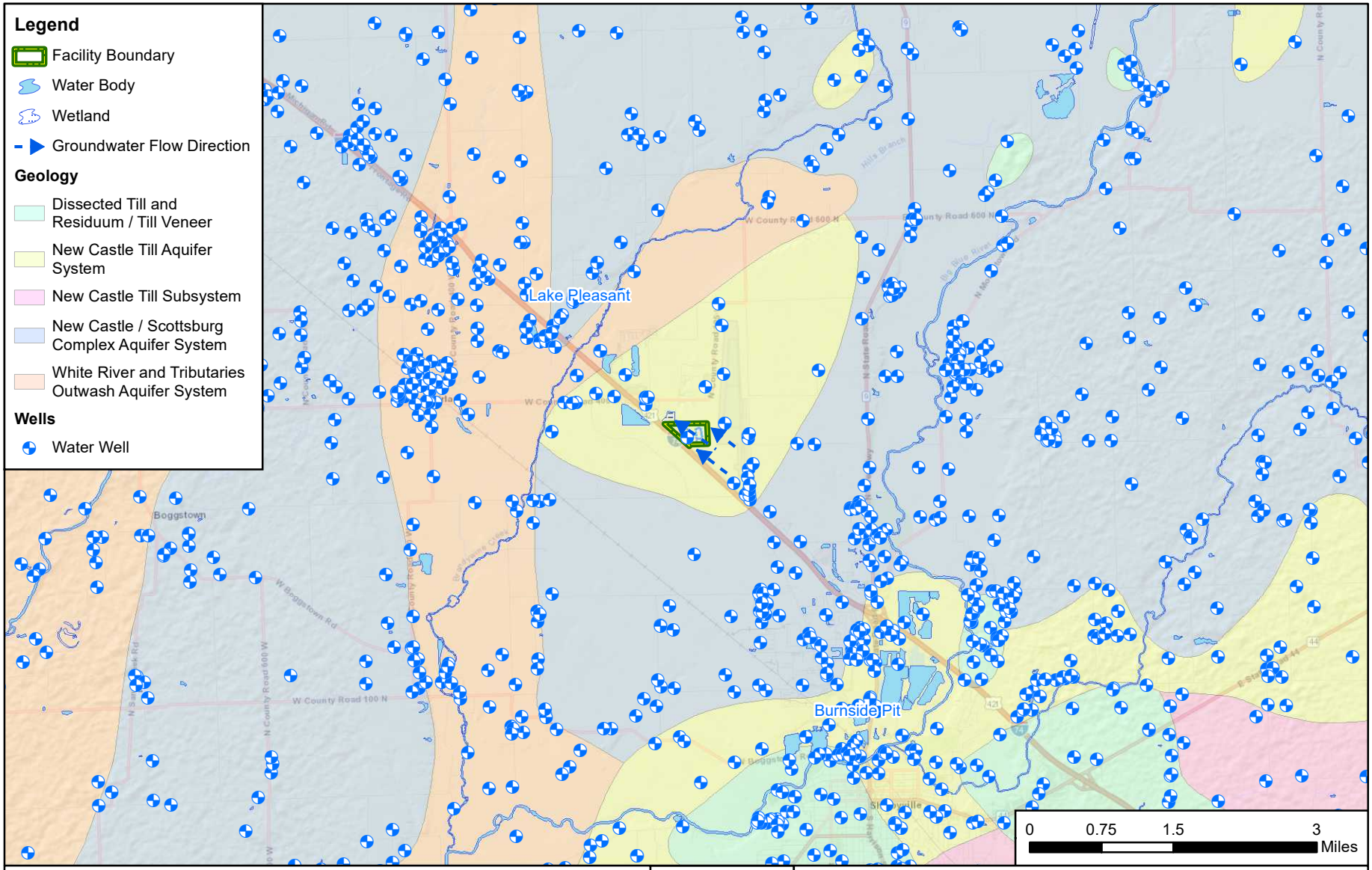

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Groundwater Features

AECOM
12420 Milestone Center Drive
Germantown, MD 20876

Figure 2-3

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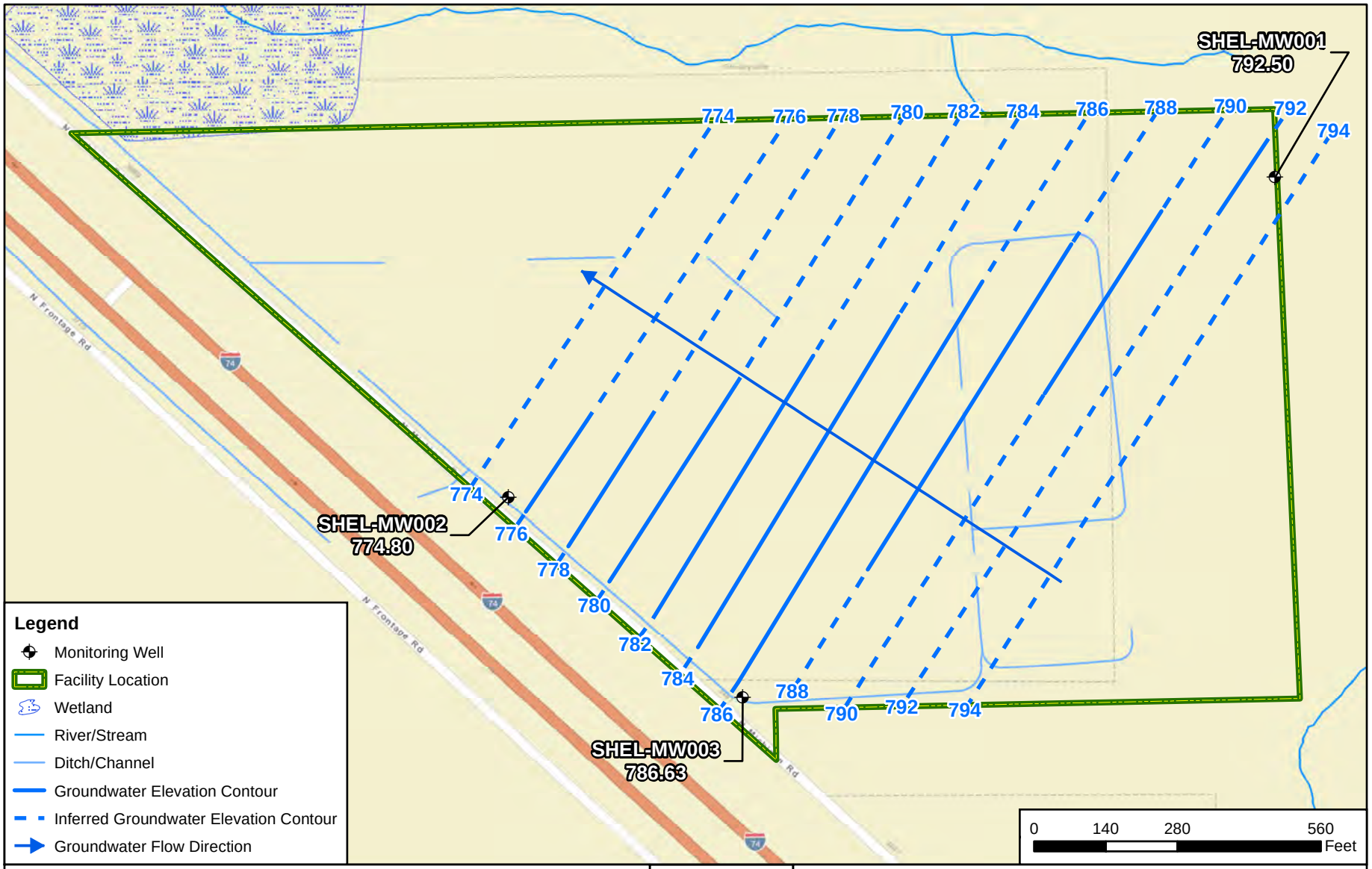

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TITLE

Groundwater Elevation Contours, April 2021

AECOM

12420 Milestone Center Drive
Germantown, MD 20876

Figure 2-4

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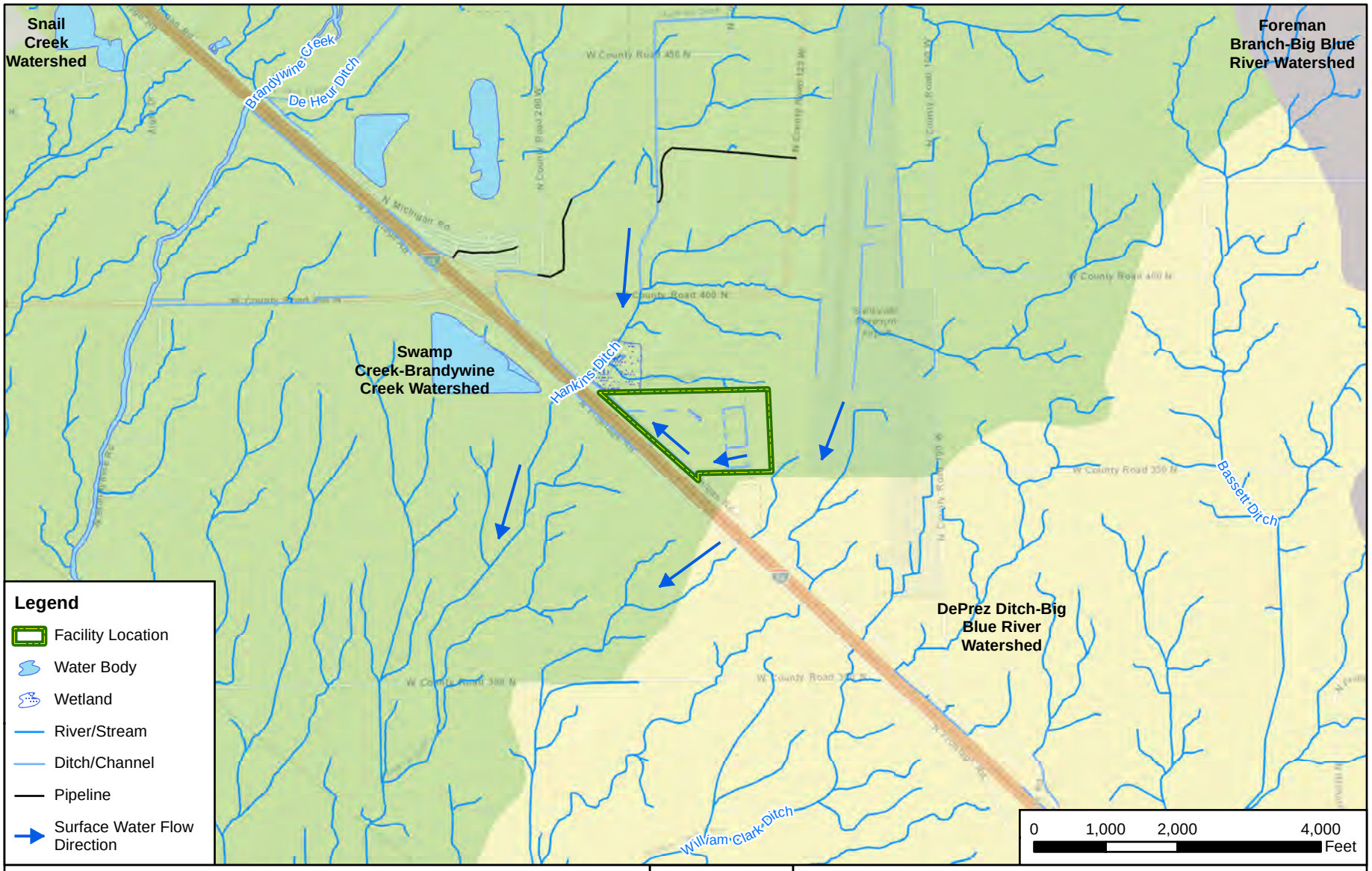

CLIENT	ARNG			
PROJECT	Site Inspection for PFAS at Shelbyville AASF, IN			
REVISED	6/4/2021	GIS BY	MS	6/4/2021
SCALE	1:24,000	CHK BY	AP	6/4/2021
Base Map: Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c)		PM	CM	6/4/2021

N

Surface Water Features

AECOM
12420 Milestone Center Drive
Germantown, MD 20876

Figure 2-5

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3. Summary of Areas of Interest

PFAS were potentially released to soil and groundwater within the boundary of Shelbyville AASF through fire training, AFFF storage, and stormwater conveyance. Three AOIs were identified based on preliminary data and assumed groundwater flow directions. These AOIs are described below and presented on **Figure 3-1**.

3.1 AOI 1 North Drainage Ditch

AOI 1 is a drainage ditch that runs adjacent to the onsite fuel point fire training area (FTA) and runs east-west and parallel to the northern edge of the paved area of the AASF. The ditch, which ultimately drains to Hankins Ditch (a tributary of the Big Blue River), is filled with cattails and other grasses and shrubs, indicating at least an ephemeral flow of water.

In 2003, nearly 50 gallons of AFFF solution were discharged into the ditch as a dual hydrostatic testing of portable Tri-Max™ units and weed control measure by facility staff; this operation was only performed once. No further training or nozzle testing that resulted in an AFFF discharge into this ditch was performed. It is unknown when the six Tri-Max™ units were acquired, but the testing indicates that the units were present at least since 1998, as hydrostatic testing is typically performed every 5 years. Land use prior to AASF construction was rural/residential; therefore, storage of AFFF could date back as far as 1971.

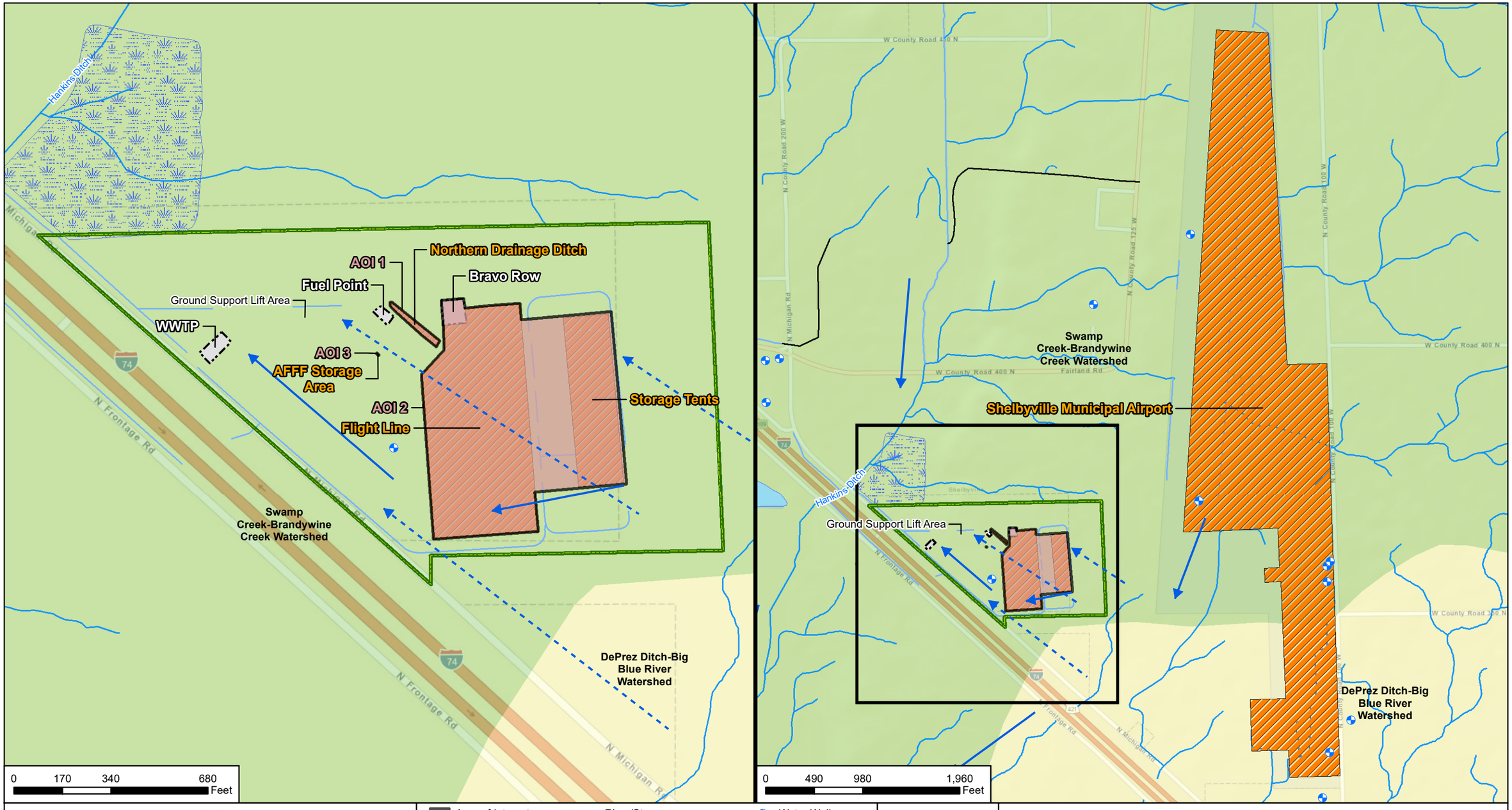
3.2 AOI 2 AASF Flight Line and Storage Tents

AOI 2 consists of the Flight Line and the Storage Tents. As a requirement, the AASF would have stationed at least one Tri-Max™ cart on the ramp for every two helicopters parked on the Flight Line. This practice would have occurred until 2015, when all of the Tri-Max™ units at Shelbyville were relocated to Camp Atterbury. It is unknown how early the units were acquired at Shelbyville, but information obtained during interviews positively confirms AASF Tri-Max™ possession as far back as 2003; units may have been present as early as 1998, based on maintenance schedule. Prior to approximately 2003 to 2005, Tri-Max™ units would have been stationed outside and uncovered year-round. Tenure of interviewees dates back to 1985. No instances of Tri-Max™ usage or leakage were reported on the Flight Line from current personnel; however, given the length of time Tri-Max™ units were present on the Flight Line (at least 12 years) and the uncertainty of how Tri-Max™ units were stored during the winter, it is possible that units leaked AFFF onto the ramp surface. Surface flow from the flight line flows west into storm drains located within the tarmac, ultimately draining into the Northern Drainage Ditch (AOI 1), which is located northwest of the Flight Line.

Four storage tents (hereby referred to as the “Storage Tents”), located east of the Flight Line, were constructed sometime between 2003 and 2005. The tents are primarily used for storage and are large enough to house at least one helicopter. When the AASF was in possession of its Tri-Max™ carts, they were stored in the tents when not in use. Interviewees reported that no leaks or spills have occurred from the portable units since the Storage Tents were constructed. The Storage Tents were not identified as an AOI during the PA but were later added to AOI 2 for the SI as the result of a more recently adopted conservative approach to investigate areas where AFFF has been stored. Although no instances of Tri-Max™ usage or leakage were reported on the AASF Flight Line and Storage Tents, given the amount of time the Tri-Max™ units were present and the uncertainty of how they were stored during the winter, it is possible that the Tri-Max™ units leaked AFFF onto the ramp surface.

3.3 AOI 3 AFFF Storage Area

AOI 3 is the AFFF Storage Area, which is a small, secondary-containment storage container located on the northeast side of the AASF main building in which twenty (20) 5-gallon Chemguard 3 percent (%) AFFF buckets and one 5-gallon diluted solution of Tri-Max™ AFFF are stored. No known leaks or releases occurred according to personnel with knowledge of the facility dating back to as early as 2003. The AFFF Storage Area was not identified as a potential PFAS release area in the PA but has been added as an AOI in the SI due to the more conservative approach adopted recently to investigate areas where AFFF has been stored.



CLIENT	ARNG			
PROJECT	Site Inspection for PFAS at Shelbyville AASF, IN			
REVISED	11/30/2021	GIS BY	MS	11/30/2021
SCALE	1:11,760	CHK BY	MC	11/30/2021
Base Map: Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c)		PM	CM	11/30/2021

- Area of Interest
- Potential PFAS Release
- No Suspected Release
- Facility Boundary
- Water Body
- Wetland
- River/Stream
- Ditch/Channel
- Pipeline
- Surface Water Flow Direction
- Groundwater Flow Direction
- Water Wells

N

Areas of Interest

AECOM 12420 Milestone Center Drive Germantown, MD 20876

Figure 3-1

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4. Project Data Quality Objectives

Project Data Quality Objectives (DQOs) are qualitative and quantitative statements that specify the quality of data and define the level of certainty required to support project decision-making process. The specific DQOs established for this facility are described below. These DQOs were developed in accordance with the USEPA's seven-step iterative process (USEPA, 2006).

4.1 Problem Statement

The following problem statement was developed during project planning:

The presence of PFAS, which may pose a risk to human health or the environment, in environmental media at the facility is currently unknown. PFAS are classified as emerging environmental contaminants that are garnering increasing regulatory interest due to their potential risks to human health and the environment. The regulatory framework for managing PFAS at both the federal and state level continues to evolve.

The DoD has adopted a policy to retain facilities in the CERCLA process based on risk-based SLs for soil and groundwater, as described in a memorandum from the Office of the Secretary of Defense (OSD) dated 15 September 2021 (Assistant Secretary of Defense, 2021). The ARNG program under which this SI was performed follows this DoD policy. Should the maximum site concentration for sampled media exceed the SLs established in the OSD memorandum, the AOI will proceed to the next phase under CERCLA. The SLs established in the OSD memorandum apply to three compounds: PFOS, PFOA, and PFBS. The SLs are presented in **Section 6.1** of this Report.

The following quotes from the DA policy documents form the basis for this project (DA, 2016; DA, 2018):

- "The Army will research and identify locations where PFOS- and/or PFOA-containing products, such as AFFF, are known or suspected to have been used. Installations shall coordinate with installation/facility fire response or training offices to identify AFFF use or storage locations. The Army will consider FTAs, AFFF storage locations, hangars/buildings with AFFF suppression systems, fire equipment maintenance areas, and areas where emergency response operations required AFFF use as possible source areas. In addition, metal plating operations, which used certain PFOS-containing mist suppressants, shall be considered possible source areas."
- "Based on a review of site records…determine whether a CERCLA PA is appropriate for identifying PFOS/PFOA release sites. If the PA determines a PFOS/PFOA release may have occurred, a CERCLA SI shall be conducted to determine presence/absence of contamination."
- "Identify sites where perfluorinated compounds are known or suspected to have been released, with the priority being those sites within 20 miles of the public systems that tested above USEPA HA levels." (USEPA, 2016a; USEPA, 2016b).

4.2 Goals of the Study

The following goals were established for this SI:

1. Determine the presence or absence of PFOA, PFOS, and PFBS at or above SLs.
2. Develop information to potentially eliminate a release from further consideration because it is determined that it poses no significant threat to human health or the environment.

3. Determine the potential need for a TCRA (applies to drinking water only). The primary actions that will be considered include provision of alternative water supplies or wellhead treatment.
4. Collect data to better characterize the release areas for more effective and rapid initiation of a RI (if determined necessary).
5. If PFOA, PFOS, and PFBS are determined to be present, evaluate whether the concentrations can be attributed to on-facility or off-facility sources that were identified within 4 miles of the installation as part of the PA (e.g., fire stations, major manufacturers, other DoD facilities).
6. Determine whether a potentially complete pathway exists between the source and potential receptors and whether ARNG is the likely source of the contamination.

4.3 Information Inputs

Primary information inputs included:

- The PA for Shelbyville AASF (AECOM, 2020);
- Analytical data from soil, groundwater, and sediment samples collected as part of this SI in accordance with the site-specific Uniform Federal Policy (UFP)-Quality Assurance Project Plan (QAPP) Addendum (AECOM, 2021a); and
- Field data collected during the SI, including groundwater elevation and water quality parameters measured at the time of sampling.

4.4 Study Boundaries

The scope of the SI was bounded by the property limits of the facility (**Figure 2-1**). Off-facility sampling was not included in the scope of this SI. If future off-facility sampling is required, the proper stakeholders will be notified, and necessary rights of entry will be obtained by ARNG with property owner(s).

4.5 Analytical Approach

Samples were analyzed by Pace Analytical Gulf Coast, accredited under the DoD Environmental Laboratory Accreditation Program (ELAP; Accreditation Number 74960) and the National Environmental Laboratory Accreditation Program (NELAP; Certificate Number 01955). Data were compared to applicable SLs and decision rules as defined in the SI QAPP Addendum (AECOM, 2021a). These rules governed response actions based on the results of the SI sampling effort.

The decision rules described in the **Worksheet #11** of the SI QAPP Addendum identify actions based on the following:

Groundwater:

- Is there a human receptor within 4 miles of the facility?
- What is the concentration of PFOA, PFOS, and PFBS at the potential release areas?
- What is the concentration of PFOA, PFOS, and PFBS at the facility boundary upgradient and downgradient of the potential release areas?
- What does the conceptual site model (CSM) suggest in terms of source, pathway and receptor?

Soil:

- What is the concentration of PFOA, PFOS, and PFBS in shallow surface soil (0 to 2 feet bgs)?
- What is the concentration of PFOA, PFOS, and PFBS in deep soil (i.e., capillary fringe)?
- What does the CSM suggest in terms of source, pathway, and receptor?

Soil/sediment samples were collected from each of the potential release areas. Groundwater was sampled from three locations at the facility boundaries not associated with specific release areas to characterize groundwater sitewide. Groundwater was encountered at varying depths depending where permeable zones encountered. Static groundwater levels were measured between approximately 5 to 11 feet bgs.

4.6 Data Usability Assessment

The Data Usability Assessment (DUA) is an evaluation at the conclusion of data collection activities that uses the results of both data verification and validation in the context of the overall project decisions or objectives. Using both quantitative and qualitative methods, the assessment determines whether project execution and the resulting data have met installation-specific DQOs. Both sampling and analytical activities are considered to assess whether the collected data are of the right type, quality, and quantity to support the decision-making (DoD, 2019a; DoD, 2019b; USEPA, 2017b).

Data Quality Indicators (DQIs) (Precision, Accuracy, Representativeness, Comparability, Completeness and Sensitivity) are important components in assessing data usability. These DQIs were evaluated in the subsequent sections and demonstrate that the data presented in this SI report are of high quality. Although the SI data are considered reliable, some degree of uncertainty can be associated with the data collected. Specific factors that may contribute to the uncertainty of the data evaluation are described below. The Data Validation Report (DVR) (**Appendix A**) presents explanations for all qualified data in greater detail.

4.6.1 Precision

Precision is the degree of agreement among repeated measurements of the same characteristic on the same sample or on separate samples collected as close as possible in time and place. Field sampling precision is measured with the field duplicate relative percent differences (RPD); laboratory precision is measured with calibration verification, internal standard recoveries, laboratory control spike (LCS) and matrix spike (MS) duplicate RPD.

Extraction internal standards (EIS) were added by the laboratory during sample extraction to measure relative responses of target analytes and used to correct for bias associated with matrix interferences and sample preparation efficiencies, injection volume variances, mass spectrometry ionization efficiencies, and other associated preparation and analytical anomalies. The EIS area counts were within the project established precision limits presented in the QAPP Addendum (AECOM, 2021a).

Injection internal standards (IIS) were added by the laboratory after sample extraction and prior to analysis as a legacy requirement of DoD QSM 5.1 to measure relative responses of target analytes. Even though not required under the current DoD QSM 5.3 analysis, the IIS are still added to the sample after extraction as an additional QC measure. The IIS percent recoveries were within the established precision limits presented in the QAPP Addendum (AECOM, 2021a).

LCS/LCS duplicate (LCSD) pairs were prepared by addition of known concentrations of each analyte in a matrix-free media known to be free of target analytes. LCS/LCSD pairs were analyzed for every analytical batch to demonstrate the ability of the laboratory to detect similar

concentrations of a known quantity in matrix-free media. One LCS/LCSD performed displayed an RPD greater than the QC limit of 30% 6:2 fluorotelomer sulfonic acid (6:2 FTS), at 33%. The positive associated field sample results were qualified as estimate and should be considered usable as qualified.

MS/MS duplicate (MSD) samples were prepared, analyzed, and reported for all preparation batches. MS/MSD samples demonstrated that the analytical system was in control for the matrix being tested with one exception. MS/MSD samples were submitted to the laboratory for analysis at a rate of 5%. One MS/MSD displayed a RPD greater than the QC limit of 30% for n-methyl perfluorooctanesulfonamidoacetic acid (NMeFOSAA) at 33%. The associated parent sample results were qualified due to a MS percent recovery exceedance and should be considered usable as qualified as an estimated value.

Field duplicate samples were collected at a rate of 10% to assess the overall sampling and measurement precision for this sampling effort. The field duplicate samples were analyzed for PFAS and general chemistry parameters. The field duplicate samples were within the project established precision limits presented in the QAPP Addendum (AECOM, 2021a) with limited exceptions. Two separate field duplicate pairs displayed positive results in one sample and non-detect results in the associated field duplicate.

4.6.2 Accuracy

Accuracy is a measure of confidence in a measurement. The smaller the difference between the measurement of a parameter and its "true" or expected value, the more accurate the measurement. The more precise or reproducible the result, the more reliable or accurate the result. Accuracy is measured through percent recoveries in the LCS/LCSD, MS/MSD, and surrogates.

LCS/LCSD samples were prepared by addition of known concentrations of each analyte in a matrix free media known to be free of target analytes. LCS/LCSD samples were analyzed for every analytical batch and demonstrated that the analytical system was in control during sample preparation and analysis. The LCS/LCSD samples were within the project established accuracy limits presented in the QAPP Addendum (AECOM, 2021a).

MS/MSD samples were prepared, analyzed, and reported at a rate of 5%. MS/MSD samples demonstrated that the analytical system was in control for the matrix being tested, with several exceptions. Parent samples AOI03-01-SB-00-02 and AOI03-01-SB-00-02DL displayed MS/MSD percent recoveries outside the QC limits for several analytes. The parent sample and duplicate results associated with native concentrations greater than 4 times the spiked concentrations were not qualified based on the MS/MSD percent recovery anomalies. The associated field sample results should be considered usable as reported. The positive field sample results associated with high percent recoveries were qualified as estimate with a high bias and should be considered usable as qualified.

Calibration verifications were performed routinely to ensure that instrument responses for all calibrated analytes were within established QC criteria. The calibration verifications performed during the laboratory analyses were within the project established precision limits presented in the QAPP Addendum (AECOM, 2021a).

4.6.3 Representativeness

Representativeness qualitatively expresses the degree to which data accurately reflect site conditions. Factors that affect the representativeness of analytical data include appropriate sample population definitions, proper sample collection and preservation techniques, analytical

holding times, use of standard analytical methods, and determination of matrix or analyte interferences.

Relating to the use of standard analytical methods, the laboratory followed the method as established in PFAS by liquid chromatography with tandem mass spectrometry LC/MS/MS Compliant with QSM 5.3 Table B-15, including the specific preparation requirements (i.e. ENVI-Carb or equivalent used), mass calibration, spectra, all the ion transitions identified in Table B-15 were monitored, standards that contained both branch and linear isomers when available were used, and isotopically labeled standards were used for quantitation.

Field QC samples were collected to assess the representativeness of the data collected. Field duplicates were collected at a rate of 10% for all field samples, while MS/MSD samples were collected at a rate of 5%. All preservation techniques were followed by the field staff, and all technical and analytical holding times were met by the laboratory. The laboratory used approved standard methods in accordance with the QAPP Addendum (AECOM, 2021a) for all analyses.

Instrument blanks and method blanks were prepared by the laboratory in each batch as a negative control. Several laboratory blanks displayed concentrations for 6:2 FTS, perfluoroheptanoic acid (PFHpA), and perfluorobutyrate (PFBA) greater than the detection limits. One investigative field sample (SHEL-MW003-040921) has a field sample result for PFBA qualified as a likely false positive due to a blank detection.

Equipment blanks and one field reagent blank (FRB) were also collected for groundwater and soil samples. The positive PFBA result for FRB SHEL-FRB-01 was qualified as a false positive due to a laboratory blank detection.

A sample of the water used for decontamination of the drill rig was collected in advance of the field effort. The drill rig decontamination sample was non-detect for all target analytes.

Field samples were extracted and analyzed within the appropriate holding time in order to qualitatively express the degree to which data accurately reflect site conditions with no exceptions.

Overall, the data are usable for evaluating the presence or absence of PFAS at the facility. Sufficient usable data were obtained to meet the objectives of the SI and to complete the risk assessment.

4.6.4 Comparability

Comparability is the extent to which data from one study can be compared directly to either past data from the current project or data from another study. Using standardized sampling and analytical methods, units of reporting, and site selection procedures help ensure comparability. Standard field sampling and typical laboratory protocols were used during the SI and are considered comparable to ongoing investigations.

4.6.5 Completeness

Completeness is a measure of the amount of valid data obtained from a measurement system compared to the amount of data expected under normal conditions. The laboratory provided data meeting system QC acceptance criteria for all samples tested. Project completeness was determined by evaluating the planned versus actual quantities of data. Percent completeness per parameter is as follows and reflects the exclusion of “X” flagged data, if applicable:

- PFAS in groundwater by DoD QSM Table B-15 at 100%
- PFAS in soil by DoD QSM Table B-15 at 100%

- pH in soil by USEPA Method 9045D at 100%
- Total organic carbon (TOC) by USEPA Method 9060 at 100%

4.6.6 Sensitivity

Sensitivity is the capability of a test method or instrument to discriminate between measurement responses representing different levels (e.g., concentrations) of a variable of interest. Examples of QC measures for determining sensitivity include laboratory fortified blanks, a method detection limit (MDL) study, and calibration standards at the limit of quantitation (LOQ). In order to meet the needs of the data users, project data must meet the measurement performance criteria for sensitivity and project LOQs specified in the QAPP Addendum (AECOM, 2021a). This requirement was achieved with one exception. Two instrument sensitivity checks displayed high percent recoveries for PFOS and 8:2 fluorotelomer sulfonic acid (8:2 FTS). The positive field sample results associated with the positive biases were qualified “J+” and should be considered usable as an estimated value with a positive bias. The laboratory provided the requested MDL studies and provided applicable calibration standards at the LOQ. In order to achieve the DQOs for sensitivity outlined in the QAPP Addendum (AECOM, 2021a), the laboratory reported all field sample results at the lowest possible dilution. Additionally, any analytes detected below the LOQ and above the MDL were reported and qualified “J” as estimated values by the laboratory.

5. Site Inspection Activities

This section describes the environmental investigation and sampling activities that occurred as part of the SI. The SI sampling approach was based on the findings of the PA and implemented in accordance with the following approved documents:

- *Final Preliminary Assessment Report, Shelbyville AASF, Indiana* dated July 2020 (AECOM, 2020);
- *Final Site Inspection Programmatic Uniform Federal Policy-Quality Assurance Project Plan* dated March 2018 (AECOM, 2018a);
- *Final Site Inspection Uniform Federal Policy-Quality Assurance Project Plan Addendum, Shelbyville AASF, Shelbyville, Indiana* dated March 2021 (AECOM, 2021a);
- *Final Programmatic Accident Prevention Plan* dated July 2018 (AECOM, 2018b); and
- *Final Site Safety and Health Plan, Shelbyville AASF, Indiana* dated March 2021 (AECOM, 2021b).

SI field activities were conducted in a single mobilization from 5-9 April 2021. This mobilization included grab sampling of surface soil, subsurface soil, and sediment, as well as installation of three permanent groundwater monitoring wells used for low-flow groundwater sampling. Field activities were conducted in accordance with the SI QAPP Addendum (AECOM, 2021a), except as noted in **Section 5.9**.

The following samples were collected during the SI and analyzed for a subset of 18 PFAS by LC/MS/MS compliant with QSM 5.3 Table B-15 to fulfill the project DQOs:

- Thirteen (13) soil grab samples from seven boring locations;
- Three groundwater samples from three newly installed permanent monitoring well locations;
- Two sediment samples from two locations.

Figure 5-1 provides the sample locations for all media across the facility. **Table 5-1** presents the list of samples collected for each media. Field documentation is provided in **Appendix B**. A Log of Daily Notice of Field Activity was completed throughout the SI field activities, which is provided in **Appendix B1**. Field sampling forms and logs are provided in **Appendix B2**. A Field Change Request Form is provided in **Appendix B3**. Field survey data for the sample locations are included in **Appendix B4**. Additionally, a photographic log of field activities is provided in **Appendix C**.

5.1 Pre-Investigation Activities

In preparation for the SI field activities, project team members participated in Technical Project Planning (TPP) meetings, performed utility clearance, and sampled decontamination source water. Details for each of these activities are presented below.

5.1.1 Technical Project Planning

The USACE TPP Process, Engineer Manual (EM) 200-1-2 (USACE, 2016) defines four phases to project planning: 1.) defining the project phase; 2.) determining data needs; 3.) developing data collection strategies; and 4.) finalizing the data collection plan. The process encourages stakeholder involvement in the SI, beginning with defining overall project objectives, including quantitative and qualitative DQOs, and formulating a sampling approach to address the AOIs identified in the PA.

A combined TPP Meeting 1 and 2 was held on 14 January 2021, prior to SI field activities. The combined TPP Meeting 1 and 2 was conducted in general accordance with EM 200-1-2. The stakeholders for this SI include the ARNG, INARNG, including personnel from Shelbyville AASF, USACE, and the Indiana Department of Environmental Management (IDEM). Stakeholders were provided the opportunity to make comments on the technical sampling approach and methods at the combined TPP Meeting 1 and 2. The outcome of the combined TPP Meeting 1 and 2 was memorialized in the SI QAPP Addendum (AECOM, 2021a).

TPP Meeting 3 was held on 22 February 2022 to discuss the results of the SI. Meeting minutes for TPP 3 are included in **Appendix D** of this report. Future TPP meetings will provide an opportunity to discuss the results and findings, and future actions, where warranted.

5.1.2 Utility Clearance

Utility clearance was conducted by Ground Penetrating Radar Systems, LLC on 5 April 2021, with input from the AECOM field team. Both AECOM and their drilling subcontractor, Cascade Technical Services, LLC, contacted Indiana 811 one-call utility clearance contractor prior to mobilization to notify them of intrusive work. Because Indiana 811 locators do not locate private utilities, such as those belonging to Shelbyville AASF, AECOM contracted Ground Penetrating Radar Services, LLC (GPRS) to perform utility clearance for private utilities and for locations at the AASF. GPRS performed utility clearance on 5 April 2021 with input from the AECOM field team. Additionally, the first 5 feet of each boring were advanced using hand augering methods to verify utility clearance in shallow subsurface where utilities would typically be encountered.

5.1.3 Source Water and PFAS Sampling Equipment Acceptability

The potable water source used for decontamination of drilling equipment was confirmed to be acceptable for use in a PFAS investigation prior to the start of field activities. A sample of the water supply collected from the spigot along the southeast side of the administrative building at Shelbyville AASF on 3 March 2021, prior to the SI sampling and well installation mobilization. The sample was analyzed for PFAS by LC/MS/MS compliant with QSM 5.3 Table B-15. The results of the decontamination water sample are provided in **Appendix F**. A discussion of the results is presented in **Section 4.6.3**.

Materials that were used within the sampling zone were confirmed as acceptable for use in the PFAS sampling environment. The checklist of acceptable materials for use in the PFAS sampling environment was provided in the Standard Operating Procedures (SOPs) appendix to the SI QAPP Addendum (AECOM, 2021a). Prior to the start of field work each day, a PFAS Sampling Checklist was completed as an additional layer of control. The checklist served as a daily reminder to each field team member regarding the allowable materials within the sampling environment.

5.2 Soil Borings and Soil Sampling

Soil samples were collected using a combination of hang auger and roto-sonic drilling methods, in accordance with the SI QAPP Addendum (AECOM, 2021a). A hand auger was used to collect all surface soil samples in addition to soil from the top five feet of the three soil borings where wells were installed, compliant with utility clearance procedures. The remainder of the three well soil borings were completed using a GeoProbe® 8140DT sonic drilling sampling system with 4-inch diameter core barrel and 6-inch diameter override casing to collect continuous soil cores to the target depth. The soil boring locations are shown on **Figure 5-1**. Soil sample depths are provided in **Table 5-1**.

Soils samples were collected for each location for chemical analysis. Surface soil samples were collected at a target interval of 0-2 feet bgs. The overlying 8 inches of concrete at AOI 3 were removed using a concrete-coring machine prior to collection of the surface soil sample with the

hand auger. At each well soil boring, three discrete soil samples were collected from the observed vadose (unsaturated) zone; one subsurface soil sample was collected from the shallow surface soil from 0-2 feet bgs, one sample was collected approximately 1 foot above the groundwater table, and one subsurface soil sample at the mid-point between the ground surface and the groundwater table. The surface soil at each location was collected using the hand auger. Subsurface soil samples were collected directly from the dedicated high-density polyethylene (HDPE) core bags used during sonic drilling.

The soil cores were continuously logged for lithological descriptions by a field geologist using the Unified Soil Classification System (USCS). A photoionization detector (PID) was used to screen the breathing zone during boring activities as part of personal safety requirements. Observations and measurements were recorded on sampling forms (**Appendix B2**) and in a non-treated field logbook (i.e., composition notebook). Depth interval, recovery thickness, PID concentrations, moisture, relative density, color (using a Munsell soil color chart), and texture (using the USCS) were recorded. The boring logs are provided in **Appendix E**.

Each soil sample was collected into laboratory-supplied PFAS-free HDPE bottles and labeled using a PFAS-free marker or pen. Samples were packaged on ice and transported via Federal Express (FedEx) under standard chain of custody (CoC) procedures to the laboratory and analyzed for PFAS (LC/MS/MS compliant with QSM 5.3 Table B-15), TOC (USEPA Method 9060A) and pH (USEPA Method 9045D) in accordance with the SI QAPP Addendum (AECOM, 2021a).

Field duplicate samples were collected at a rate of 10% and analyzed for the same parameters as the accompanying samples. MS/MSDs were collected at a rate of 5% and analyzed for the same parameters as the accompanying samples. In instances when non-dedicated sampling equipment was used, such as a hand auger for the shallow soil samples, equipment rinsate blanks were collected at a rate of 5% and analyzed for the same parameters as the soil samples. A temperature blank was placed in each cooler to ensure that samples were preserved at or below 6 degrees Celsius (°C) during shipment.

Sonic borings were converted to permanent monitoring wells in accordance with the SI QAPP Addendum (AECOM, 2021a). The wells were completed with flush-mounted well manways installed in grass areas to avoid disturbing concrete or asphalt surfaces.

5.3 Sediment Sampling

Sediment samples were collected from AOI 1, within the Northern Drainage Ditch, in accordance with the SI QAPP Addendum (AECOM, 2021a). A sediment coring device (hand auger) was initially used to attempt to collect the sediment samples; however, the tooling was not able to sample the sediment due to rip rap (rock) that lined the ditch. Instead, samples were collected by hand using dedicated clean nitrile gloves from the first 0.8 feet of sediment (see **Section 5.9**). The sediment was transferred to a Ziploc bag, where the sample was homogenized and stones in excess of 1 centimeter were removed. Sediment samples were described and characterized on sediment sample collection forms (**Appendix B2**). The sediment sample locations are shown on **Figure 5-1**, and sample depths are provided **Table 5-1**.

Each sample was collected into laboratory-supplied PFAS-free HDPE bottles and labeled using a PFAS-free marker or pen. Samples were packaged on ice and transported via FedEx under standard CoC procedures to the laboratory for analysis of PFAS by LC/MS/MS compliant with QSM 5.3 Table B-15. Sediment samples were also analyzed for TOC (USEPA Method 9060A) and pH (USEPA Method 9045D), in accordance with the SI QAPP Addendum (AECOM, 2021a).

Field duplicate samples were collected at a rate of 10% and analyzed for the same parameters as the accompanying samples. MS/MSDs were collected at a rate of 5% and analyzed for the

same parameters as the accompanying samples. A temperature blank was placed in each cooler to ensure that samples were preserved at or below 6°C during shipment.

5.4 Permanent Well Installation and Groundwater Sampling

During the SI, three permanent monitoring wells were installed at the facility boundary in the inferred upgradient and downgradient directions of potential source areas. The locations of the wells are shown on **Figure 5-1**.

A GeoProbe® 80140DT drill rig was used to install three 2-inch diameter monitoring wells. The monitoring wells were constructed with Schedule 40 poly-vinyl chloride, flush threaded 10-foot sections of riser, 0.010-inch slotted well screen, and a threaded bottom cap. The location and depth of the permanent wells were determined based on the inferred groundwater flow direction. A filter pack consisting of #1 filter sand was installed in the annulus around the well screen to a minimum of 2 feet above the well screen. A 2-foot thick bentonite seal was placed above the filter sand and hydrated with water. Bentonite grout was placed in the well annulus from the top of the bentonite seal to ground surface. The bentonite grout was allowed to set for 24 hours prior to well completion in accordance with the SI QAPP Addendum (AECOM, 2021a). All monitoring wells were completed with flush mount well vaults. The screen interval of each of the groundwater monitoring well is provided in **Table 5-2**.

Development and sampling of wells was completed in accordance with the SI QAPP Addendum (AECOM, 2021a). The newly installed monitoring wells were developed no sooner than 24 hours following installation by pumping and surging using a Waterra© Hydrolift pump with an attachable surge block. Samples were collected no sooner than 24 hours following development via low-flow sampling methods using a peristaltic pump with disposable PFAS-free, HDPE tubing. New, dedicated tubing was used at each well. The wells were purged at a rate determined in the field to reduce draw down prior to sampling. Water quality parameters (e.g., temperature, specific conductance, pH, dissolved oxygen, and oxidation-reduction potential) were measured using a water quality meter and recorded on the field sampling form (**Appendix B2**). Water levels were measured to the nearest 0.01 foot and recorded. Additionally, shaker tests were performed to identify if there were any foaming. No foaming was noted in any of the groundwater samples.

Each sample was collected into laboratory-supplied PFAS-free HDPE bottles and labeled using a PFAS-free marker or pen. Samples were packaged on ice and transported via FedEx under standard CoC procedures to the laboratory and analyzed for PFAS by LC/MS/MS compliant with QSM 5.3 Table B-15 in accordance with the SI QAPP Addendum (AECOM, 2021a).

Field duplicate samples were collected at a rate of 10% and analyzed for the same parameters as the accompanying samples. MS/MSDs were collected at a rate of 5% and analyzed for the same parameters as the accompanying samples. One FRB was collected in accordance with the PQAPP (AECOM, 2018a). A temperature blank was placed in each cooler to ensure that samples were preserved at or below 6°C during shipment.

5.5 Synoptic Water Level Measurements

A synoptic groundwater gauging event was performed on 9 April 2021. Groundwater elevation measurements were collected from the 3 new monitoring wells. Water level measurements were taken from the northern side of the well casing. A groundwater flow contour map is provided in **Figure 2-4**. Groundwater elevation data is provided in **Table 5-3**.

5.6 Surveying

The northern side of each well casing was surveyed by Indiana-Licensed land surveyor following guidelines provided in the SOPs provided in the SI QAPP Addendum (AECOM, 2021a). Survey

data from the newly installed wells on the facility were collected on 9 April 2021 in the applicable Universal Transverse Mercator zone projection with World Geodetic System 84 datum (horizontal) and North American Vertical Datum 1988 (vertical). The surveyed well data are provided in **Appendix B4**.

5.7 Investigation-Derived Waste

As of the date of this report, the disposal of PFAS investigation-derived waste (IDW) is not regulated federally. PFAS IDW generated during the SI is considered non-hazardous waste and was managed in accordance with the SI QAPP Addendum (AECOM, 2021a).

Soil IDW (i.e., soil cuttings) were generated during the SI activities from the three soil boring locations associated with the permanent wells. No soil IDW was generated at the surface soil sample locations. All soil IDW were containerized in labeled 55-gallon drums. The IDW drums were segregated by location and stored within the second Storage Tent from the south (#2) at the AASF, as designated by INARNG, pending laboratory analysis. ARNG will land-spread all soil IDW with PFAS concentrations below the relevant state criteria (IDEM, 2020) on-facility in accordance with IDEM's Uncontaminated Soil Policy (IDEM, 2015).

Liquid IDW generated during SI activities (i.e., purge water, development water, and decontamination fluids) were containerized in labeled 55-gallon drums. The liquid IDW drums were segregated by location and stored within the second Storage Tent from the south (#2) at the AASF, as designated by INARNG, pending laboratory analysis. ARNG will land-spread all liquid IDW with PFAS concentrations below the relevant state criteria (IDEM, 2020) on-facility.

Other solids such as spent personal protective equipment, plastic sheeting, tubing, rope, unused monitoring well construction materials, and other environmental media generated during the field activities were disposed of at a licensed solid waste landfill.

5.8 Laboratory Analytical Methods

Samples were analyzed for a subset of 18 PFAS by LC/MS/MS compliant with QSM 5.3 Table B-15 at Pace Analytical Gulf Coast in Baton Rouge, Louisiana, a DoD ELAP and NELAP certified laboratory. The 18 PFAS analyzed as part of the ARNG SI program include the following:

- 6:2 fluorotelomer sulfonic acid (6:2 FTS)
- 8:2 fluorotelomer sulfonic acid (8:2 FTS)
- N-ethyl perfluorooctanesulfonamidoacetic acid (NEtFOSAA)
- N-methyl perfluorooctanesulfonamidoacetic acid (NMeFOSAA)
- Perfluorobutyrate (PFBA)
- Perfluorobutanesulfonic acid (PFBS)
- Perfluorodecanoic acid (PFDA)
- Perfluorododecanoic acid (PFDoA)
- Perfluoroheptanoic acid (PFHpA)
- Perfluorohexanoic acid (PFHxA)
- Perfluorohexanesulfonic acid (PFHxS)
- Perfluorononanoic acid (PFNA)
- Perfluorooctanoic acid (PFOA)
- Perfluorooctanesulfonic acid (PFOS)
- Perfluoropentanoic acid (PFPeA)
- Perfluorotetradecanoic acid (PFTeDA)
- Perfluorotridecanoic acid (PFTrDA)
- Perfluoroundecanoic acid (PFUdA)

Soil and sediment samples were also analyzed for TOC using USEPA Method 9060A and pH by USEPA Method 9045D.

5.9 Deviations from SI QAPP Addendum

One deviation from the SI QAPP Addendum occurred based on field conditions, and it is noted below and documented in the Field Change Request Form (**Appendix B3**):

- The SI QAPP Addendum stated that sediment samples would be collected using a sediment coring device (or similar) from each sediment sampling location at AOI 1: Northern Drainage Ditch. While collecting the samples, it was found that the large rip rap (rock) that covers the entire AOI prevented the use of sample tooling as originally planned. The tooling was unable to articulate around rip-rap erosion control to collect adequate sediment samples. Smaller rock was moved to attempt to create access for the tooling but was unsuccessful. Collection of the two sediment samples at the AOI was instead completed by hand with clean, dedicated nitrile gloves. Further, the total depth of the collected sediment samples were 0.8 feet, less than the standard 1 foot, due to refusal caused by underlying rock material. This action was documented in a Field Change Request Form provided in **Appendix B3**.

Table 5-1
Site Inspection Samples by Medium
Site Inspection Report, Shelbyville AASF

Sample Identification	Sample Collection Date	Sample Depth (feet bgs)	PFAS (LC/MS/MS QSM 5.3 Table B-15)	TOC (USEPA Method 9060A)	pH (USEPA Method 9045D)	Comments
Soil Samples						
AOI02-01-SB-00-02	4/7/2021	0-2	x	x	x	
AOI02-01-SB-00-02-D	4/7/2021	0-2	x	x	x	Duplicate
AOI02-01-SB-00-02-MS	4/7/2021	0-2		x	x	MS/MSD
AOI02-01-SB-00-02-MSD	4/7/2021	0-2		x	x	MS/MSD
AOI02-02-SB-00-02	4/8/2021	0-2	x			
AOI02-02-SB-00-02-D	4/8/2021	0-2	x			Duplicate
AOI02-03-SB-00-02	4/8/2021	0-2	x			
AOI03-01-SB-00-02	4/7/2021	0-2	x	x	x	
AOI03-01-SB-00-02-D	4/7/2021	0-2	x			Duplicate
AOI03-01-SB-00-02-MS	4/7/2021	0-2	x			MS/MSD
AOI03-01-SB-00-02-MSD	4/7/2021	0-2	x			MS/MSD
SHEL-MW001-SB-00-02	4/5/2021	0-2	x			
SHEL-MW001-SB-13-15	4/5/2021	13-15	x			
SHEL-MW001-SB-32-34	4/5/2021	32-34	x			
SHEL-MW002-SB-00-02	4/6/2021	0-2	x			
SHEL-MW002-SB-13-15	4/6/2021	13-15	x			
SHEL-MW002-SB-28-30	4/6/2021	28-30	x			
SHEL-MW003-SB-00-02	4/6/2021	0-2	x			
SHEL-MW003-SB-06-08	4/6/2021	6-8	x			
SHEL-MW003-SB-12-14	4/6/2021	12-14	x			
Sediment Samples						
AOI01-01-SD-00-0.8	4/6/2021	0-0.8	x	x	x	
AOI01-02-SD-00-0.8	4/6/2021	0-0.8	x			
AOI01-02-SD-00-0.8-D	4/6/2021	0-0.8	x			Duplicate
AOI01-02-SD-00-0.8-MS	4/6/2021	0-0.8	x			MS/MSD
AOI01-02-SD-00-0.8-MSD	4/6/2021	0-0.8	x			MS/MSD
Groundwater Samples						
SHEL-MW001-040921	4/9/2021	30-40	x			
SHEL-MW001-040921-D	4/9/2021	30-40	x			Duplicate
SHEL-MW001-040921-MS	4/9/2021	30-40	x			MS/MSD
SHEL-MW001-040921-MSD	4/9/2021	30-40	x			MS/MSD
SHEL-MW002-040921	4/9/2021	28-38	x			
SHEL-MW003-040921	4/9/2021	10-20	x			

Table 5-1
Site Inspection Samples by Medium
Site Inspection Report, Shelbyville AASF

Sample Identification	Sample Collection Date	Sample Depth (feet bgs)	PFAS (LC/MS/MS QSM 5.3 Table B-15)	TOC (USEPA Method 9060A)	pH (USEPA Method 9045D)	Comments
Blank Samples						
SHEL-FRB-01	4/9/2021	NA	x			FRB
SHEL-ERB-01	4/7/2021	NA	x			ERB
SHEL-ERB-02	4/7/2021	NA	x			ERB

Notes:

AASF = Army Aviation Support Facility
AOI = Area of Interest
bgs = below ground surface
D = duplicate
ERB - equipment blank
FRB - field reagent blank
MW = monitoring well
MS/MSD = matrix spike/matrix spike duplicate
PFAS = per- and polyfluoroalkyl substances
pH = potential for hydrogen
SB = soil boring
SHEL = Shelbyville
TOC = total organic carbon
USEPA = United States Environmental Protection Agency

Table 5-2
Boring Depths and Permanent Well Screen Intervals
Site Inspection Report, Shelbyville AASF

Area of Interest	Soil Boring ID	Monitoring Well ID	Soil Boring Depth (feet bgs)	Permanent Well Screen Interval (feet bgs)
Sitewide	SHEL-MW001	SHEL-MW001	70	30-40
	SHEL-MW002	SHEL-MW002	40	30-40
	SHEL-MW003	SHEL-MW003	20	10-20

Notes:
AASF = Army Aviation Support Facility
AOI = Area of Interest
bgs = below ground surface
SHEL = Shelbyville
ID = identification
MW = monitoring well
NA = not applicable

Table 5-3
Depths to Water and Groundwater Elevations
Site Inspection Report, Shelbyville AASF

Location ID	Ground Surface Elevation (ft amsl)	Top of Casing Elevation (ft amsl)	Depth to Water (ft btoc)	Groundwater Elevation (ft amsl)
SHEL-MW001	797.55	797.27	4.77	792.50
SHEL-MW002	785.98	785.72	10.92	774.80
SHEL-MW003	791.83	791.54	4.91	786.63

Notes:

AOI = Area of Interest

amsl = above mean sea level

btoc = below top of casing

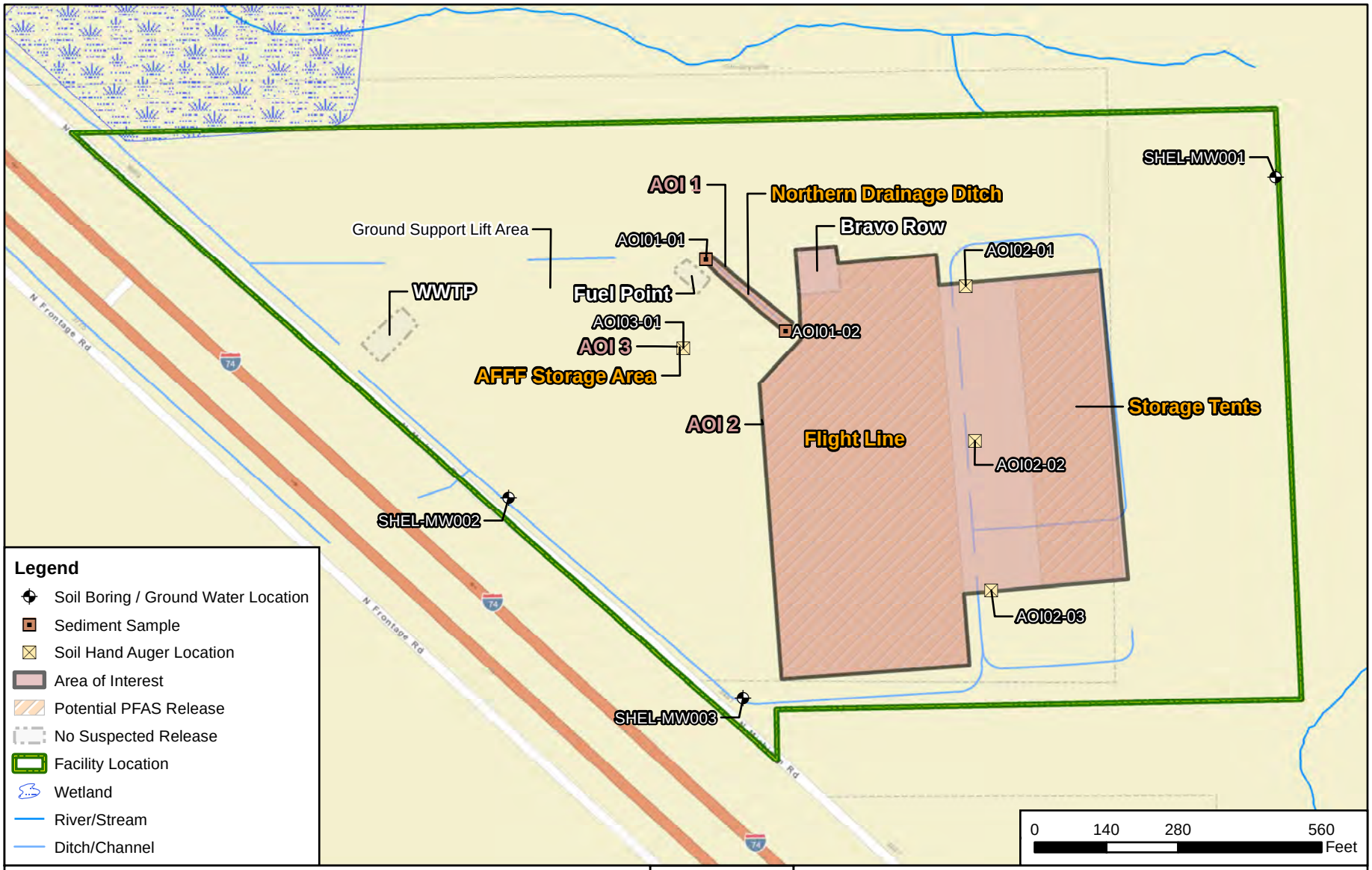
ft = feet

HAASF = Helena Army Aviation Support Facility

ID = identification

MW = monitoring well

NA = not applicable



CLIENT	ARNG			
PROJECT	Site Inspection for PFAS at Shelbyville AASF, IN			
REVISED	6/2/2021	GIS BY	MS	6/2/2021
SCALE	1:3,360	CHK BY	MC	6/2/2021
Base Map: Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c)		PM	CM	6/2/2021

TITLE

Site Inspection Sample Locations

AECOM

12420 Milestone Center Drive
Germantown, MD 20876

Figure 5-1

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6. Site Inspection Results

This section presents the analytical results of the SI for each AOI. The SLs used in this evaluation are presented in **Section 6.1**. A discussion of the results for each AOI is provided in **Section 6.3** through **Section 6.5**, while **Section 6.6** discussed the sitewide locations. **Table 6-2** through **Table 6-4** present PFAS results for samples with detections in surface soil, sediment, or groundwater; only constituents detected in one or more samples are included. Tables that contain all results are provided in **Appendix F**, and the laboratory reports are provided in **Appendix G**.

6.1 Screening Levels

The DoD has adopted a policy to retain facilities in the CERCLA process based on risk-based SLs for soil and groundwater, as described in a memorandum from the OSD dated 15 September 2021 (Assistant Secretary of Defense, 2021). The ARNG program under which this SI was performed follows this DoD policy. Should the maximum concentration for sampled media exceed the SLs established in the OSD memorandum, the AOI will proceed to an RI, the next phase under CERCLA. The SLs apply to three compounds, PFOA, PFOS, and PFBS. The SLs were calculated using the USEPA Office of Superfund Sites On-Line Calculator, which was updated on 8 April 2021 based on the release of the final Human Health Toxicity Values for PFBS (USEPA, 2021).

The SLs are presented in **Table 6-1**. All other results presented in this report are considered informational in nature and serve as an indication as to whether soil, groundwater, and sediment contain or do not contain PFAS within the boundaries of the facility.

Table 6-1 Screening Levels (Soil and Groundwater)

Analyte	Residential (Soil) (µg/kg)[a] 0-2 feet bgs	Industrial/ Commercial Composite Worker (Soil) (µg/kg)[a] 2-15 feet bgs	Tap Water (Groundwater) (ng/L)[a]
PFOA	130	1,600	40
PFOS	130	1,600	40
PFBS[b]	1,900	25,000	600

Notes:

a.) Assistant Secretary of Defense, 2021. Risk Based Screening Levels Calculated for PFOS, PFOA, PFBS in Groundwater and Soil using United States Environmental Protection Agency's (USEPA's) Regional Screening Level Calculator. Hazard Quotient (HQ) = 0.1. 15 September 2021.

ng/L= nanograms per liter

6.2 Soil Physicochemical Analyses

To provide basic soil parameter information, soil and sediment samples collected within the AOIs were analyzed for TOC and pH, which are important for evaluating transport through the soil medium. **Appendix F** contains the results of the TOC and pH sampling.

The data collected in this investigation will be used in subsequent investigations, where appropriate, to assess fate and transport of PFAS contaminants. According to the Interstate Technology Regulatory Council (ITRC), several important PFAS partitioning mechanisms include hydrophobic and lipophobic effects, electrostatic interactions, and interfacial behaviors. At relevant environmental pH values, certain PFAS are present as organic anions and are therefore relatively mobile in groundwater (Xiao et al., 2015) but tend to associate with the organic carbon fraction that may be present in soil or sediment (Higgins and Luthy 2006; Guelfo and Higgins,

2013). When sufficient organic carbon is present, organic carbon normalized distribution coefficients (K_{oc} values) can help in evaluating transport potential, though other geochemical factors (for example, pH and presence of polyvalent cations) may also affect PFAS sorption to solid phases (ITRC, 2018).

6.3 AOI 1

This section presents the analytical results for sediment samples collected at AOI 1: Northern Drainage Ditch. There are no established SLs for sediment; therefore, these results are presented for informational purposes only. The detected compounds in sediment are summarized on **Table 6-4**. The detections of PFOS, PFOA, and PFBS in sediment are presented on **Figure 6-5**.

6.3.1 AOI 1 Sediment Analytical Results

Sediment was sampled from two locations, AOI01-01 and AOI01-02, at the northwest (downstream) and southeast (upstream) ends of the drainage ditch, respectively. PFOS and PFOA were detected in the sediment sample collected at AOI01-01 at concentrations of 16.7 micrograms per kilogram (µg/kg) and 0.113 J µg/kg, respectively. PFOS and PFOA were not detected at location AOI01-02. PFBS was not detected at AOI 1.

6.3.2 AOI 1 Conclusions

Based on the results of the SI, PFOS and PFOA were detected in sediment at AOI 1. There are no established SLs for sediment; therefore, these results are presented for informational purposes only. No soil or surface water samples were collected from AOI 1 during the SI. Groundwater was assessed sitewide at locations outside of the potential release areas, near the facility boundary. Groundwater sample locations are not associated with specific AOIs and results are therefore presented separately.

6.4 AOI 2

This section presents the analytical results for soil in comparison to SLs for AOI 2, which includes two potential PFAS release areas: the Flight Line and Storage Tents. Groundwater was assessed sitewide at locations outside of the potential release areas, near the facility boundary. Groundwater sample locations are not associated with specific AOIs, and results are therefore presented separately. The detected compounds in soil at AOI 2 are presented in **Table 6-2**. The detections of PFOS, PFOA, and PFBS in soil are presented on **Figure 6-1** through **Figure 6-3**.

6.4.1 AOI 2 Soil Analytical Results

PFOS, PFOA, and PFBS in soil did not exceed the SLs in samples collected at AOI 2. Surface soil samples (0-2 feet bgs) were collected from three locations at AOI 2; AOI02-01, AOI02-02, and AOI02-03, all located in the swale between the Flight Line and Storage Tents. PFOS was detected at locations AOI02-02 and AOI02-03, at concentrations several orders of magnitude below the SLs, with the maximum PFOS concentration detected in AOI02-02 at 0.332 J µg/kg. PFOA was detected only at location AOI02-02, at a concentration of 0.082 J µg/kg. PFBS was not detected in soil samples collected at AOI 2.

6.4.2 AOI 2 Conclusions

Based on the results of the SI, PFOS and PFOA were detected in soil at AOI 2; however, the detected concentrations were at least three orders of magnitude lower than the soil SLs. PFBS was not detected in soil samples collected at AOI 2. Groundwater was assessed sitewide and results are therefore presented separately.

6.5 AOI 3

This section presents the analytical results for soil in comparison to SLs for AOI 3, which includes one potential release area: AFFF Storage Area. Groundwater was assessed sitewide at locations outside of the potential release areas, near the facility boundary. Groundwater sample locations are not associated with specific AOIs and results are therefore presented separately. The detected compounds in soil at AOI 3 are presented in **Table 6-2**. The detections of PFOS, PFOA, and PFBS in soil are presented on **Figure 6-1** through **Figure 6-3**.

6.5.1 AOI 3 Soil Analytical Results

PFOS exceeded the SL of 130 µg/kg in the soil sample collected at AOI 3. The surface soil sample (0-2 feet bgs) was collected at location AOI03-01 from beneath the concrete adjacent to the AFFF secondary containment and a nearby trench drain. PFOS was detected at a concentration of 2,680 J µg/kg. PFOA was also detected at AOI03-01 at a concentration of 9.45 J+ µg/kg, several orders of magnitude below the SL. PFBS was not detected in the soil samples collected at AOI 3.

6.5.2 AOI 3 Conclusions

The SI results indicate that PFOS and PFOA were detected in soil at AOI 3. Based on the exceedance of the PFOS SL in soil at location AOI03-01, further evaluation of AOI 3 is warranted.

6.6 Sitewide Locations

This section presents the analytical results for soil and groundwater in comparison to SLs for the three sitewide sample locations: SHEL-MW001, SHEL-MW002, and SHEL-MW003. These locations are not associated with any specific AOI but were chosen to assess soil and groundwater at the facility boundaries in the inferred upgradient and downgradient directions identified during the PA and SI planning. Location SHEL-MW001 was selected as the background sample placed at the inferred upgradient boundary, between facility AOIs and the potential adjacent off-facility source (Shelbyville Municipal Airport). Locations SHEL-MW002 and SHEL-MW003 are located at the inferred downgradient boundary. The detected compounds in soil and groundwater are summarized on **Table 6-2 and 6-3**. The detections of PFOS, PFOA, and PFBS in soil and groundwater are presented on **Figures 6-1** though **Figure 6-4**.

6.6.1 Sitewide Locations Soil Analytical Results

Soil was sampled at three intervals at each of the three sitewide sample locations: the shallow surface interval (0 to 2 feet bgs), the deep interval (just above groundwater), and the intermediate interval (the midpoint). Depths of the intermediate and deep soil sample intervals varied between locations depending on the observed depth of groundwater.

PFOS, PFOA, and PFBS were not detected in soil at any interval at location SHEL-MW001. At the opposite facility boundary, PFOS was detected below the SL of 130 µg/kg in the shallow soil at both SHEL-MW002 (1.09 J+ µg/kg) and SHEL-MW003 (0.491 J+ µg/kg). PFOA was only detected in the shallow interval at SHEL-MW002, below the SL, at a concentration of 0.188 J µg/kg. PFBS was not detected in soil in any interval at the three sitewide sample locations. PFOS, PFOA, and PFBS were not detected in the intermediate or deep intervals at any of the three sitewide locations.

6.6.2 Sitewide Locations Groundwater Analytical Results

Groundwater samples were collected from permanent monitoring wells installed at the three sitewide sample locations. No exceedances of the groundwater SLs were observed. PFOS,

PFOA, and PFBS were not detected in groundwater samples collected at locations SHEL-MW001 and SHEL-MW002. Additionally, PFOS and PFOA were not detected in the groundwater sample collected at location SHEL-MW003. PFBS was detected in groundwater at SHEL-MW003 at a concentration of 4.71 nanograms per liter (ng/L), below the SL of 600 ng/L.

6.6.3 Sitewide Locations Conclusions

Based on the results of the SI, PFBS was detected in groundwater at sitewide sample location SHEL-MW003. PFOS and PFOA were not detected in groundwater at any location. No exceedances of groundwater SLs were observed. Further evaluation of groundwater at the AASF based solely on PFOS, PFOA, and PFBS results relative to the SLs is not warranted. However, the observed groundwater flow direction at the AASF leaves data gaps in groundwater characterization due to the apparent absence of well control downgradient from the AOIs.

Table 6-2
PFAS Detections in Surface Soil
Site Inspection Report, Shelbyville AASF

Area of Interest		AOI 2								AOI 3				Sitewide					
Sample ID		AOI02-01-SB-00-02		AOI02-02-SB-00-02		AOI02-02-SB-00-02-D		AOI02-03-SB-00-02		AOI03-01-SB-00-02		AOI03-01-SB-00-02-D		SHEL-MW001-SB-00-02		SHEL-MW002-SB-00-02		SHEL-MW003-SB-00-02	
Sample Date		04/07/2021		04/08/2021		04/08/2021		04/08/2021		04/07/2021		04/07/2021		04/05/2021		04/06/2021		04/06/2021	
Depth		0 - 2 ft		0 - 2 ft		0 - 2 ft		0 - 2 ft		0 - 2 ft		0 - 2 ft		0 - 2 ft		0 - 2 ft		0 - 2 ft	
Analyte	**OSD Screening Level [a,b]**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**
Soil, PFAS by LCMSMS Compliant with QSM 5.3 Table B-15 (ug/Kg)																			
6:2 FTS	-	ND		ND		ND		ND		31.1		40.9		ND		ND		ND	
8:2 FTS	-	ND		ND		ND		ND		101		114		ND		ND		ND	
PFBA	-	ND		0.115	J	0.116	J	ND		ND		ND		ND		0.103	J	ND	
PFHxA	-	ND		0.070	J	0.057	J	ND		8.71	J	13.2	J	ND		0.091	J	0.062	J
PFHxS	-	ND		0.191	J	ND		ND		23.2		33.8		ND		0.143	J	ND	
PFOA	130	ND		0.082	J	ND	UJ	ND		5.64	J+	9.45	J+	ND		0.188	J	ND	
PFOS	130	ND		0.332	J	0.251	J	0.302	J	2680	J	2590		ND		1.09	J+	0.491	J+
PFPeA	-	ND		0.076	J	0.063	J	ND		ND	UJ	3.26	J	ND		0.111	J	ND	
PFUnDA	-	ND		0.017	J	0.012	J	0.014	J	ND		ND		ND		ND		ND	

Grey Fill — Detected concentration exceeded OSD Screening Levels

References

a. Assistant Secretary of Defense, 2019. Risk Based Screening Levels Calculated for PFOS and PFOA in Groundwater or Soil using USEPA's Regional Screening Level Calculator. HQ=0.1. 15 October 2019. Soil screening levels based on residential scenario for direct ingestion of contaminated soil.

b. USEPA, 2021. Risk Based Screening Levels Calculated for PFBS in Groundwater and Soil using USEPA's Regional Screening Level Calculator. HQ=0.1. 8 April 2021.

Interpreted Qualifiers

J = Estimated concentration

J+ = Estimated concentration, biased high

UJ = The analyte was not detected at a level greater than or equal to the adjusted detection limit (DL). However, the reported adjusted DL is approximate and may be inaccurate or imprecise.

Chemical Abbreviations

6:2 FTS	6:2 fluorotelomer sulfonate
8:2 FTS	8:2 fluorotelomer sulfonate
PFBA	perfluorobutanoic acid
PFBS	perfluorobutanesulfonic acid
PFHxA	perfluorohexanoic acid
PFHxS	perfluorohexanesulfonic acid
PFOA	perfluorooctanoic acid
PFOS	perfluorooctanesulfonic acid
PFPeA	perfluoropentanoic acid
PFUnDA	perfluoro-n-undecanoic acid

Acronyms and Abbreviations

AASF	Army Aviation Support Facility
AOI	Area of Interest
D	Duplicate
ft	feet
HQ	Hazard quotient
LCMSMS	Liquid Chromatography Mass Spectrometry
LOD	Limit of Detection
ND	Analyte not detected above the LOD
OSD	Office of the Secretary of Defense
QSM	Quality Systems Manual
Qual	Interpreted Qualifier
SB	Soil boring
SHEL	Shelbyville
USEPA	United States Environmental Protection Agency
ug/Kg	micrograms per Kilogram
-	Not applicable

Table 6-3
PFAS Detections in Groundwater
Site Inspection Report, Shelbyville AASF

Area of Interest			Sitewide							
Sample ID			SHEL-MW001-040921		SHEL-MW001-040921-D		SHEL-MW002-040921		SHEL-MW003-040921	
Sample Date			04/09/2021		04/09/2021		04/09/2021		04/09/2021	
Analyte	OSD Screening Level [a,b]	USEPA HA [c]	Result	Qual	Result	Qual	Result	Qual	Result	Qual
Water, PFAS by LCMSMS Compliant with QSM 5.3 Table B-15 (ng/L)										
PFBA	-	-	ND		ND		9.31		33.6	
PFBS	600	-	ND		ND		ND		4.71	
PFHpA	-	-	ND		ND		ND		34.2	
PFHxA	-	-	ND		ND		ND		48.0	
PFHxS	-	-	ND		ND		ND		1.86	J
PFPeA	-	-	ND		ND		3.94	J	71.9	

Grey Fill	Detected concentration exceeded OSD Screening Levels
Bold Font	Detected concentration exceeded USEPA HA Screening Levels

References

a. Assistant Secretary of Defense, 2019. Risk Based Screening Levels Calculated for PFOS and PFOA in Groundwater or Soil using USEPA's Regional Screening Level Calculator. HQ=0.1. 15 October 2019. Groundwater screening levels based on residential scenario for direct ingestion of groundwater.

b. USEPA, 2021. Risk Based Screening Levels Calculated for PFBS in Groundwater and Soil using USEPA's Regional Screening Level Calculator. HQ=0.1. 8 April 2021.

c. USEPA, 2016. Drinking Water Health Advisory for PFOA. Office of Water (4304T). Health and Ecological Criteria Division, Washington, DC 20460. EPA Document Number: 822-R-16-005. May 2016. / EPA. 2016. Drinking Water Health Advisory for PFOS. Office of Water (4304T). Health and Ecological Criteria Division, Washington, DC 20460. EPA Document Number: 822-R-16-004. May 2016.

Interpreted Qualifiers

J = Estimated concentration

Chemical Abbreviations

PFBA	perfluorobutanoic acid
PFBS	perfluorobutanesulfonic acid
PFHpA	perfluoroheptanoic acid
PFHxA	perfluorohexanoic acid
PFHxS	perfluorohexanesulfonic acid
PFOA	perfluorooctanoic acid
PFOS	perfluorooctanesulfonic acid
PFPeA	perfluoropentanoic acid

Acronyms and Abbreviations

AASF	Army Aviation Support Facility
D	Duplicate
HA	Health Advisory
HQ	Hazard quotient
LCMSMS	Liquid Chromatography Mass Spectrometry
LOD	Limit of Detection
ND	Analyte not detected above the LOD
OSD	Office of the Secretary of Defense
QSM	Quality Systems Manual
Qual	Interpreted Qualifier
SHEL	Shelbyville
USEPA	United States Environmental Protection Agency
ng/L	nanogram per liter
-	Not applicable

Table 6-4
PFAS Detections in Sediment
Site Inspection Report, Shelbyville AASF

Area of Interest	AOI 1					
Sample ID	AOI01-01-SD-00-0.8		AOI01-02-SD-00-0.8		AOI01-02-SD-00-0.8-D	
Sample Date	04/06/2021		04/06/2021		04/06/2021	
Depth	0 - 0.8 ft		0 - 0.8 ft		0 - 0.8 ft	
Analyte	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**
Sediment, PFAS by LCMSMS Compliant with QSM 5.3 Table B-15 (ug/Kg)						
6:2 FTS	0.387	J	ND		ND	
8:2 FTS	1.25	J+	ND		ND	
PFDA	0.050	J	ND		ND	
PFHxA	0.077	J	ND		ND	
PFHxS	0.482	J	ND		ND	
PFOA	0.113	J	ND		ND	
PFOS	16.7		ND		ND	

Interpreted Qualifiers

J = Estimated concentration

J+ = Estimated concentration, biased high

Chemical Abbreviations

6:2 FTS	6:2 fluorotelomer sulfonate
8:2 FTS	8:2 fluorotelomer sulfonate
PFDA	perfluorodecanoic acid
PFHxA	perfluorohexanoic acid
PFHxS	perfluorohexanesulfonic acid
PFOA	perfluorooctanoic acid
PFOS	perfluorooctanesulfonic acid

Acronyms and Abbreviations

AASF	Army Aviation Support Facility
AOI	Area of Interest
D	Duplicate
ft	feet
LCMSMS	Liquid Chromatography Mass Spectrometry
LOD	Limit of Detection
ND	Analyte not detected above the LOD
QSM	Quality Systems Manual
Qual	Interpreted Qualifier
SD	Sediment
SHEL	Shelbyville
ug/Kg	micrograms per Kilogram

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Shallow

SHEL-MW001
ND

AOI02-01
ND

AOI03-01
2680 J

AOI02-02
0.332 J

SHEL-MW002
1.09 J+

AOI02-03
0.302 J

SHEL-MW003
0.491 J+

Intermediate

SHEL-MW001
ND

SHEL-MW002
ND

SHEL-MW003
ND

Deep

SHEL-MW001
ND

SHEL-MW002
ND

SHEL-MW003
ND

N Frontage Rd

74

Legend

- Facility Location
- Wetland
- River/Stream
- Ditch/Channel

PFOS Results (µg/Kg)

- ND
- >ND - 10
- >10 - 130
- >130 - 1,600
- >1,600

SHEL-MW002 / ND - Sample Location ID / Result Value

J = Estimated concentration
J+ = Estimated concentration, biased high

0 175 350 700 Feet

Depth intervals shown represent respective sampling position within a given soil boring location.

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PFOS Detections in Soil

CLIENT	ARNG			
PROJECT	Site Inspection for PFAS at Shelbyville AASF, IN			
REVISED	11/30/2021	GIS BY	MS	11/30/2021
SCALE	1:4,200	CHK BY	MC	11/30/2021
Base Map: Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong		PM	CM	11/30/2021

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Figure 6-1

Shallow

SHEL-MW001
ND

AOI02-01
ND

AOI03-01
9.45 J+

AOI02-02
0.082 J

SHEL-MW002
0.188 J

AOI02-03
ND

SHEL-MW003
ND

Intermediate

SHEL-MW001
ND

SHEL-MW002
ND

SHEL-MW003
ND

Deep

SHEL-MW001
ND

SHEL-MW002
ND

SHEL-MW003
ND

N Frontage Rd

74

Legend

Facility Location

Wetland

River/Stream

Ditch/Channel

PFOA Results (µg/Kg)

ND

>ND - 10

>10 - 130

>130 - 1,600

>1,600

SHEL-MW002
ND
- Sample Location ID
- Result Value

J = Estimated concentration
J+ = Estimated concentration, biased high

0 175 350 700 Feet

Depth intervals shown represent respective sampling position within a given soil boring location.

PFOA Detections in Soil

CLIENT	ARNG			
PROJECT	Site Inspection for PFAS at Shelbyville AASF, IN			
REVISED	11/30/2021	GIS BY	MS	11/30/2021
SCALE	1:4,200	CHK BY	MC	11/30/2021
Base Map: Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong		PM	CM	11/30/2021

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Figure 6-2

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Shallow

SHEL-MW001
ND

AOI02-01
ND

AOI03-01
ND

AOI02-02
ND

SHEL-MW002
ND

AOI02-03
ND

SHEL-MW003
ND

Intermediate

SHEL-MW001
ND

SHEL-MW002
ND

SHEL-MW003
ND

Deep

SHEL-MW001
ND

SHEL-MW002
ND

SHEL-MW003
ND

Legend

- Facility Location
- Wetland
- River/Stream
- Ditch/Channel

PFBS Results (µg/Kg)

- ND
- >ND - 10
- >10 - 1,900
- >1,900 - 25,000
- >25,000

SHEL-MW002
ND
- Sample Location ID
- Result Value

0 175 350 700 Feet

Depth intervals shown represent respective sampling position within a given soil boring location.

PFBS Detections in Soil

CLIENT	ARNG			
PROJECT	Site Inspection for PFAS at Shelbyville AASF, IN			
REVISED	10/7/2021	GIS BY	MS	10/7/2021
SCALE	1:4,200	CHK BY	MC	10/7/2021
Base Map: Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong		PM	CM	10/7/2021

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Figure 6-3

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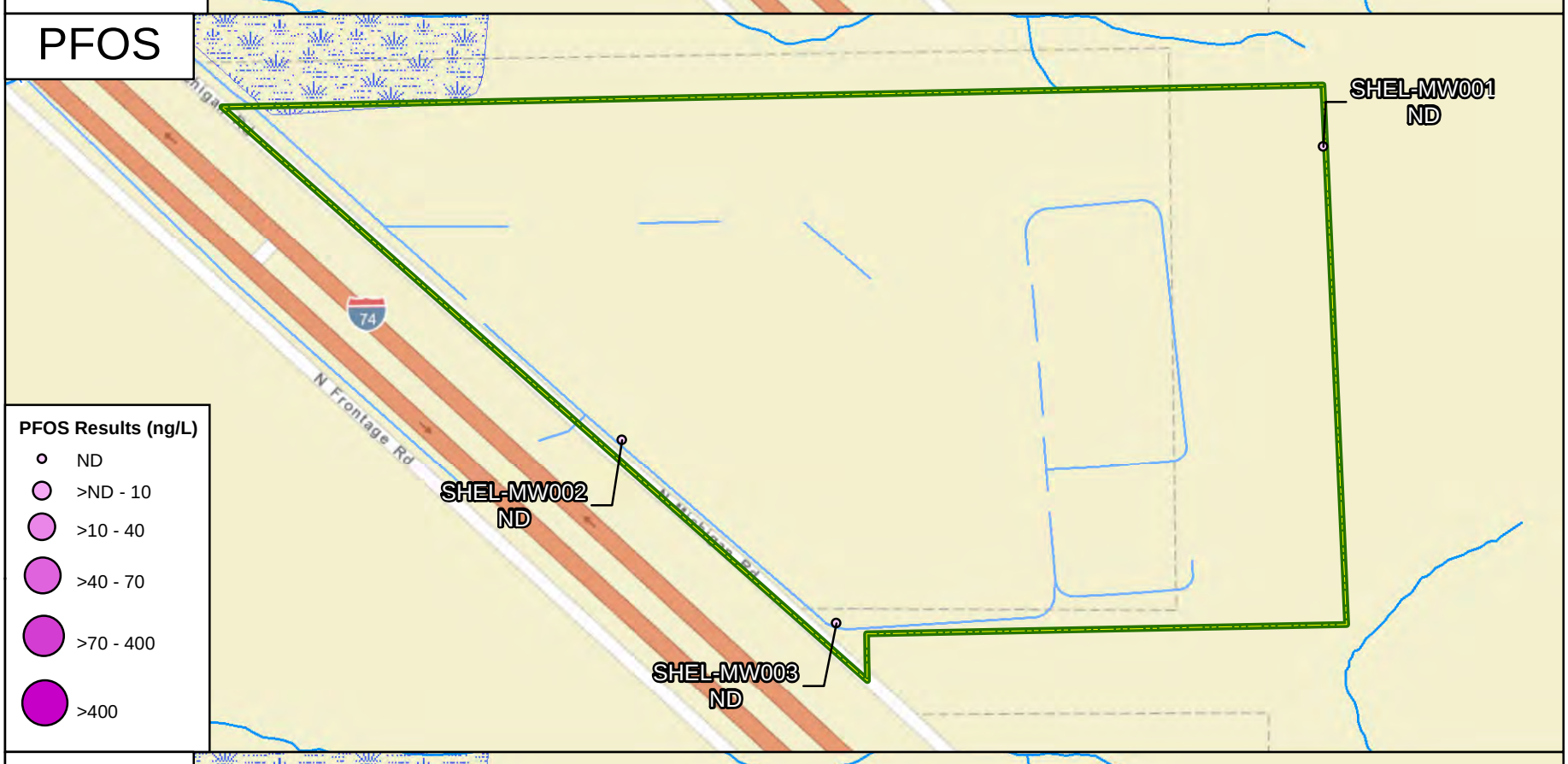
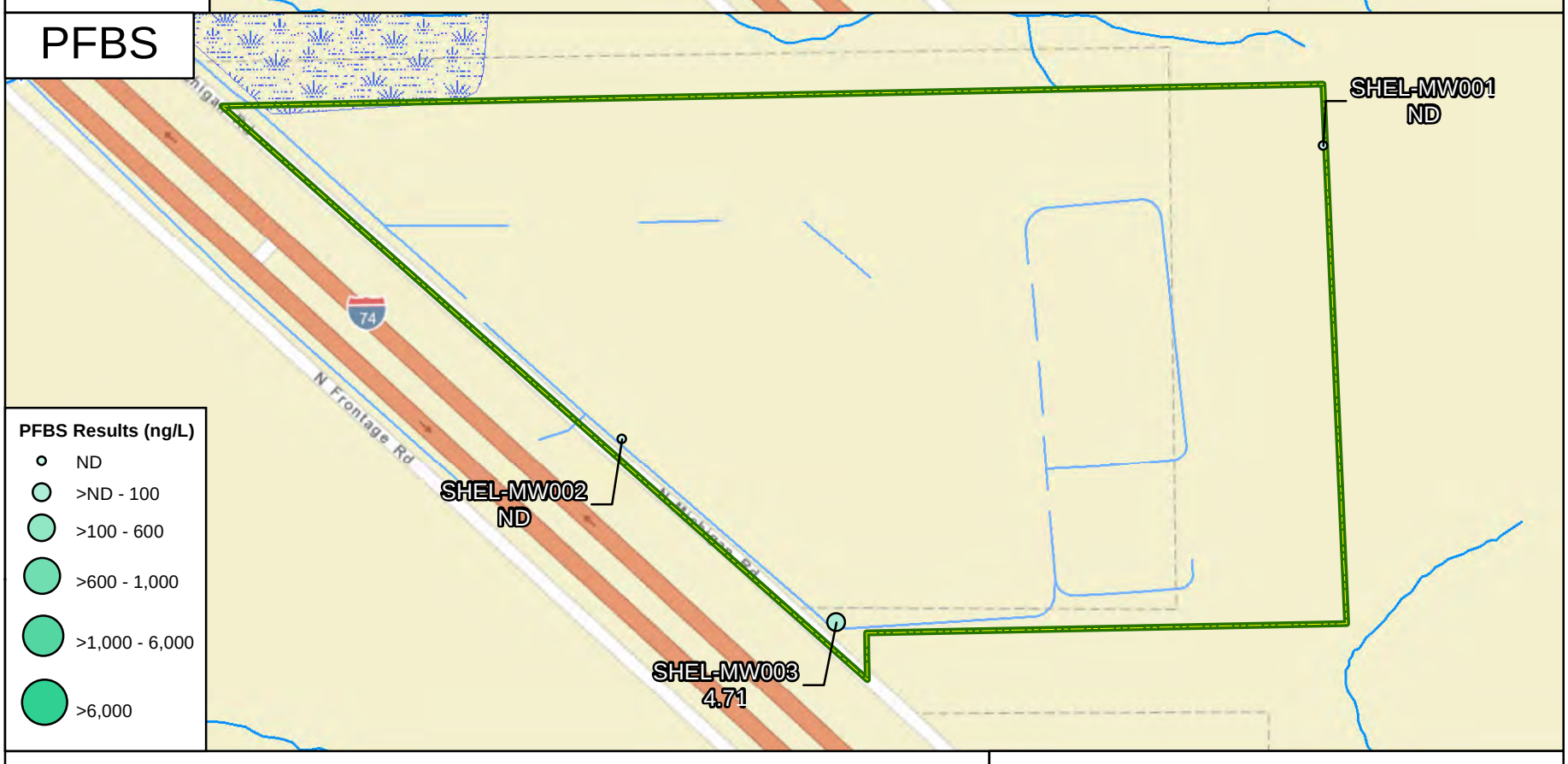
PFOA

PFOS



PFBS



SHEL-MW002 - Sample Location ID
ND - Result Value

Legend

- Facility Location
- Wetland
- River/Stream
- Ditch/Channel

0 175 350 700 Feet

PFOA, PFOS, and PFBS Detections in Groundwater

CLIENT	ARNG			
PROJECT	Site Inspection for PFAS at Shelbyville AASF, IN			
REVISED	10/7/2021	GIS BY	MS	10/7/2021
SCALE	1:4,200	CHK BY	MC	10/7/2021
Base Map: Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong		PM	CM	10/7/2021

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Figure 6-4

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PFOA

AOI01-01
0.113 J

AOI01-02
ND

N Frontage Rd

74

PFOA Results (µg/Kg)

- ND
- >ND - 10
- >10 - 100
- >100 - 1,000
- >1,000

PFOS

AOI01-01
16.7

AOI01-02
ND

N Frontage Rd

74

PFOS Results (µg/Kg)

- ND
- >ND - 10
- >10 - 100
- >100 - 1,000
- >1,000

PFBS

AOI01-01
ND

AOI01-02
ND

N Frontage Rd

74

PFBS Results (µg/Kg)

- ND
- >ND - 10
- >10 - 100
- >100 - 1,000
- >1,000

Legend

- Facility Location
- Wetland
- River/Stream
- Ditch/Channel

SHEL-MW002 - Sample Location ID
ND - Result Value

J = Estimated concentration
J+ = Estimated concentration, biased high

0 175 350 700 Feet

PFOA, PFOS, and PFBS Detections in Sediment

CLIENT	ARNG			
PROJECT	Site Inspection for PFAS at Shelbyville AASF, IN			
REVISED	11/30/2021	GIS BY	MS	11/30/2021
SCALE	1:4,200	CHK BY	MC	11/30/2021
Base Map: Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong		PM	CM	11/30/2021

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Figure 6-5

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7. Exposure Pathways

The CSMs for each AOI, revised based on the SI findings, are presented on **Figure 7-1** through **Figure 7-3**. A CSM presents the current understanding of the site conditions with respect to known and suspected sources, potential transport mechanisms and migration pathways, and potentially exposed human receptors. A human exposure pathway is considered potentially complete when the following conditions are present:

1. Contaminant source;
2. Environmental fate and transport;
3. Exposure point;
4. Exposure route; and
5. Potentially exposed populations.

If any of these elements are missing, the pathway is incomplete. The CSM figures use an empty circle symbol to represent an incomplete exposure pathway. Areas with an incomplete pathway generally warrant no further action. However, the pathway is considered potentially complete if PFOA, PFOS, or PFBS are detected, in which case the CSM figure uses a half-filled circle symbol to represent a potentially complete exposure pathway. Additionally, a completely filled circle symbol is used to indicate when a potentially complete exposure pathway has detections of PFOA, PFOS, or PFBS above the SLs. Areas with an identified potentially complete pathway may warrant further investigation.

In general, the potential routes of exposure to PFAS 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. The receptors evaluated are consistent with those listed in USEPA guidance for risk screening (USEPA, 2001). Receptors at the facility include site workers (e.g., facility staff and visiting soldiers), construction workers, trespassers (though unlikely due to restricted access), residents outside the facility boundary, and recreational users outside of the facility boundary.

7.1 Soil Exposure Pathway

The SI results for PFOA, PFOS, and PFBS in soil were used to determine whether a potentially complete pathway exists between the source and potential receptors at each AOI based on the aforementioned criteria. At AOI 1, where soil samples were not collected, data from sediment and groundwater, in conjunction with the history of PFAS use and knowledge of the fate and transport properties of PFAS, were used to determine whether a potentially complete pathway exists between the source and potential receptors.

7.1.1 AOI 1

AFFF was released to the drainage ditch at AOI 1 in 2003 as part of a dual hydrostatic testing of Tri-Max™ units and weed control measure. While the assumption is that the release occurred to sediment and surface water, the ephemeral nature of the ditch – meaning water is only present for part of the year – suggests that the sediment exposure pathway may be a proxy for surface soil when the ditch is dry, as was the case during the SI sampling. As a result, the ingestion and inhalation of dust exposure pathways via surface soil (i.e., unsaturated ditch sediments) at AOI 1 may also be considered potentially complete for site workers, trespassers, and future construction workers. The discussion of sediment and surface water is presented in **Section 7.3.1**. Surface

water infiltration within the drainage ditch could facilitate the downward migration of PFAS into the subsurface soil. Ground-disturbing activities to the subsurface soil could result in future construction worker exposure to PFOA and PFOS via ingestion or inhalation of dust. AOI 1 is not located adjacent to residential areas; therefore, the residential exposure pathway is considered incomplete. The CSM for AOI 1 is presented on **Figure 7-1**.

7.1.2 AOI 2

AFFF-equipped Tri-Max™ units were staged along the Flight Line from as early as 1998 to 2015. Additionally, Tri-Max™ units were stored in the Storage Tents when not in use. There were no known releases or leaks of AFFF. PFOS was detected in two of the three sample locations, whereas PFOA was detected in one sample location, and PFBS was not detected in any samples. All detections were several orders of magnitude below the SLs. Ground-disturbing activities of surface soil may result in potential PFAS exposure via ingestion and inhalation of dust to site workers, trespassers, and future construction workers. No subsurface soil samples were taken at AOI 2, but it is possible that PFAS may have infiltrated into the subsurface soil; therefore, ground-disturbing activities could result in future construction worker exposure to PFOA and PFOS via ingestion and inhalation of dust. AOI 2 is not located adjacent to residential areas; therefore, the residential exposure pathway is considered incomplete. The CSM for AOI 2 is presented on **Figure 7-2**.

7.1.3 AOI 3

AFFF is stored in buckets in a small, secondary-containment storage container staged on concrete beside the main facility building. There were no known releases of AFFF reported. PFOS was detected in concentrations above the SLs, whereas PFOA was detected at concentrations below the SL, and PFBS was not detected. It is possible that unreported releases of AFFF may have infiltrated into joints or small cracks in the concrete near the storage area or, more likely, through leaks in the trench drain adjacent to the AOI. Because the surface soil is covered by thick concrete at AOI 3, exposure to soil is restricted to potential future construction activities. Additionally, although no subsurface data were collected at AOI 3, PFAS likely infiltrated downward to the subsurface soil; therefore ground disturbing activities to the subsurface soil may result in potentially complete exposure to construction workers. Based on these factors, future ground-disturbing activities could potentially result in site worker, construction worker, and trespasser exposure to PFAS via ingestion of surface soil and inhalation of dust particles, and construction workers may potentially be exposed to ingestion of subsurface soil and inhalation of dust. However, due to the absence of any current construction or similar activities, all exposure is for future receptors. AOI 3 is not located adjacent to residential areas; therefore, the residential exposure pathway is considered incomplete. The CSM for AOI 3 is presented on **Figure 7-3**.

7.2 Groundwater Exposure Pathway

The SI results for PFOA, PFOS, and PFBS in groundwater were used to determine whether a potentially complete pathway exists between the source and potential receptors based on the aforementioned criteria. Because groundwater was assessed sitewide at the facility boundaries, the following discussion is not split up by specific AOIs.

7.2.1 Sitewide

PFBS was detected in one out of three groundwater sampling locations, SHEL-MW03, which is located along the southern boundary of the facility. The concentration detected was more than two orders of magnitude below the SL. PFOA and PFOS were not detected in any of the groundwater samples. Drinking water at the AASF is supplied by an onsite supply well. This well was sampled for PFAS in 2017, and PFOA, PFOS, and PFBS were not detected. Additionally, the

decontamination water sample (**Appendix F**), which was collected from water supplied by this same well, had no detections; therefore, the ingestion pathway for the site worker is considered incomplete. While static depths to groundwater were observed in monitoring wells between approximately 5 and 11 feet bgs, groundwater in soil borings was only observed within transmissive zones that were encountered between 10 and 34 feet bgs. In locations where these transmissive zones are shallow enough for groundwater to be encountered during trenching activities (i.e., close to SHEL-MW003), the ingestion pathway for future construction workers is considered potentially complete. In locations where transmissive zones are deeper than 15 feet, the pathway is considered incomplete. Additionally, the ingestion pathway for offsite residents is potentially complete for residents with drinking water supplied from the surficial aquifer downgradient of the facility. The groundwater ingestion exposure pathway for trespassers is incomplete; however, it is potentially complete for offsite recreational users where shallow groundwater transmissive zones may discharge to surface water bodies offsite. The CSMs for AOIs 1 through 3 all use the sitewide groundwater data, as no groundwater was collected at individual AOIs. The observed groundwater flow direction during the SI suggests that further evaluation of groundwater may be warranted in order to adequately assess groundwater conditions at or downgradient of the AOIs. The CSMs are presented on **Figure 7-1** through **Figure 7-3**.

7.3 Surface Water and Sediment Exposure Pathway

The SI results for PFOA, PFOS, and PFBS in sediment were used to determine whether a potentially complete pathway exists between the source and potential receptors at each AOI based on the aforementioned criteria. At AOIs where sediment samples were not collected (and for surface water pathways at all AOIs), data from soil and groundwater, in conjunction with the history of PFAS use and knowledge of the fate and transport properties of PFAS, were used to determine whether a potentially complete pathway exists between the source and potential receptors.

7.3.1 AOI 1

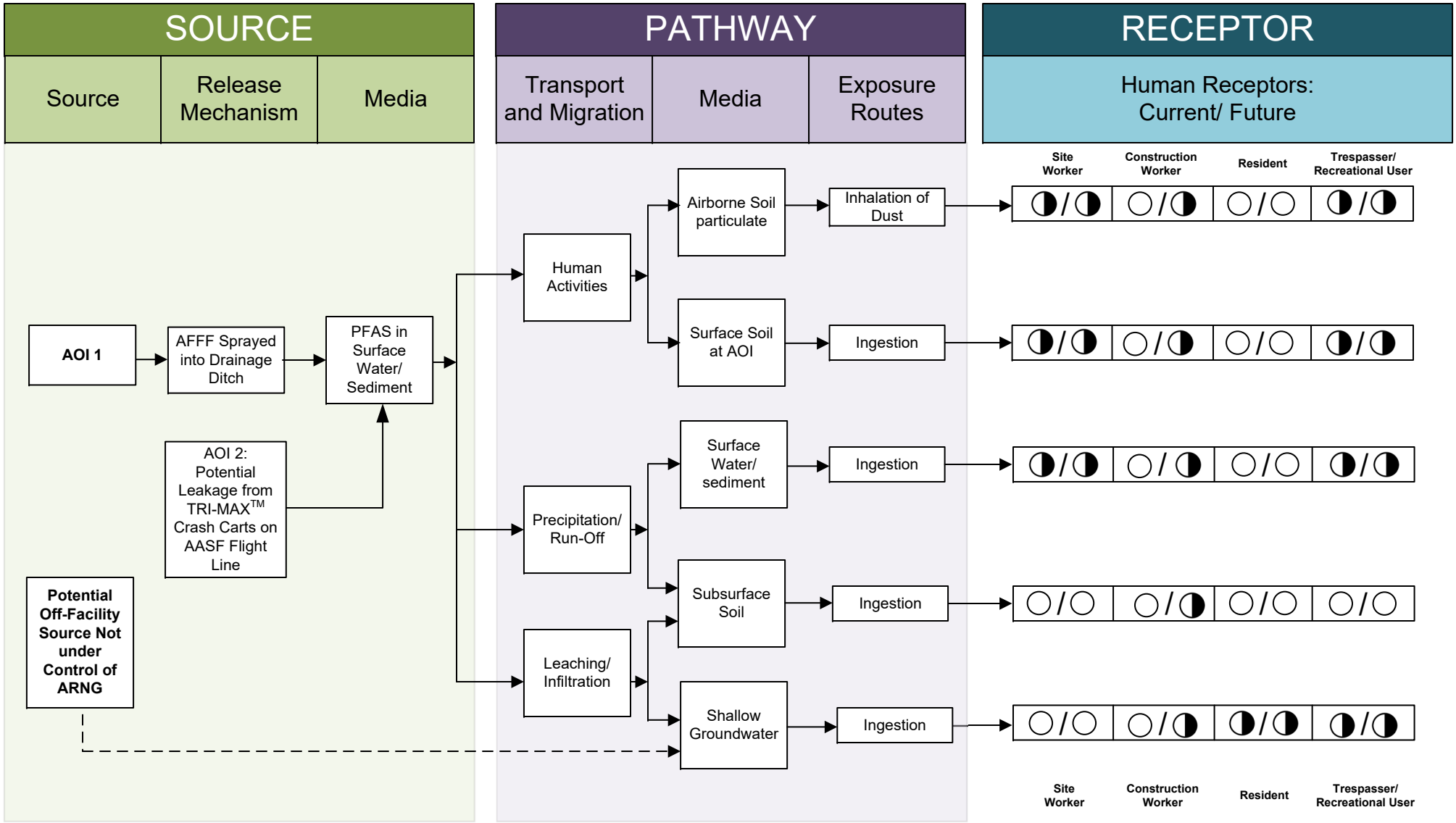
PFOA and PFOS were detected in sediment samples collected from the westernmost portion of the Northern Drainage Ditch. PFBS were not detected in either of the samples. Based on the SI results, the ingestion pathway for surface water and sediment is potentially complete for site workers, trespassers, and future construction workers. According to the site Spill Prevention, Control, and Countermeasures Plan, the drainage ditch discharges directly into an outfall that flows west and into tributaries of the Big Blue River. Brandywine Creek and the Big Blue River are not used as drinking water sources but are used for recreation (e.g., fishing and swimming) (INARNG, 2017). Therefore, the ingestion exposure pathways for surface water and sediment are potentially complete for offsite recreational users of Brandywine Creek and the Big Blue River but incomplete for off-facility residents. The CSM for AOI 1 is presented on **Figure 7-1**.

7.3.2 AOI 2

PFAS are water soluble and can migrate readily from surface soil to sediment and surface water. Grass-lined drainage swales are present around the Flight Line and Storage Tents and eventually discharge to larger drainage ditches, including in the vicinity of AOI 1, and ultimately towards Hankins Ditch. Due to these factors and the detections of PFOS and PFOA in surface soils within this AOI, the ingestion pathway for surface water and sediment is potentially complete for site workers, trespassers, and future construction workers. Additionally, consistent with discussion of AOI 1, the ingestion exposure pathway for surface water is potentially complete for offsite recreational users of Brandywine Creek and the Big Blue River and incomplete for off-facility residents. The CSM for AOI 2 is presented on **Figure 7-2**.

7.3.3 AOI 3

The trench drain adjacent to AOI 3 eventually drains into a drainage ditch to the northwest. This drainage ditch eventually discharges into the Hankins Ditch. Due to detections of PFOS and PFOA in soil adjacent to the trench drain, the ingestion pathway for surface water and sediment is potentially complete for site workers, trespassers, and future construction workers. Additionally, the ingestion exposure pathway for surface water and sediment is potentially complete for offsite recreational users of Brandywine Creek and the Big Blue River and incomplete for off-facility residents. The CSM for AOI 3 is presented on **Figure 7-3**.



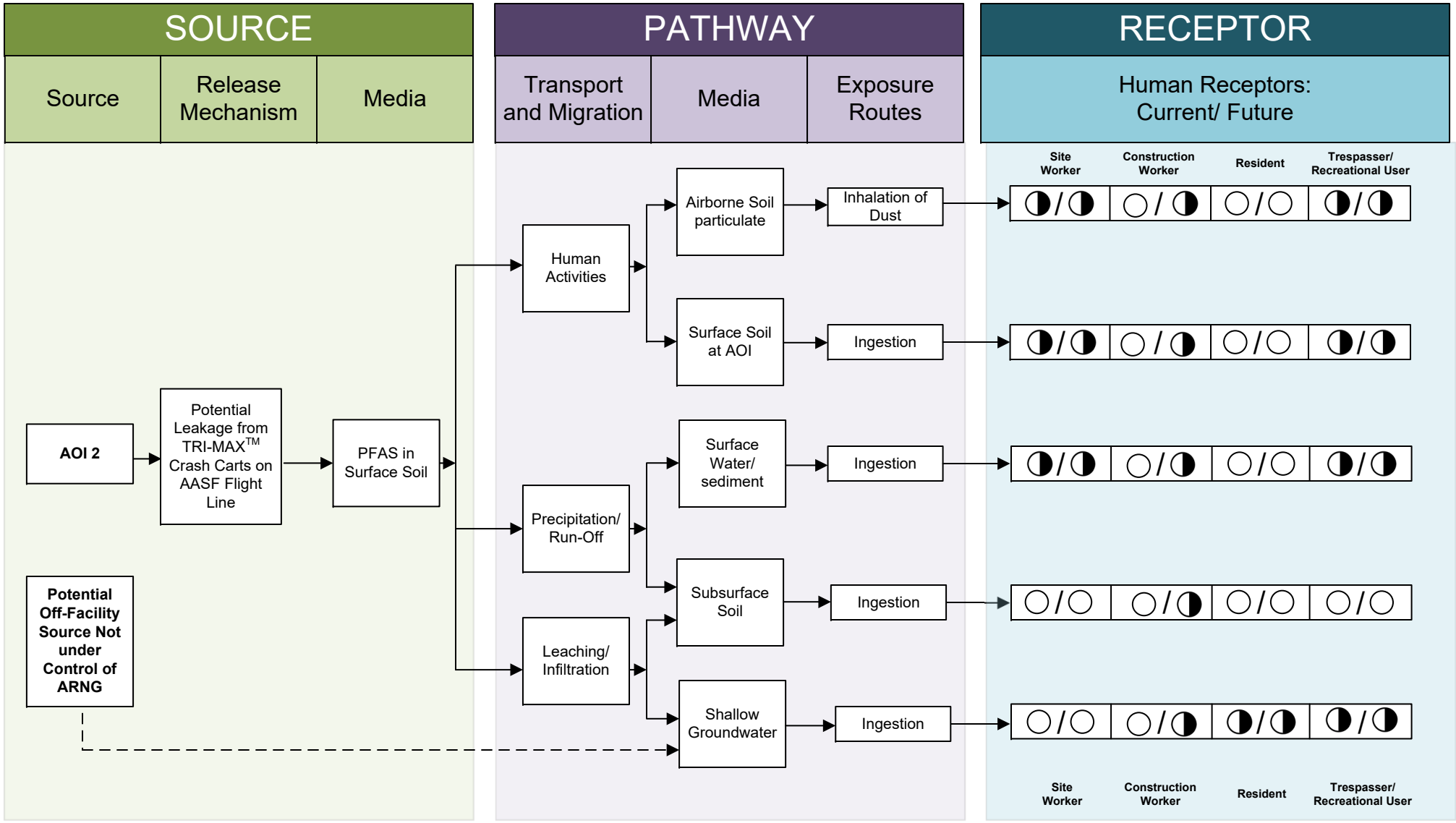
LEGEND

- Flow-Chart Stops
- Flow-Chart Continues
- Partial / Possible Flow
- Incomplete Pathway
- Potentially Complete Pathway
- Potentially Complete Pathway with Exceedance of SL

Notes:

1. The resident and recreational user receptors refer to an off-site resident or recreational user.
2. Dermal contact exposure pathway is incomplete for PFAS.
3. No groundwater samples collected at AOI 1. CSM reflects sitewide groundwater data.

Figure 7-1
Conceptual Site Model
AOI 1 Northern Drainage Ditch
Shelbyville AASF, IN



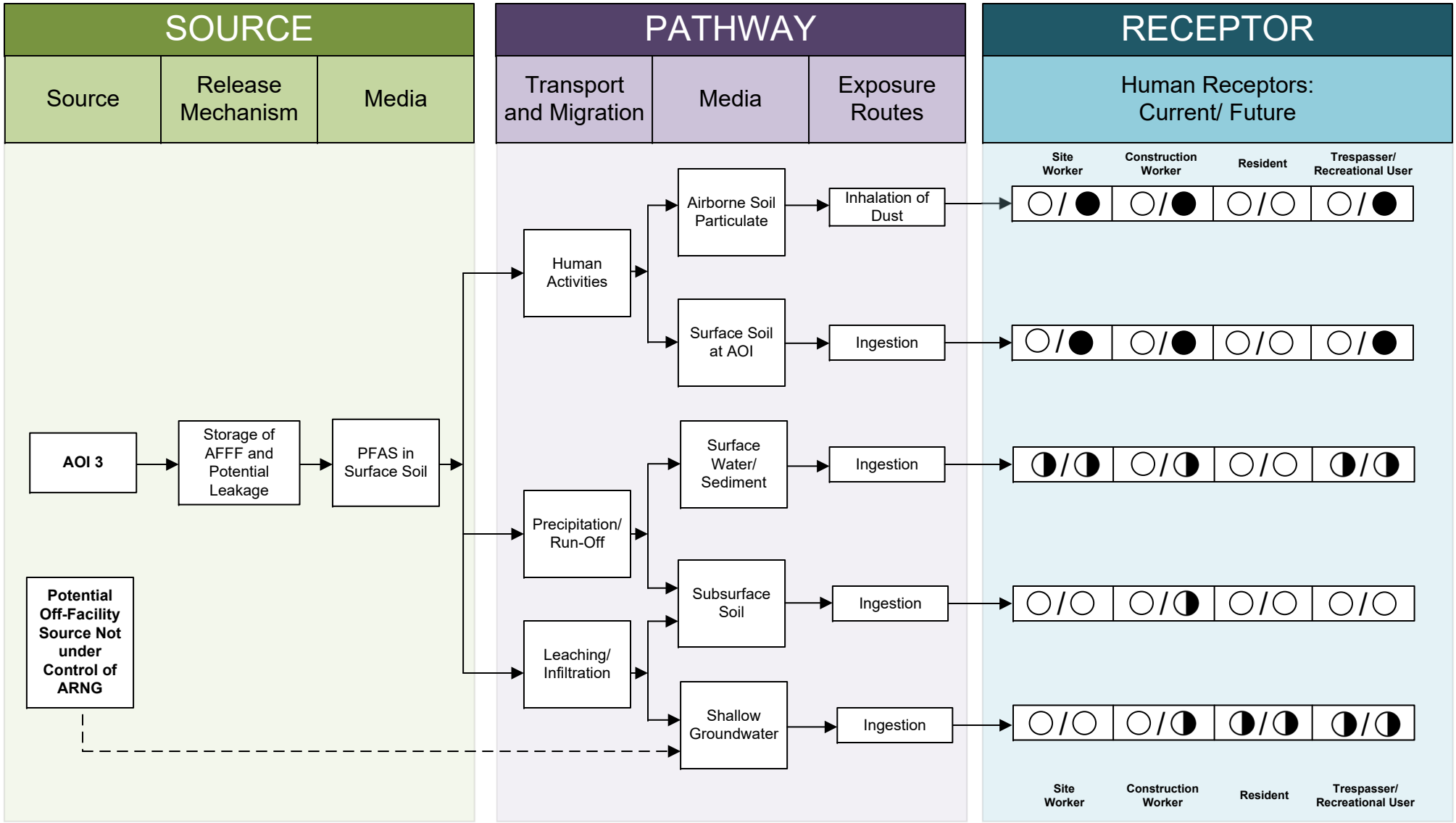
LEGEND

- Flow-Chart Stops
- Flow-Chart Continues
- Partial / Possible Flow
- Incomplete Pathway
- Potentially Complete Pathway
- Potentially Complete Pathway with Exceedance of SL

Notes:

1. The resident and recreational user receptors refer to an off-site resident or recreational user.
2. Dermal contact exposure pathway is incomplete for PFAS.
3. No groundwater samples collected at AOI 2. CSM reflects sitewide groundwater data.

Figure 7-2
Conceptual Site Model
AOI 2 AASF Flight Line and Storage Tents
Shelbyville AASF, IN



LEGEND

- Flow-Chart Stops
- Flow-Chart Continues
- Partial / Possible Flow
- Incomplete Pathway
- Potentially Complete Pathway
- Potentially Complete Pathway with Exceedance of SL

Notes:

1. The resident and recreational user receptors refer to an off-site resident or recreational user.
2. Dermal contact exposure pathway is incomplete for PFAS.
3. No groundwater samples collected at AOI 3. CSM reflects sitewide groundwater data.

Figure 7-3
Conceptual Site Model
AOI 3 AFFF Storage Area
Shelbyville AASF, IN

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8. Summary and Outcome

This section summarizes SI activities and findings. The most significant findings are summarized in this section and are reproduced directly or abstracted from information contained in this report. The outcome provides general and comparative interpretations of the findings relative to the SLs.

8.1 SI Activities

SI field activities were completed 5 April to 9 April 2021 and included soil and sediment sampling as well as permanent monitoring well installation, development, and low-flow groundwater sampling. Field activities were conducted in accordance with the SI QAPP Addendum (AECOM, 2021a), except as previously noted in **Section 5.9**.

To fulfill the project DQOs set forth in the approved SI QAPP Addendum (AECOM, 2021a), samples were collected and analyzed for a subset of PFAS by LC/MS/MS compliant with QSM 5.3 Table B-15 as follows. The 18 PFAS analyzed as part of the ARNG SI program are specified in **Section 5.8** of this Report.

- Thirteen (13) soil grab samples from seven boring locations;
- Three groundwater samples from three newly installed permanent monitoring well locations;
- Two sediment samples from two locations;
- Thirteen (13) Quality Assurance (QA) samples collected.

The information gathered during this investigation was used to determine if PFOA, PFOS, and/or PFBS were present at or above SLs. Additionally, the CSMs were refined to assess whether a potentially complete pathway exists between the source and potential receptors for potential exposure to PFOA, PFOS, and PFBS at the AOIs, which are described in **Section 7**.

8.2 SI Goals Evaluation

As described in **Section 4.2**, the SI activities were designed to achieve six main goals or DQOs. This section describes the SI goals and the conclusions that can be made for each based on the data collected during this investigation.

1. *Determine the presence or absence of PFOA, PFOS, and PFBS at or above SLs.*

   PFOA and PFOS were detected at facility the in soil and sediment at the facility, whereas PFBS was detected in groundwater at the facility. The only exceedance of an SL occurred in soil at AOI 3, where a PFOS concentration of 2,680 J µg/kg exceeded the soil SL of 130 µg/kg. Detections of PFOA and PFOS below SLs were observed elsewhere both at the source areas and at the facility boundary. PFBS was detected below the SL in groundwater at the facility boundary.

2. *Develop information to potentially eliminate a release from further consideration because it is determined that it poses no significant threat to human health or the environment.*

   No releases were removed from further consideration. While the only SL exceedance was found in soil at AOI 3, the lack of monitoring well control at or downgradient from the AOIs, including where a known release occurred, prevents the adequate evaluation of groundwater needed in order to remove any releases from consideration. Further data collection is recommended at the RI phase in order to make this determination.

3. *Determine the potential need for a TCRA (applies to drinking water only). The primary actions that will be considered include provision of alternative water supplies or wellhead treatment.*

   Based on the data collected during this SI, there is not a complete pathway between source and on-facility drinking water receptors. Drinking water for Shelbyville AASF is sourced from an onsite supply well centrally located within the facility. The well was sampled for PFAS in 2017, and results indicated that PFOA and PFOS were not detected. Further, PFOA, PFOS, and PFBS were not detected in the decontamination water sample collected from the same well in March 2021 as part of the SI activities.

   A potentially complete pathway exists between source and off-facility residential drinking water receptors, as PFBS was detected in groundwater at the facility boundary. Groundwater wells in the area are typically screened between 50 to 150 feet bgs, suggesting that some wells may exist in the same unconsolidated aquifer investigated during the SI. However, results indicate groundwater concentrations are below SLs and are therefore unlikely to pose a risk to off-facility drinking water receptors.

   The SI findings recognize a possible data gap in groundwater control as a result of differences between inferred groundwater flow direction based preliminary data and the observed flow direction during SI field activities. This data gap suggests that groundwater at the observed downgradient facility boundary was not adequately characterized.

4. *Collect data to better characterize the release areas for more effective and rapid initiation of a RI (if determined necessary).*

   The geological data collected during the SI indicate that site conditions across the facility are characterized by soils with low permeability and conductivity, dominated by stiff silts and clays interspersed with occasional minor components of sand, gravel, or cobbles.

   These site observations are consistent with the glacial till found over much of central Indiana and are representative of the till of the Trafalgar Formation, the surficial geological unit identified at the AASF. Typical of glacial till, the soils encountered were noted to be stiff and well compacted, particularly the dry, massive silt sections that required significant force to break from the cores and powdered like rock flour. The soil borings were observed dry throughout much of their length outside of the considerably thinner, interbedded sections of poorly sorted sand and gravel. Depositionally, the fine-grained materials that make up the majority of the length of the borings likely represent direct deposition by the ice, whereas the thinner intra-till sand and gravel layers resulted from periods when moving meltwater was the predominant depositional mechanism.

   Groundwater transmissivity beneath the facility is likely dominated by the thin intra-till layers described above. Surface infiltration to these layers is limited by the overlying till, which often acts as an aquitard. As such, susceptibility to surface contamination is low (IDNR, 2005). While static depth to groundwater was measured in wells between 5 and 11 feet bgs, groundwater was not observed in soil borings until these transmissive zones were encountered. Depths of these zones ranged from 10 feet bgs at SHEL-MW003 to 34 feet bgs at SHEL-MW001.

   The groundwater flow direction at the facility is to the northwest, as determined by static groundwater elevations collected during the SI. This direction differs from the inferred southwest groundwater flow direction used for SI planning, which was based on information available at that time. The relatively steep ground surface gradient observed at the facility and hydrogeological information noted above suggest that groundwater may correlate more closely with topography, which drops in the very northwest corner of the facility, than was originally anticipated, and that the resulting flow may be controlled by the relative head pressure and connectivity between the aforementioned transmissive zones.

The SI was designed to evaluate groundwater sitewide by sampling in the inferred up- and downgradient directions from the potential release areas. The discrepancy between the inferred and observed groundwater flow at the facility may warrant additional data collection in order to adequately characterize groundwater. Additional data collection at the RI stage is recommended for a more complete evaluation of groundwater.

It is recommended that the three AOIs be grouped collectively going forward. This determination was based on the proximity of the release areas within the AASF and on the connectivity between these release areas, as it relates to overlapping transport and migration pathways (e.g., combined drainage features). Grouping the release areas into a single AOI will allow for the evaluation of soil and groundwater data at locations that otherwise would not have been included in the RI.

5. *If PFOA, PFOS, and PFBS are determined to be present, aim to evaluate whether the concentrations can be attributed to on-facility or off-facility sources that were identified within 4 miles of the installation as part of the PA (e.g., fire stations, major manufacturers, other DoD facilities).*

   Based upon the evaluation of groundwater and soil results in comparison to SLs, in combination with the currently understood groundwater flow direction analysis, the results of the SI indicate that the source of detected concentrations of PFOA, PFOS, and PFBS at the facility is likely attributable to ARNG activities. Groundwater results at location SHEL-MW001 show that PFOA, PFOS, and PFBS were not detected at the facility boundary nearest the Shelbyville Municipal Airport, the only identified potential adjacent source.

6. *Determine whether a potentially complete pathway exists between the source and potential receptors and whether ARNG is the likely source of the contamination.*

   Detections of PFOS and PFOA in soil and sediment at source areas and soil at the facility boundary indicate there is a potentially complete exposure pathway between the source and site workers, construction workers, and trespassers. The PFBS concentration detected in groundwater indicates there is a potentially complete exposure pathway between source and construction workers and off-facility residents; however, the discrepancy between the inferred and observed groundwater flow directions create uncertainties whether well control were achieved to adequately characterize groundwater.

8.3 Outcome

Based on the CSMs developed and revised in light of the SI findings, there is potential for exposure from sources on-facility resulting from historical DoD activities. Sample analytical concentrations collected during the SI were compared against the project SLs for PFOA, PFOS, and PFBS in soil and groundwater, as described in **Table 6-1**. The following bullets summarize the SI results:

- PFOS in soil at AOI 3: AFFF Storage Area exceeded the SL of 130 µg/kg, with a concentration of 2,680 µg/kg at location AOI03-01. Based on the results of the SI, further evaluation of AOI 3 is warranted in the RI.
- PFOS and PFOA were not detected in groundwater at the facility, and the concentration of PFBS detected at SHEL-MW003 was below the groundwater SL. While the groundwater concentrations did not exceed the SLs at the facility for the samples collected as part of this SI, the observed groundwater flow direction suggests that well control downgradient of source areas was not achieved. Additional data collected during the RI would improve the understanding of groundwater conditions at the facility.

- It is further recommended that, because the AOIs are closely interconnected, they be combined into a single AOI and move forward collectively to the RI phase, on the basis of the two previous findings, for additional evaluation.

Table 8-1 summarizes the SI results for soil and groundwater. Based on the CSMs developed and revised in light of the SI findings, there is potential for on-facility and off-facility receptors caused by DoD activities at the facility.

Table 8-2 summarizes the rationale used to determine if an AOI should be considered for further investigation under CERCLA and undergo an RI. Based on the results of this SI, further evaluation is warranted at Shelbyville AASF. It is recommended that the release areas be combined into a single AOI and investigated collectively. This determination is based on the release areas being closely interconnected, and that further evaluation can be adequately addressed recognizing a single AOI.

Table 8-1: Summary of Site Inspection Findings

AOI	Potential PFAS Release Area	Soil – Source Area	Groundwater – Source Area	Groundwater – Facility Boundary
1	Northern Drainage Ditch	N/A[1]	N/A[2]	N/A[2]
2	Flight Line & Storage Tents	◐	N/A[2]	N/A[2]
3	AFFF Storage Area	●	N/A[2]	N/A[2]
Sitewide Locations[3]	Unknown	◐	N/A[2]	◐

Legend:
N/A = Not applicable
1) Due to the nature of AOI 1, only sediment samples were collected.
2) Groundwater was assessed sitewide at the facility boundary. Results are not associated with a specific AOI. See Section 6.6 "Sitewide Locations".
3) Sitewide locations are not considered source areas.

● = detected; exceedance of the screening levels
◐ = detected; no exceedance of the screening levels
○ = not detected

Table 8-2: Site Inspection Recommendations

AOI	Description	Rationale	Future Action
1	Northern Drainage Ditch	Detections in sediment. No groundwater or soil samples collected. Groundwater was assessed at the facility boundary; however, downgradient well control was not achieved.	Group AOI 1 with the other two AOIs based on proximity and relation. Proceed to RI collectively based on the soil exceedance at AOI 3.
2	Flight Line & Storage Tents	Detections in soil but no exceedances of SLs. No groundwater sample collected at the AOI. Groundwater was assessed at the facility boundary; however, downgradient well control was not achieved.	Group AOI 2 with the other two AOIs based on proximity and relation. Proceed to RI collectively based on the soil exceedance at AOI 3.
3	AFFF Storage Area	Exceedance of PFOS SL in soil. No groundwater sample collected at the AOI. Groundwater was assessed at the facility boundary; however, downgradient well control was not achieved.	Group AOI 3 with the other two AOIs based on proximity and relation. Proceed to RI.
Sitewide Locations	Facility Boundary	Detections in soil and groundwater but no exceedances of SLs. Downgradient well control was not achieved.	Collect additional groundwater data at the up- and downgradient facility boundaries during the RI

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