FINAL
Site Inspection Report
Helena Army Aviation Support Facility
Helena, Montana

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

August 2021

Prepared for:

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

UNCLASSIFIED

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Acronyms and Abbreviations

6:2 FTS	6:2 Fluorotelomer sulfonate
8:2 FTS	8:2 Fluorotelomer sulfonate
µg/Kg	micrograms per Kilogram
°C	degrees Celsius
°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
btoc	below top of casing
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
DO	dissolved oxygen
DQI	data quality indicator
DQO	data quality objective
DUA	data usability assessment
DVR	data validation report
EIS	extraction internal standards
ELAP	Environmental Laboratory Accreditation Program
EM	Engineers Manual
FedEx	Federal Express
HDPE	high-density polyethylene
HRAA	Helena Regional Airport Authority
HSA	hollow stem auger
IDW	investigation-derived waste
ITRC	Interstate Technology Regulatory Council
LC/MS/MS	liquid chromatography tandem mass spectrometry
LCS	laboratory control spike
LCSD	laboratory control spike duplicate
LOQ	limit of quantitation
MBMG	Montana Bureau of Mines and Geology
MDL	method detection limit
mph	miles per hour
MS	matrix spike
MSD	matrix spike duplicate
MTARNG	Montana Army National Guard
MTDEQ	Montana Department of Environmental Quality

NELAP	National Environmental Laboratory Accreditation Program
NEtFOSAA	N-ethyl perfluorooctanesulfonamidoacetic acid
ng/L	nanograms per liter
NMeFOSAA	N-methyl perfluorooctanesulfonamidoacetic acid
ORP	oxidation-reduction potential
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	perfluoroheptanoic 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
Pioneer	Pioneer Technical Services, Inc
PPE	personal protective equipment
PQAPP	Programmatic UFP-QAPP
PVC	polyvinyl chloride
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
UCMR	Unregulated Contaminant Monitoring Rule
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
USGS	United States Geological Survey

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 Area of Interest (AOI) 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 Helena Army Aviation Support Facility (AASF) in Helena, Montana. The Helena AASF will be referred to as the “facility” throughout this document.

The facility is on a 75-acre parcel of land adjacent to the Helena Regional Airport in Lewis and Clark County. The AASF is on the eastern city limits of Helena, east of Interstate Highway 15, south of Canyon Ferry Road, and north of the Burlington Northern Railroad Tracks. The PFAS PA Report identified two potential release areas which were grouped into one AOI and investigated during the SI (AECOM, 2018c; AECOM, 2020b). The SI field activities were conducted from 6 to 13 July 2020 and included the collection of soil and groundwater samples.

To fulfill the project Data Quality Objectives (DQOs) set forth in the approved SI Quality Assurance Project Plan (QAPP) Addendum (AECOM, 2020b), samples were collected and analyzed for a subset of 18 PFAS by liquid chromatography tandem mass spectrometry (LC/MS/MS) compliant with Quality Systems Manual (QSM) 5.1 Table B-15. The 18 PFAS analyzed as part of the ARNG SI program are specified in **Section 5.7** 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 (OSD) dated 15 October 2019 (Assistant Secretary of Defense, 2019). The ARNG PFAS SIs follow this DoD policy and, when the maximum site concentration for sampled media exceed the SLs, the site 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, sediment, and surface water 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:

- PFOA, PFOS, and PFBS were detected in groundwater at AOI 1 and PFOS exceeded the individual SL of 40 nanograms per liter (ng/L), with maximum concentrations of 775 ng/L (814 ng/L duplicate) and 175 ng/L at locations HAASF-MW005 and HAASF-MW003, respectively. Based on the results of the SI, further evaluation of AOI 1 is warranted in the RI.
- Based on the SL exceedances and well information from the Montana Bureau of Mines and Geology (MBMG) database, a potentially complete pathway exits to off-facility residential wells.
- The detected concentrations of PFOA, PFOS, and PFBS in soil samples from the AOI were below the SLs.

Table ES-2 summarizes the SI results for soil and groundwater at AOI 1: 60 and 47 Hangar Fire Suppression System Release and Tri-Max™ Spill/Release Area. Based on the conceptual site

model (CSM) developed and revised in light of the SI findings, there is potential for PFOS exposure to drinking water receptors caused by DoD activities.

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 is warranted in the RI for AOI 1: 60 and 47 Hangar Fire Suppression System Release and Tri-Max™ Spill/Release Area.

Table ES-1: Screening Levels (Soil and Groundwater)

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

Notes:

a.) Assistant Secretary of Defense, 2019. 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 October 2019.

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.

Table ES-2: Summary of Site Inspection Findings

AOI	Potential PFAS Release Area	Soil – Source Area	Groundwater – Source Area	Groundwater – Facility Boundary
1	60 and 47 Hangar Fire Suppression System Release and Tri-Max™ Spill/Release Area	◐	●	●

Legend:

● = 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	60 and 47 Hangar Fire Suppression System Release and Tri-Max™ Spill/Release Area	Exceedances of SLs in groundwater at source area and downgradient facility boundary. No exceedances of SLs in soil.	Proceed to RI

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) Impacted Sites at 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 Helena Army Aviation Support Facility (AASF) in Helena, Montana. The Helena AASF is 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 (AECOM, 2018c) that identified two potential PFAS release areas, which were grouped into one Area of Interest (AOI), was performed at the facility. The objective of the SI is to identify whether there has been a release to the environment from the AOI 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 AASF is adjacent to the Helena Regional Airport (**Figure 2-1**) in Lewis and Clark County in Helena, Montana. The AASF is on the eastern city limits of Helena, east of Interstate Highway 15, south of Canyon Ferry Road, and north of the Burlington Northern Railroad Tracks. The communities of Helena, East Helena, Clancy, and Jefferson City lie within 15 miles of the AASF (Montana ARNG [MTARNG], 1994).

In 1998, due to insufficient space, the AASF relocated to its present location on the north-central portion of the Helena Regional Airport property, approximately 750 feet north of Runway 9/27. The facility includes operation, maintenance, and repair for ARNG rotary-winged aircraft (60 Hangar and 47 Hangar), administrative offices, and classrooms (Helena Regional Airport Authority [HRAA], 2018). The two rotary-winged hangars are equipped with independent fire suppression systems. The facility also includes an armory and a fixed-wing aircraft hangar. The armory and the fixed-wing aircraft hangar does not have a fire suppression system or portable aqueous film forming foam (AFFF) extinguishers as of the date of this SI Report.

2.2 Facility Environmental Setting

The facility is located on the edge of the Helena Valley. The valley is bounded on the west by the Scratchgravel Hills, on the south by the Elkhorn Mountains, on the north by the Big Belt Mountains, and on the east by the Spokane Bench (MTARNG, 1994). The elevation of the facility is approximately 3,825 feet above mean sea level. The Continental Divide is located 15 miles west of the valley. The western part of the valley is gently sloping, while the eastern portion of the valley consists of low-rolling hills. The terrain around the AASF can be characterized as the transition between the rolling foothills of Mount Ascension and the flats of the Helena Valley (Pioneer Technical Services, Inc. [Pioneer], 2009).

2.2.1 Geology

Helena lies within the Northern Rocky Mountains physiographic province. Quaternary-age sediments fill the valley and form a northeast-sloping alluvial plain. The sedimentary plain is bounded by broad pediments and alluvial fans of the Elkhorn Mountains, the Scratchgravel Hills, and the Big Belt Mountains (Pioneer, 2009).

The AASF is situated on Quaternary-age alluvium derived from carbonate rocks and shale (Pioneer, 2009). A slope wash deposit, approximately 20 feet thick, underlies the soil at the AASF. This deposit consists of beds of coarse gravel interlayed with thin irregular beds and lenses of silt and clay. The gravel, in a matrix of sandy and silty clay, is composed of fragments of quartzite, shale, and limestone (US Geological Survey [USGS], 1986). Sedimentary bedrock from the Late Cretaceous to Middle Proterozoic Age underlies the slope wash and stream deposits. The bedrock layer is several thousand meters thick and is made up of sandstone, shale, limestone, and dolomite (MTARNG, 1994).

2.2.2 Hydrogeology

The facility is located along the southern boundary of the Helena Valley-Fill Aquifer System. This aquifer system is a major source of domestic water for local residents, with the majority of domestic water wells at a depth of less than 70 feet (MTARNG, 1994). Groundwater flow is generally from the southern, western, and northern margins of the valley, toward Lake Helena.

Based on a Helena AASF groundwater study (Pioneer, 2009), groundwater flow directions at the facility vary from due north to due east (**Figure 2-2**). During the SI, depth to water ranged from 40.91 feet below top of casing (btoc) to 56.78 feet btoc. Groundwater elevations were calculated, and an updated groundwater flow map indicated groundwater flows northeast (**Figure 2-3**).

Lateral discontinuity of fine-grained layers allows hydraulic interconnection of water-yielding zones that function as one complex aquifer (USGS, 1992). Aquifer recharge is through infiltration of streamflow, leakage from irrigation canals, infiltration of excess irrigation water, and inflow from fractures in bedrock. Discharge is through leakage to streams and drains, upward leakage to Lake Helena, and withdrawals from wells (MTARNG, 1994).

No potable water wells are located on the facility; however, a review of the Montana Bureau of Mines and Geology (MBMG) database indicated as many as 3,842 wells exist within a 4-mile radius of the facility (MBMG, 2020), as shown on **Figure 2-2**. A query of the MBMG database showed a public supply well on the eastern boundary of the AASF; however, the MTARNG has no knowledge of a well on the property boundary, and the well could not be located during the PA. The MBMG database classifies wells based on their use: domestic, commercial, or industrial. Of the 3,842 wells within 4 miles of the facility, 805 potential domestic wells exist in the downgradient direction of the facility (north of the facility), some as close as 0.5 miles from the facility boundary (MBMG, 2020). The majority of these downgradient domestic wells range in depth from 50 to over 100 feet below ground surface (bgs) and are cased off to the bottom of the well. However, a small percentage of the 805 domestic wells were screened shallower (less than 50 feet). Drinking water for the facility is supplied by the City of Helena. The City of Helena uses groundwater and surface water as water sources for its residents (Helena Water Utilities Public Water System, 2004). More information is provided in Section 2.2.3. Additionally, the City of Helena was selected to participate in the USEPA Third Unregulated Contaminant Monitoring Rule (UCMR) assessment monitoring. Results from the sampling indicated the six PFAS contaminants analyzed were below the method detection limit (USEPA, 2017a; MTDEQ, 2020).

2.2.3 Hydrology

Surface water was diverted around the AASF during construction; therefore, no surface water currently enters the facility. The largest stream and the closest to the facility is Prickly Pear Creek, about 2 miles to the east of the facility, which flows towards the north (**Figure 2-4**). A detention pond near the northeast corner of the AASF collects runoff from most of the facility. The detention pond was originally approximately 3 feet deep and seeded with vegetation (MTARNG, 1994). The detention pond was reconfigured once in 2005 or 2006 and recontoured during construction in 2017. If soil were removed during the 2005 or 2006 reconfiguration, the disposition of the soil would be unknown. Per the project manager for the 2017 construction, if soil were removed during the recontouring, it was likely re-used elsewhere at the facility during the construction project or removed by the contractor (Bullock Construction) and used at a construction yard in Boulder, Montana, or another construction site in Lakeside, Montana. Unprocessed surface water is used for irrigation in the fields near the facility, but exact details are currently unavailable on this water usage.

Regional surface water features include Lake Helena, the Missouri River, and the Helena Valley Reservoir. Surface water stored in the Helena Valley Reservoir provides one source of drinking and irrigation water used by the City of Helena (the other source includes groundwater). Water from the Reservoir is distributed across the city through the Helena Valley Canal. The Canal is 31.7 miles long and flows in a clockwise direction from the Helena Valley Reservoir to its termination at Lake Helena (US Bureau of Reclamation, 2017). The 31.7 miles of the canal is lined, with the exception of a 10.2 mile stretch. Information provided by the Helena Valley Irrigation District indicated that the section of canal immediately downgradient of the facility is lined with asphalt. The facility is not located within a mapped floodplain area.

2.2.4 Climate

The climate at the AASF is northern desert with large daily temperature fluctuations and an average temperature of 58.3 degrees Fahrenheit (°F). Seasonally, temperatures vary from summer highs of 86°F to winter lows of 14°F (World Climate, 2018). Average annual precipitation is 11.2 inches of rain and 38 inches of snow (World Climate, 2018). Factors affecting the climate include invasions of maritime air masses from the Pacific Ocean and drainage of cool air into the valley from the surrounding mountains. The prevailing wind is westerly, averaging 7 to 8 miles per hour (mph), with gust speeds of 55 to 65 mph.

2.2.5 Current and Future Land Use

The AASF is a controlled access facility with public roads and is adjacent to the Helena Regional Airport. The land is owned by the Department of the Army and leased to the State of Montana (MTARNG). The Helena Regional Airport is owned and operated by the HRAA and provides commercial and general air service to the Helena area and west-central Montana. The HRAA owns a number of land parcels that have been subdivided and zoned to allow for commercial development with restriction (HRAA, 2018). Future land use is not anticipated to change.

2.2.6 Critical Habitat and Threatened/ Endangered Species

The following birds, plants, mammals, and reptiles are federally endangered, threatened, proposed, and/or are listed as candidate species in Lewis and Clark County, Montana (US Fish and Wildlife Service [USFWS], 2020).

- **Mammals**: Grizzly Bear, *Ursus arctos horribilus* (threatened)
- **Mammals**: Canada Lynx, *Lynx canadensis* (threatened)
- **Mammals**: North American Wolverine, *Gulo luscus* (proposed threatened)
- **Fish**: Bull Trout, *Salvenlinus confluentus* (threatened)
- **Bird**: Red Knot, *Calidris canutus rufa* (threatened)
- **Plants**: Whitebark Pine, *Pinus albicaulis* (candidate)

2.3 History of PFAS Use

Four potential PFAS release areas were identified at the Helena AASF during the PA (AECOM, 2018c). Two potential releases were from fire suppression system tests performed at the 60 and 47 Hangar. The other two releases were from portable Tri-Max™ fire extinguishers that leaked or spilled onto the asphalt surrounding the AASF. The two Tri-Max™ releases occurred in the same general location. All four potential releases eventually entered the detention pond on the northeast side of the AASF through the storm water drain. Findings from the PA did not indicate any other activity at the facility contributed AFFF or PFAS-containing material to the environment. A more thorough description of the releases is presented in **Section 3**.

2.4 Potable Water Sampling

Due to the historical releases of AFFF, the potential exists for exposure to offsite drinking water receptors immediately north of the facility boundary. Though not included in the original scope, programmatic contingencies are in place to add off-facility sampling if SI results deem the sampling is warranted. Based on the magnitude and location of the groundwater exceedances, the project team agreed that off-facility sampling was necessary to evaluate the potential impact to off-facility receptors. Prior to sampling, approval was obtained from the Deputy Assistant Secretary of the Army for Environment, Safety and Occupational Health. Potable water samples were collected from five potable wells located in closest proximity to the facility boundary (downgradient of AOI 1). Sample results are provided below and in **Table 2-1**:

- PFOA – Detections ranged from non-detect to 1.94 J nanograms per liter (ng/L) (HAASF-POTABLE-04).
- PFOS – Detections ranged from non-detect to 8.57 ng/L (HAASF-POTABLE-04).
- PFBS – Detections ranged from non-detect to 4.81 ng/L (HAASF-POTABLE-04).

Table 2-1
PFAS Detections in Potable Wells
Site Inspection Report, Helena AASF

	Area of Interest	POTABLE													
	Sample ID	HAASF-POTABLE-01		HAASF-POTABLE-02		HAASF-POTABLE-02-DUP		HAASF-POTABLE-03		HAASF-POTABLE-04		HAASF-POTABLE-05		HAASF-POTABLE-05 DUP	
	Sample Date	02/16/2021		02/16/2021		02/16/2021		04/29/2021		04/30/2021		04/29/2021		04/29/2021	
Analyte	**USEPA HA [a]**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**
Water, PFAS by LCMSMS Compliant with QSM 5.3 Table B-15 (ng/L)															
6:2 FTS	-	ND		ND		ND		ND		ND		1.11	J	ND	
FOSA	-	1.49	J	1.18	J	ND	UJ	ND		1.66	J	1.38	J	1.18	J
NMeFOSAA	-	ND		ND		ND		ND		ND		1.07	J	ND	UJ
PFBS	-	ND		ND		ND		ND		4.81		0.907	J	ND	UJ
PFDA	-	ND		ND		ND		ND		ND		0.898	J	ND	UJ
PFHpA	-	ND		ND		ND		ND		1.46	J	1.02	J	ND	UJ
PFHxA	-	ND		ND		ND		ND		4.65		1.53	J	ND	UJ
PFHxS	-	1.04	J	ND		ND		ND		16.2		1.03	J	ND	UJ
PFNA	-	ND		ND		ND		ND		ND		0.834	J	ND	UJ
PFNS	-	ND		ND		ND		ND		ND		0.787	J	ND	UJ
PFOA	70	ND		ND		ND		ND		1.94	J	1.36	J	ND	UJ
PFOS	70	ND		ND		ND		0.984	J	8.57		2.57	J	ND	UJ
PFPeA	-	ND		ND		ND		ND		4.31		1.01	J	ND	UJ
PFPeS	-	ND		ND		ND		ND		3.32	J	0.883	J	ND	UJ
Total PFOA+PFOS	70	ND		ND		ND		0.984		10.5		3.93		ND	

Grey Fill — Detected concentration exceeded USEPA HA

References
a. United States Environmental Protection Agency. 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
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.

Acronyms and Abbreviations

AASF	Army Aviation Support Facility
DUP	Duplicate
HA	Health Advisory
LCMSMS	Liquid Chromatography Mass Spectrometry
LOD	Limit of Detection
LOQ	Limit of Quantitation
ND	Analyte not detected above the LOD
Qual	Interpreted Qualifier
USEPA	United States Environmental Protection Agency
ng/L	nanogram per liter
-	Not applicable

Chemical Abbreviations

6:2 FTS	6:2 fluorotelomer sulfonate
FOSA	Perfluorooctane sulfonamide
NMeFOSAA	N-methyl perfluorooctanesulfonamidoacetic acid
PFBS	perfluorobutanesulfonic acid
PFDA	perfluorodecanoic acid
PFHpA	perfluoroheptanoic acid
PFHxA	perfluorohexanoic acid
PFHxS	perfluorohexanesulfonic acid
PFNA	perfluorononanoic acid
PFNS	perfluorononanesulfonic acid
PFOA	perfluorooctanoic acid
PFOS	perfluorooctanesulfonic acid
PFPeA	perfluoropentanoic acid
PFPeS	perfluoropentanesulfonic acid

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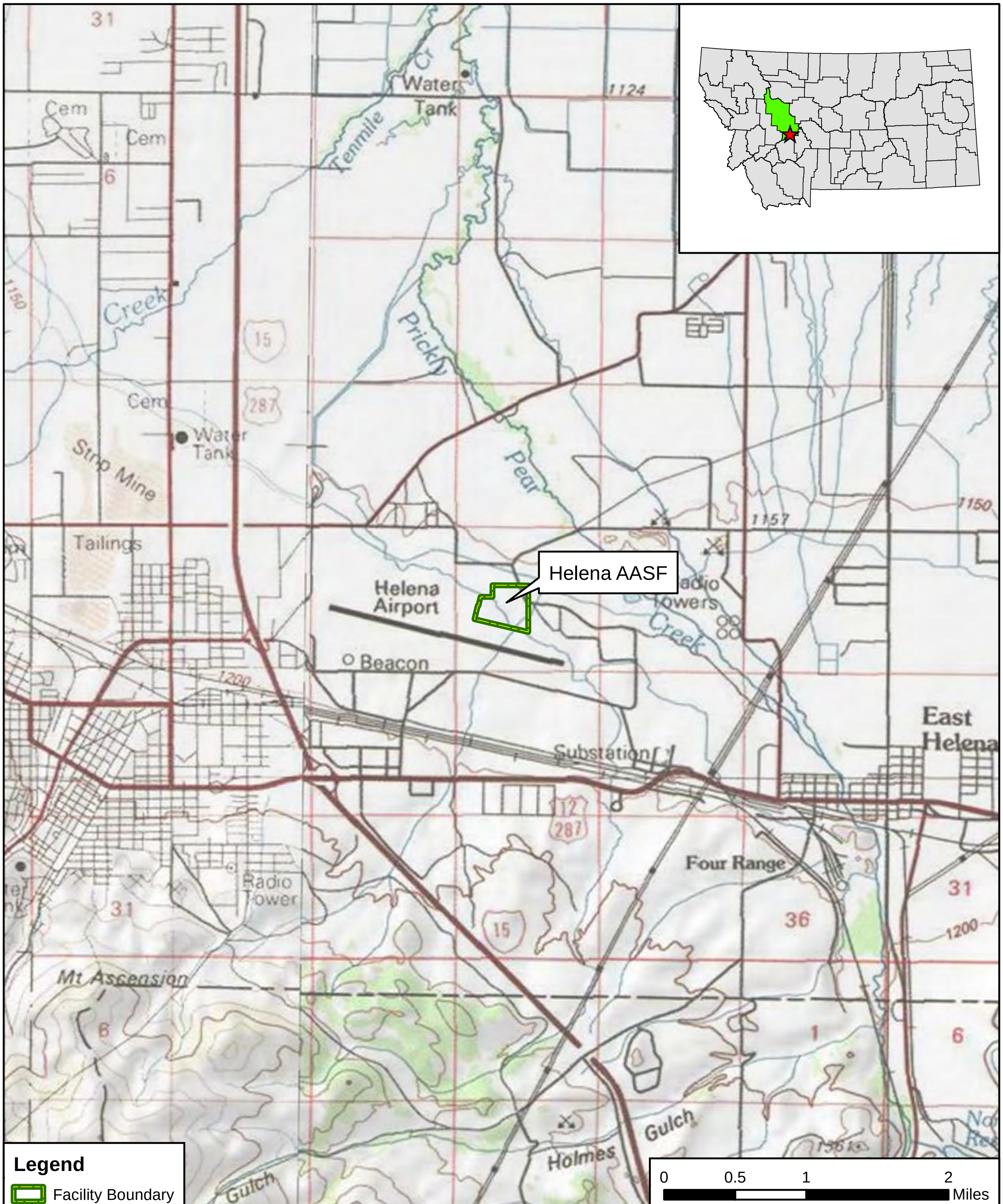

CLIENT	ARNG			
NOTES	Site Inspection for PFAS at Helena AASF, MT			
REVISED	10/15/2020	GIS BY	MS	10/15/2020
SCALE	1:63,360	CHK BY	AB	10/15/2020
Base Map: Copyright:© 2013 National Geographic Society, i-cubed		PM	RG	10/15/2020

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Facility Location

AECOM

12420 Milestone Center Drive
Germantown, MD 20876

Figure 2-1

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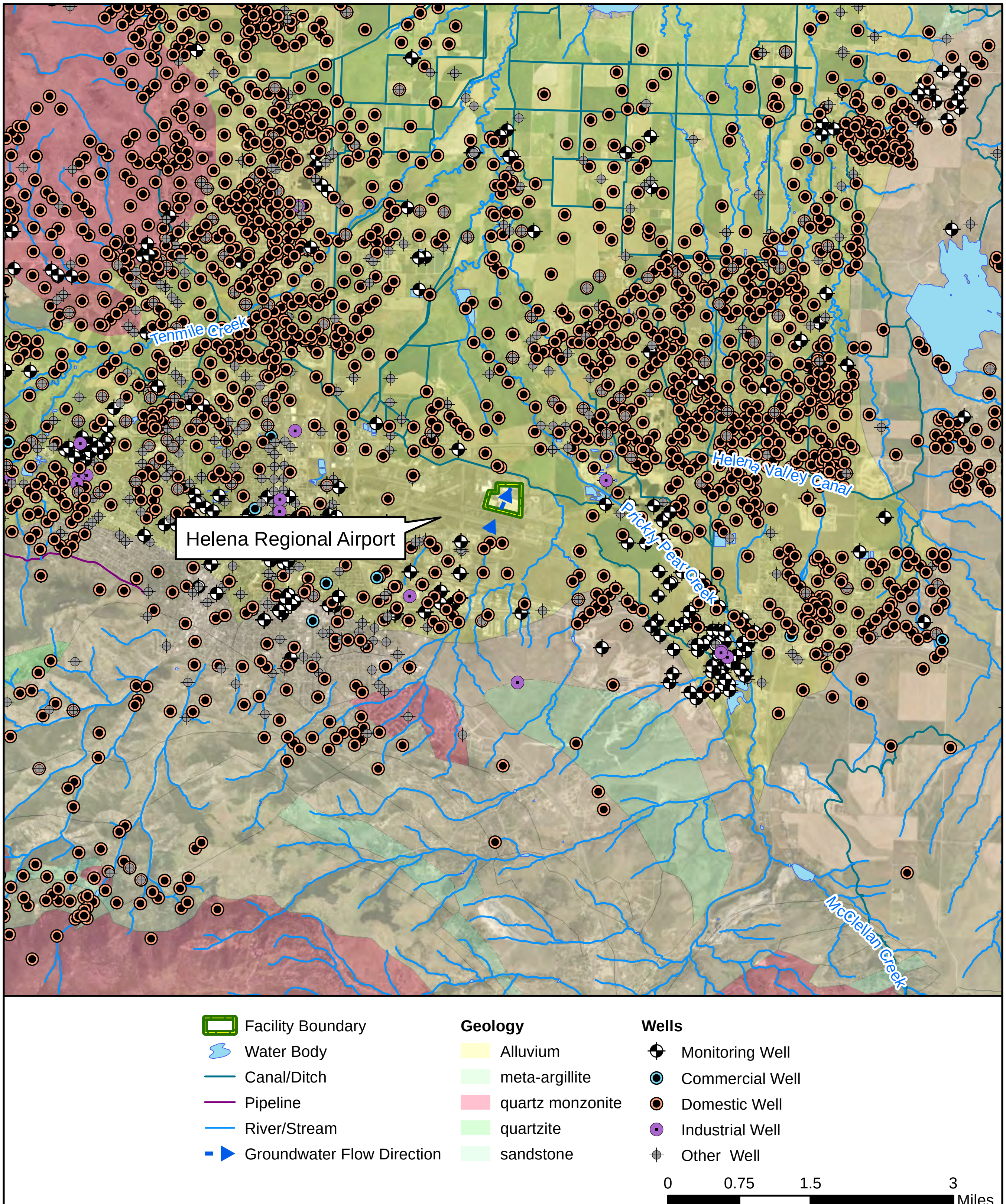

CLIENT	ARNG			
NOTES	Site Inspection for PFAS at Helena AASF, MT			
REVISED	10/15/2020	GIS BY	MS	10/15/2020
SCALE	1:95,040	CHK BY	AB	10/15/2020
Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and		PM	RG	10/15/2020

Groundwater Features

AECOM
12420 Milestone Center Drive
Germantown, MD 20876

Figure 2-2

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CLIENT	ARNG			
PROJECT	Site Inspection for PFAS at Helena AASF, MT			
REVISED	2/3/2021	GIS BY	MS	2/3/2021
SCALE	1:3,000	CHK BY	AB	2/3/2021
Base Map: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community		PM	CM	2/3/2021

Soil Boring/Temporary Monitoring Well
Storm Drain Inlet
Storm Drain Line
Facility Boundary
Canal/Ditch
Groundwater Contour
Inferred Groundwater Contour
Groundwater Flow Direction

N

Groundwater Elevation - July 12, 2020

AECOM 12420 Milestone Center Drive
Germantown, MD 20876

Figure 2-3

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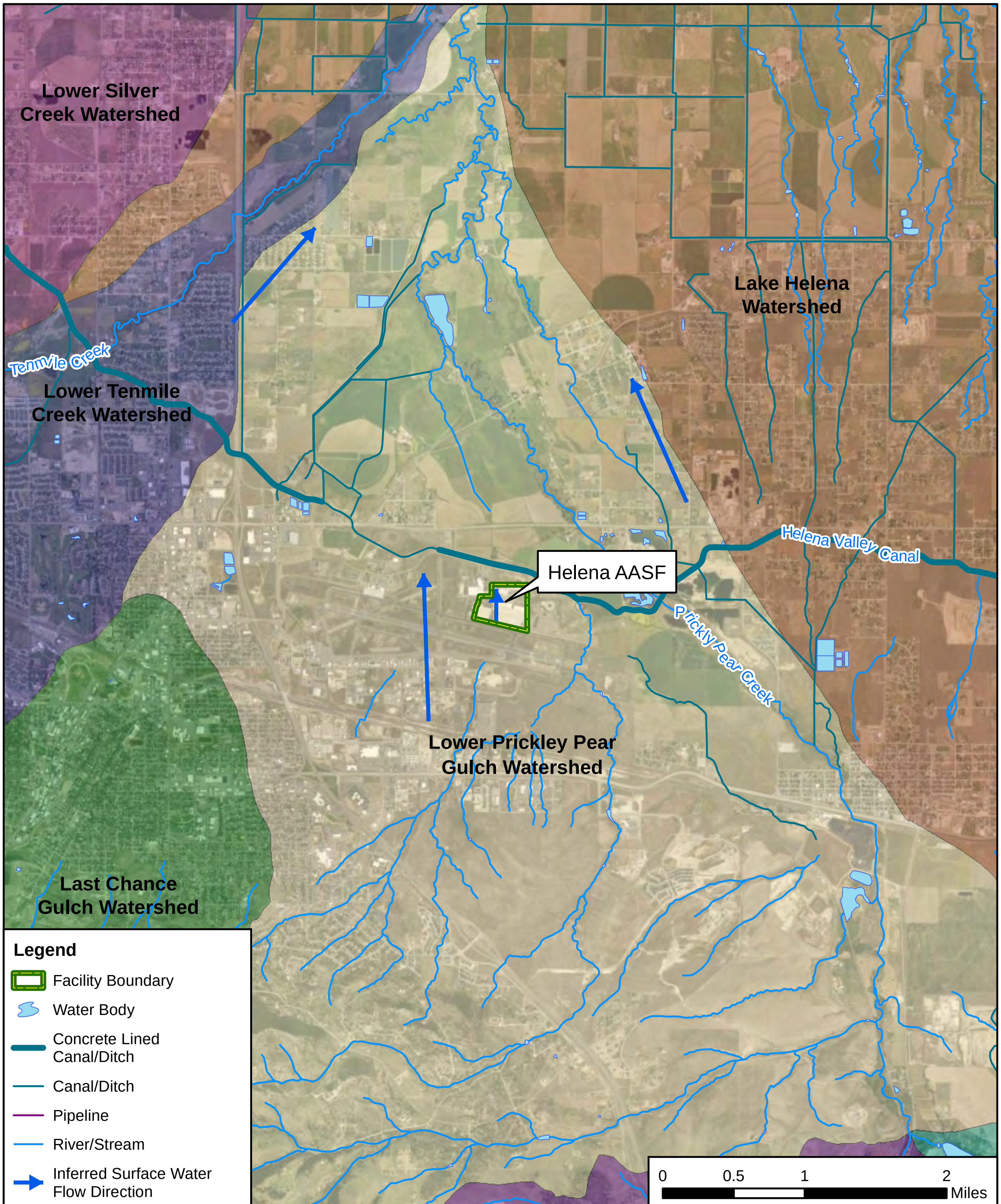

CLIENT	ARNG				
NOTES	Site Inspection for PFAS at Helena AASF, MT				
REVISED	2/3/2021	GIS BY	MS	2/3/2021	
SCALE	1:63,360	CHK BY	AB	2/3/2021	
Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and		PM	CM	2/3/2021	

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Surface Water Features

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Figure 2-4

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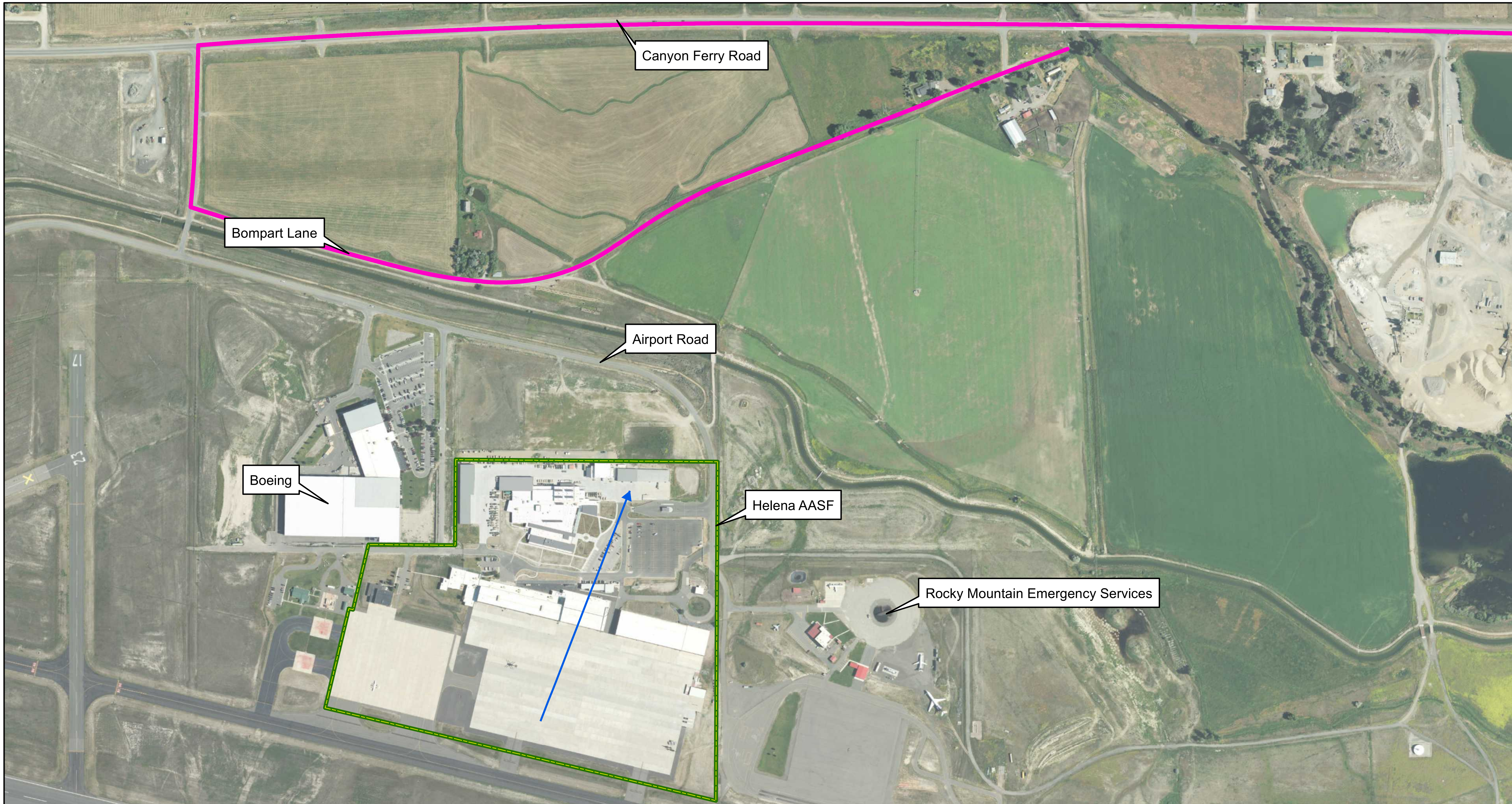

CLIENT	ARNG			
PROJECT	Site Inspection for PFAS at Helena AASF, MT			
REVISED	7/28/2021	GIS BY	MS	7/28/2021
SCALE	1:6,000	CHK BY	AB	7/28/2021
Base Map: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community		PM	CM	7/28/2021

Legend

- Potable Well Sampling Area
- Facility Boundary
- Groundwater Flow Direction

0 250 500 1,000 Feet

N

Potable Well Sampling Area

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Figure 2-5

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3. Summary of Areas of Interest

This section presents a summary of each potential PFAS release area by AOI. The two potential PFAS release areas were grouped into one AOI (AOI 1) based on proximity and direction of groundwater flow (**Figure 3-1**).

3.1 AOI 1

AOI 1 consists of four potential PFAS release areas, as described below.

3.1.1 60 Hangar

The 60 Hangar is located on the western side of the AASF. The 60 Hangar was built in 1999 and houses rotary-winged aircraft. Originally, AFFF was stored at the 60 Hangar in a 400-gallon aboveground storage tank which supplied the fire suppression system. During the PA interviews, it was originally determined that no AFFF was released from the 60 Hangar. However, subsequent interviews were performed which revealed that the AFFF fire suppression system was tested shortly after installation. Specific details regarding the volume, chemical composition, and concentration of the AFFF released during the test are not known, but interviewees confirmed that after the test was completed, AFFF was coming out of the bay and settled on the apron in front of the 60 Hangar. It is believed that AFFF entered the floor drains inside the 60 Hangar which go to the Helena Publicly Owned Treatment Works and storm drains outside the 60 Hangar which flow to the onsite retention basin.

In 2011 the fire suppression system was retrofitted. During the renovation, the AFFF was removed by Tyco SimplexGrinnell and replaced with Jet-X High Expansion Foam. The Jet-X High Expansion Foam system was tested in 2012 during which all material from the new suppression system flowed into a floor drain that runs the length of the 60 Hangar and discharged to the Helena Publicly Owned Treatment Works.

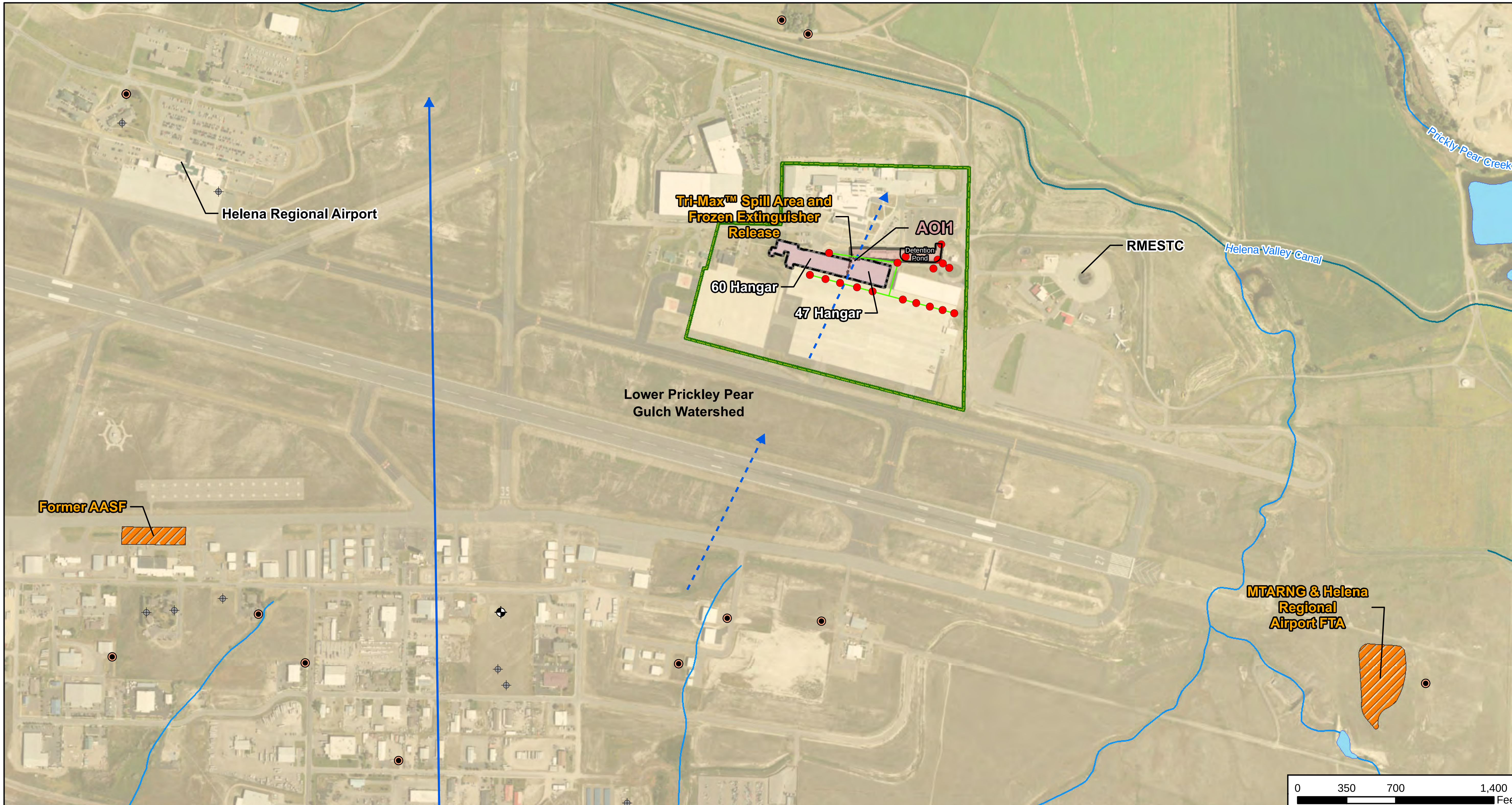
3.1.2 47 Hangar

The 47 Hangar is located adjacent to the 60 Hangar on the eastern side of the AASF. The 47 Hangar was constructed in 2006 and houses rotary-winged aircraft. According to interviewees, the 47 Hangar contains a fire suppression system supplied with Jet-X High Expansion Foam and was tested once in 2006. For the test, 60 gallons of Jet-X concentrate was mixed with 1940 gallons of water. All the released Jet-X High Expansion Foam flowed into a floor drain that runs the length of the 47 Hangar and discharged to the Helena Publicly Owned Treatment Works.

3.1.3 Tri-Max™ Spill Area and Frozen Extinguisher Release Area

PFAS were potentially released once to a concrete surface at AOI 1 by the MTARNG in the early-2000s. During filling of fire extinguishers, a 5-gallon jug of Tri-Max™ 30 spilled onto the concrete behind the most eastern end of the 60 Hangar. The spilled Tri-Max™ 30 possibly ran into a drain that empties into a detention pond to the northeast of the 47 Hangar. Additionally, a second release occurred during the winter of 1998 or 1999 in which a fire extinguisher stored outside froze, split, and released its contents. The exact location of this release is unknown, but it is assumed to have occurred in the same general location as the 5-gallon AFFF spill. A spill was not noted; however, it is likely the contents were released to the concrete surface. As a corrective action, fire extinguishers are now stored in the hangars. No specific information regarding the exact location, contents of the extinguisher, or the volume released was available at the time of the PA or SI. It is unknown if fire extinguishers with AFFF were used during training. Further, it is unknown how fire extinguishers at the AASF are emptied and/or disposed.

The detention pond is approximately 5 feet deep and collects runoff from most of the facility, including industrial stormwater runoff. Drainages have been diverted around the AASF, and unprocessed surface water is not used in the area, except for irrigation. Drinking water is supplied by the City of Helena; however, domestic wells are located downgradient of AOI 1, within 4 miles of the AASF.



CLIENT	ARNG			
PROJECT	Site Inspection for PFAS at Helena AASF, MT			
REVISED	12/7/2020	GIS BY	MS	12/7/2020
SCALE	1:8,400	CHK BY	AB	12/7/2020
Base Map: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community		PM	RG	12/7/2020

Storm Drain Inlet
Storm Drain Line
Area of Interest
Potential PFAS Release
No Suspected Release
Facility Boundary
Water body
Canal/Ditch
River/Stream
Surface Water Flow Direction
Groundwater Flow Direction
Monitoring Well
Domestic Well
Other Well

N

Areas of Interest

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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 October 2019 (Assistant Secretary of Defense, 2019). 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 site 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 fire training areas, 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 removal action.
4. Collect data to better characterize the release areas for more effective and rapid initiation of a RI.
5. Identify within 4 miles of the installation other potential PFAS sources (fire stations, major manufacturers, other DoD facilities) and receptors, including both groundwater and surface water receptors, to determine whether the ARNG is the likely source of PFAS, or whether there is an off-facility source of PFAS responsible for installation detections of PFAS (USEPA, 2005).
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 following:

- The PA for the Helena AASF (AECOM, 2018c);
- Analytical data from groundwater and soil samples collected as part of this SI in accordance with the site-specific Uniform Federal Policy (UFP)-Quality Assurance Project Plan (QAPP) Addendum (AECOM, 2020b); and
- Field data collected during the SI, including groundwater elevation and water quality parameters measured at the time of sampling.
- Analytical data from potable water samples collected from five potable wells located in closest proximity to the facility boundary downgradient of AOI1.

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 performed at potable wells within 0.5 miles of the facility boundary.

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, 2020b). 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 and groundwater samples were collected from each of the potential release areas. Groundwater was encountered at approximately 40 to 56 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. Several field samples displayed EIS area counts outside the quality control (QC) limits of 50-150 percent (%). The non-detect field sample results associated with EIS area counts less than 10% were initially flagged "X" but should be considered for inclusion in the data set. Since PFAS compounds are quantitated based on a normalized 100% internal standard percent recovery for this method and in MS pairs with low area counts and the target compounds were shown to be able to be recovered. The data points flagged "X" were non-detect results for perfluorotetradecanoic acid (PFTeDA) and perfluorotridecanoic (PFTrDA). The non-detect field sample results associated with the remaining EIS area counts less than the lower QC limit of 50% but greater than 20% were qualified "UJ". The qualified field sample results associated with a negative bias should be considered usable as estimated values and as likely true negatives.

Calibration verifications were performed routinely to ensure that instrument responses for all calibrated analytes were within established QC criteria. The calibration verifications were within the project established precision limits presented in the SI QAPP Addendum (AECOM, 2020b).

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. The LCS/LCSD samples were within the project established precision limits presented in the SI QAPP Addendum (AECOM, 2020b).

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. MS/MSD samples were submitted to the laboratory for analysis at a rate of 5%. The MS/MSD performed on parent sample AOI01-01-SB-55-57 displayed an RPD greater than the QC limit of 30% for PFTrDA at 63%. The associated parent sample result was non-detect; therefore, no data qualifying action was required, and the associated parent sample result should be considered usable as reported.

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 SI QAPP Addendum (AECOM, 2020b).

Laboratory duplicate samples were prepared and analyzed to assess the overall laboratory analytical method and measurement precision for this sampling effort. The laboratory duplicates were analyzed for total organic carbon (TOC). The laboratory duplicate pair performed on samples AOI01-03-SB-20-22 and AOI01-03-SB-20-22-D displayed an RPD greater than the QC limit of 25% for TOC at 47% and 38%, respectively. The positive results in the associated batch were qualified “J” and should be considered as estimate.

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, with a limited number of exceptions. PFTrDA displayed an LCSD recovery outside the QC limits of 70%-130% at 68% for batch 688084. The field sample results associated with a negative bias were non-detect and were qualified “UJ”. The qualified field sample results should be considered usable as estimated values. The polyfluorinated compound 6:2 fluorotelomer sulfonate (6:2 FTS) displayed LCSD recovery outside the QC limits at 132% for batch 687724. The field sample results associated with a positive bias were non-detect; no data-qualifying action was required, and results should be considered usable as reported.

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 the following exceptions. The MS/MSD performed on parent sample AOI01-01-SB-55-57RE displayed percent recoveries less than the lower QC limit of 70% for PFTrDA at 63%. The parent sample results associated with a negative bias were qualified “UJ” and should be considered usable as estimated values with a negative bias. The MS/MSD performed on parent sample AOI01-01-SB-55-57 displayed percent recoveries greater than the upper QC limit of 130% for PFTrDA at 183%. The parent sample results associated with a positive bias were non-detect; no data-qualifying action was required, and the results should be considered usable as reported.

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 tandem mass spectrometry (LC/MS/MS) Compliant with Quality Systems Manual (QSM) 5.1 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, with the exception of pH. For the pH analysis, the holding time is “immediate”. The associated field sample results were qualified “J” and should be considered usable as estimated values. The laboratory used approved standard methods in accordance with the SI QAPP Addendum (AECOM, 2020b) for all analyses.

Instrument blanks and method blanks were prepared by the laboratory in each batch as a negative control. All associated instrument blanks and method blanks were non-detect for all target analytes.

Equipment blanks and field blanks were also collected for groundwater and soil samples. All equipment blanks and field blanks were non-detect for all target analytes.

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.

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:

- PFAS in groundwater by LC/MS/MS compliant with QSM 5.1 Table B-15 at 100%;
- PFAS in soil by LC/MS/MS compliant with QSM 5.1 Table B-15 at 98.8%;
- pH in soil by USEPA Method 9045D at 100%; and
- 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 SI QAPP Addendum (AECOM, 2020b). 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 SI QAPP Addendum (AECOM, 2020b), 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 Army Aviation Support Facility, Helena, Montana dated October 2018* (AECOM, 2018c).
- *Final Site Inspection Programmatic Uniform Federal Policy-Quality Assurance Project Plan dated March 2018* (AECOM, 2018a);
- *Final Site Inspection Quality Assurance Project Plan Addendum, Helena Army Aviation Support Facility, Helena, Montana dated July 2020* (AECOM, 2020b);
- *Final Programmatic Accident Prevention Plan dated July 2018* (AECOM, 2018b); and
- *Final Site Safety and Health Plan, Helena Army Aviation Support Facility, Helena, Montana dated June 2020* (AECOM, 2020a).

SI field activities were conducted from 6 to 13 July 2020 and included soil sampling, permanent groundwater monitoring well installation, development, and low-flow groundwater sampling. Field activities were conducted in accordance with the SI QAPP Addendum (AECOM, 2020b), except as noted in **Section 5.8**.

The following samples were collected during the SI and analyzed for a subset of 18 PFAS by LC/MS/MS compliant with QSM 5.1 Table B-15 to fulfill the project DQOs:

- 17 soil grab samples from 7 boring locations; and
- 5 groundwater samples from 5 permanent monitoring well 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**. 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, Engineers 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 AOI identified in the PA.

A combined TPP Meeting 1 and 2 was held on 29 April 2020, prior to SI field activities. Meeting minutes are provided in **Appendix D**. TPP meetings 1 and 2 were conducted in general accordance with EM 200-1-2.

The stakeholders for this SI include the ARNG G9, MTARNG, USACE, and Montana Department of Environmental Quality (MTDEQ). 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, 2020b).

TPP Meeting 3 was held on 15 January 2021 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 Montana811 and facilitated by MTARNG. MTARNG contacted Montana811 one-call utility clearance contractor to notify them of intrusive work. AECOM field staff were onsite during the utility locate. 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

Under normal circumstances, a potable water sample would have been collected from the facility during TPP Meeting 1 and 2; however, a virtual meeting was held instead. As a result, potable water used for decontamination of drilling equipment was taken from Fort William Henry Harrison which has been previously sampled and confirmed to be PFAS-free. The results of the potable well sample are provided in **Appendix F**.

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, 2020b). 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 via hollow stem auger (HSA) in accordance with the SI QAPP Addendum (AECOM, 2020b). A CME-75 auger rig with 18-inch split-spoon was used to collect one core every 5 feet. A hand auger was used to collect soil from the top 5 feet of the boring to be compliant with utility clearance procedures.

Three discrete soil samples were collected from the vadose zone for chemical analysis from each soil boring. One surface soil sample and two subsurface soil samples (one approximately 1 foot above the groundwater table and one at the mid-point between the ground surface and the groundwater table) were collected at each boring using HSA.

The soil boring locations are shown on **Figure 5-1** and depths are provided **Table 5-1**. The soil boring locations were selected based on the AOI information as agreed on through TPP and SI QAPP Addendum review.

The soil cores were 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, 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**.

Lithology observed during the SI was consistent with descriptions from previous investigations at the facility and surrounding area. Borings advanced in the subsurface consisted of sands, silts, and clays with lenses of small, subangular gravel. Sand layers varied from brown, yellow, and, gray; generally-poorly sorted; sub-angular to rounded grains. Silt and clay layers were encountered, but did not terminate drilling at any locations. Generally, silts and clays intervals were described as brown, cohesive, with low to medium plasticity and containing trace to some fine-grained sand. Calcium carbonate (derived from the surrounding sedimentary bedrock) was observed in most of the borings and confirmed by testing using dilute acid. Each soil sample was collected into laboratory-supplied PFAS-free high-density polyethylene (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 5.1 Table B-15), TOC (USEPA Method 9060A) and pH (USEPA Method 9045D) in accordance with the SI QAPP Addendum (AECOM, 2020b).

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 4 degrees Celsius (°C) during shipment.

5.3 Permanent Well Installation and Groundwater Sampling

A CME-75 was used to install five 2-inch diameter monitoring wells. The monitoring wells were constructed with Schedule 40 polyvinyl chloride (PVC), flush threaded 10-foot sections of riser, 0.010-inch slotted well screen, and a threaded bottom cap. The location of the permanent wells were based on proximity to potential PFAS sources and to determine PFAS concentrations at the facility boundary. The depth of the permanent wells were determined in the field based on observations made by the field geologist, targeting zones where wet soils were observed. A filter pack of 20/40 silica sand was installed in the annulus around the well screen to a minimum of 2-foot above the well screen. A 2-foot thick bentonite seal was placed above the filter sand and hydrated with water. Bentonite chips were placed in the well annulus from the top of the bentonite seal to approximately 6 inches bgs and hydrated with water. All monitoring wells were completed with flush mount well vaults. Well construction diagrams are provided in **Appendix B3**. The screen interval of each of the groundwater monitoring wells is provided in **Table 5-2**.

Development and sampling of wells was completed in accordance with the SI QAPP Addendum (AECOM, 2020b). The newly installed monitoring wells were developed no sooner than 24 hours following installation by pumping and surging using a variable speed submersible pump. Well development records are provided in **Appendix B4**. Samples were collected no sooner than 24 hours following development via low-flow sampling methods using a Geotech bladder pump (using a polytetrafluoroethylene bladder) with disposable PFAS-free, HDPE tubing. New tubing and bladder was used at each well and the pumps were decontaminated between 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 [DO], oxidation-reduction potential [ORP], and turbidity) were measured using a water quality meter and recorded on the field sampling form (**Appendix B5**). Water levels were measured to the nearest 0.01 inch and recorded. Additionally, a subsample of each groundwater sample was collected in a separate container and a shaker test was completed to identify if there was 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 5.1 Table B-15 in accordance with the SI QAPP Addendum (AECOM, 2020b).

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 field reagent blank was collected in accordance with the programmatic QAPP (PQAPP) (AECOM, 2018a). A temperature blank was placed in each cooler to ensure that samples were preserved at or below 4°C during shipment.

5.4 Synoptic Water Level Measurements

A synoptic groundwater gauging event was performed on 12 July 2020. Depth to water measurements were collected from the 5 new monitoring wells from the northern side of the well casing. A groundwater flow contour map is provided in **Figure 2-3**. Calculated groundwater elevation data is provided in **Table 5-3**.

5.5 Surveying

The northern side of each well casing was surveyed by Montana-Licensed land surveyor following guidelines provided in the SI QAPP Addendum SOPs (AECOM, 2020b). Survey data from the newly installed wells on the facility were collected on 13 July 2020 in the North American Datum of 1983 Montana State Plane. The surveyed well data are provided in **Appendix B6**.

5.6 Investigation-Derived Waste

Soil investigation-derived waste (IDW) (i.e., soil cuttings) and liquid IDW (purge and decontamination water) generated during the SI activities were containerized in 24, separate 55-gallon drums (19 soil and 5 liquid) and stored on the facility. The soil and liquid IDW was not sampled and assumes the PFAS characteristics of the associated soil samples collected from that source location.

Other solids such as spent personal protective equipment (PPE), 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.

5.7 Laboratory Analytical Methods

Samples were analyzed for a subset of 18 PFAS by LC/MS/MS compliant with QSM 5.1 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)
- Perfluorohexanoic acid (PFHxA)
- Perfluorohexanesulfonic acid (PFHxS)
- Perfluorononanoic acid (PFNA)
- Perfluorooctanoic acid (PFOA)
- Perfluorooctanesulfonic acid (PFOS)
- Perfluoropentanoic acid (PFPeA)
- Perfluorotetradecanoic acid (PFTeDA)
- Perfluorotridecanoic acid (PFTrDA)

- N-methyl perfluorooctanesulfonamidoacetic acid (NMeFOSAA)
- Perfluorobutyrate (PFBA)
- Perfluorobutanesulfonic acid (PFBS)
- Perfluorodecanoic acid (PFDA)
- Perfluorododecanoic acid (PFDoA)
- Perfluoroundecanoic acid (PFUdA)
- Perfluoroheptanoic acid (PFHpA)

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

5.8 Deviations from SI QAPP Addendum

One deviation was identified after completion of the field work during the reporting stage and therefore a Nonconformance and Corrective Action Report was not completed. The deviation from the SI QAPP Addendum is noted below:

- While advancing the borehole at HAASF-MW002, split-spoon samples were collected continuously the entire length of the borehole. Given that the depth to water was deeper than anticipated and in order to maintain the field schedule, the team determined that split-spoons would be collected once every five feet (one per five-foot auger run).

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

Sample Identification	Sample Collection Date	Sample Depth (feet bgs)	PFAS by LC/MS/MS compliant with QSM 5.1 Table B-15	TOC (USEPA Method 9060A)	pH (USEPA Method 9045D)	Comments
Soil Samples						
AOI01-01-SB-00-02	7/8/2020	0-2	x			
AOI01-01-SB-25-27	7/8/2020	25-27	x			
AOI01-01-SB-55-57	7/8/2020	55-57	x			
AOI01-02-SB-00-02	7/7/2020	0-2	x			
AOI01-02-SB-28-30	7/7/2020	28-30	x			
AOI01-02-SB-55-57	7/7/2020	55-57	x			
AOI01-03-SB-00-02	7/9/2020	0-2	x			
AOI01-03-SB-20-22	7/9/2020	20-22	x			
AOI01-03-SB-20-22-D	7/9/2020	20-22	x	x	x	Field Duplicate
AOI01-03-SB-44-46	7/9/2020	44-46	x			
AOI01-04-SB-00-02	7/8/2020	0-2	x			
AOI01-04-SB-20-22	7/8/2020	20-22	x			
AOI01-04-SB-39-41	7/8/2020	39-41	x			
AOI01-05-SB-00-02	7/9/2020	0-2	x			
AOI01-05-SB-25-27	7/9/2020	25-27	x			
AOI01-05-SB-50-52	7/9/2020	50-52	x			
AOI01-05-SB-50-52-D	7/9/2020	50-52	x			Field Duplicate
AOI01-06-SB-00-02	7/8/2020	0-2	x			
AOI01-06-SB-00-02-D	7/8/2020	0-2	x			Field Duplicate
AOI01-07-SB-00-02	7/8/2020	0-2	x			
Groundwater Samples						
HAASF-MW001	7/12/2020	58.5	x			
HAASF-MW002	7/11/2020	57.0	x			
HAASF-MW003	7/12/2020	45.0	x			
HAASF-MW004	7/12/2020	43.0	x			
HAASF-MW005	7/12/2020	51.5	x			
HAASF-MW005-D	7/12/2020	51.5	x			Field Duplicate

Notes:
AOI = Area of Interest
bgs = below ground surface
D = duplicate
HAASF = Helena Army Aviation Support Facility
MW = monitoring well
PFAS = per- and polyfluoroalkyl substances
pH = potential for hydrogen
SB = soil boring
TOC =total organic carbon
USEPA = United States Environmental Protection Agency

Table 5-2
Boring Depths and Permanent Well Screen Interval
Site Inspection Report, Helena AASF

Area of Interest	Soil Boring ID	Monitoring Well ID	Soil Boring Depth (feet bgs)	Permanent Well Screen Interval (feet bgs)
AOI 1	AOI01-01	HAASF-MW001	60.3	50.3-60.3
	AOI01-02	HAASF-MW002	62	52-62
	AOI01-03	HAASF-MW003	50	40-50
	AOI01-04	HAASF-MW004	44.1	34-44
	AOI01-05	HAASF-MW005	56.5	45-55
	AOI01-06	NA	2	NA
	AOI01-07	NA	2	NA

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

Table 5-3
Depth to Water and Groundwater Elevation
Site Inspection Report, Helena AASF

Location ID	Ground Surface Elevation (ft amsl)	Depth to Water (ft btoc)	Groundwater Elevation (ft amsl)
HAASF-MW001	3833.67	56.78	3776.89
HAASF-MW002	3812.79	44.22	3768.57
HAASF-MW003	3808.01	40.90	3767.11
HAASF-MW004	3808.36	40.71	3767.65
HAASF-MW005	3815.22	45.62	3769.60
AOI01-06	3808.62	NA	NA
AOI01-07	3807.94	NA	NA

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

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CLIENT	ARNG
PROJECT	Site Inspection for PFAS at Helena AASF, MT
REVISED	12/7/2020
SCALE	1:3,000
Base Map: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community	

GIS BY	MS	12/7/2020
CHK BY	AB	12/7/2020
PM	RG	12/7/2020

Soil Boring/Permanent Monitoring Well
Surface Soil Boings (via Hand Auger)
Storm Drain Inlet
Storm Drain Line
Area of Interest
Facility Boundary
Canal/Ditch
Inferred Surface Water Flow Direction
Groundwater Flow Direction

N

Site Inspection Surveyed 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 the AOI is provided in **Section 6.3**. **Table 6-2** through **Table 6-4** present PFAS results for samples with detections in soil 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 October 2019 (Assistant Secretary of Defense, 2019). 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 site will proceed to an 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 6-1**.

All other results presented in this Report are considered informational in nature and serve as an indication as to whether soil, groundwater, sediment, and surface water 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,b] 0-2 feet bgs	Industrial/ Commercial Composite Worker (Soil) (µg/kg)[a,b]	Tap Water (Groundwater) (ng/L)[a,b]
PFOA	130	1,600	40
PFOS	130	1,600	40
PFBS	130,000	1,600,000	40,000

Notes:

a.) Assistant Secretary of Defense, 2019. 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 October 2019.

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.

6.2 Soil Physicochemical Analyses

To provide basic soil parameter information, soil samples 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 soil and groundwater in comparison to SLs for AOI 1, which includes the 60 and 47 Hangar Fire Suppression System Releases and the Tri-Max™ Spill/Release Area. The detected compounds in soil and groundwater are summarized on **Table 6-2** through **Table 6-4**. The detections of PFOS and PFOA in soil and groundwater are presented on **Figure 6-1** through **Figure 6-3**.

6.3.1 AOI 1 Soil Analytical Results

PFOA, PFOS, and PFBS did not exceed the SLs in soil at AOI 1. **Figure 6-1** and **Figure 6-2** present detections in soil for PFOS and PFOA. The detected compounds in soil are summarized on **Table 6-2** and **Table 6-3**.

Soil was sampled from seven locations at AOI 1, the shallow interval (0 to 2 feet bgs), intermediate interval (20 to 30 feet bgs), and deep interval (39 to 57 feet bgs) from boring locations HAASF-MW001 through HAASF-MW005. Additionally, two shallow interval (0 to 2 feet bgs) samples were collected from AOI01-06, and AOI01-07. PFOA and PFBS were not detected in any soil samples. PFOS were detected in soil at concentrations several orders of magnitude lower than the SLs. In the shallow interval, PFOS was detected at one location (HAASF-MW003) at a concentration of 0.208 J micrograms per Kilogram (µg/Kg). In the intermediate interval, PFOS was detected at one location (HAASF-MW005) at a concentration of 0.219 J µg/Kg. In the deep interval, PFOS was detected at one location (HAASF-MW005) at a concentration of 1.72 µg/Kg (2.37 µg/Kg duplicate). All the soil detections of PFOS occurred at locations HAASF-MW003 and HAASF-MW005 which correspond to the elevated detections of PFOS (175 ng/L and 775 ng/L [814 ng/L duplicate]) from the groundwater samples collected at the same locations.

6.3.2 AOI 1 Groundwater Analytical Results

PFOS exceeded the SLs in groundwater at AOI 1. PFOA and PFBS were detected in groundwater did not exceed the SLs at AOI 1. **Figure 6-3** present the ranges of detections for PFOS and PFOA. The detected compounds in groundwater are summarized in **Table 6-4**.

Groundwater at AOI 1 was sampled from five permanent monitoring well locations HAASF-MW001 through HAASF-MW0005. The SL of 40 ng/L for PFOS was exceeded at HAASF-MW003 and HAASF-MW005 at maximum concentrations of 175 ng/L and 775 ng/L (814 ng/L duplicate), respectively. PFOA was detected below the SL of 40 ng/L at three well locations, with concentrations ranging from 1.89 J ng/L to 9.59 J ng/L. PFBS was detected below the SL of 40,000 ng/L at four well locations, with concentrations ranging from 1.92 J ng/L to 3.61 J ng/L.

6.3.3 AOI 1 Conclusions

Based on the results of the SI, PFOS was detected in soil at AOI 1; however, the detected concentrations were several orders of magnitude lower than the soil SLs. PFOS was detected in groundwater at concentrations exceeding the individual SL of 40 ng/L at two well locations. PFOA and PFBS were detected in groundwater in several locations but at concentrations below SLs. Based on the exceedance of the SL for PFOS in groundwater, further evaluation at AOI 1 is warranted.

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

	Area of Interest	AOI 1															
	Sample ID	AOI01-01-SB-00-02		AOI01-02-SB-00-02		AOI01-03-SB-00-02		AOI01-04-SB-00-02		AOI01-05-SB-00-02		AOI01-06-SB-00-02		AOI01-06-SB-00-02-D		AOI01-07-SB-00-02	
	Sample Date	07/08/2020		07/07/2020		07/09/2020		07/08/2020		07/09/2020		07/08/2020		07/08/2020		07/08/2020	
	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	
Analyte	OSD Screening Level [a]	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual
Soil, PFAS by LCMSMS Compliant with QSM 5.1 Table B-15 (µg/Kg)																	
PFOS	130	ND		ND	UJ	0.208	J	ND		ND		ND	UJ	ND		ND	

Grey Fill — Detected concentration exceeded OSD Screening Levels

References
a. Assistant Secretary of Defense, 2019. Risk Based Screening Levels Calculated for PFOS, PFOA, PFBS 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.

Interpreted Qualifiers
J = Estimated concentration
UJ = The analyte was not detected at a level greater than or equal to the adjusted DL. However, the reported adjusted DL is approximate and may be inaccurate or imprecise.

Chemical Abbreviations

PFBS	perfluorobutanesulfonic acid
PFOA	perfluorooctanoic acid
PFOS	perfluorooctanesulfonic acid

Acronyms and Abbreviations

AOI	Area of Interest
D	Duplicate
DL	detection limit
ft	feet
HQ	Hazard quotient
ID	identification
LCMSMS	Liquid Chromatography Mass Spectrometry
ND	Analyte not detected above the LOD
OSD	Office of the Secretary of Defense
PFAS	per- and polyfluoroalkyl substances
QSM	Quality Systems Manual
Qual	Interpreted Qualifier
SB	Soil boring
USEPA	United States Environmental Protection Agency
µg/Kg	micrograms per Kilogram

Table 6-3
PFAS Detections in Subsurface Soil
Site Inspection Report, Helena AASF

Area of Interest	AOI 1																				
Sample ID	AOI01-01-SB-25-27		AOI01-01-SB-55-57		AOI01-02-SB-28-30		AOI01-02-SB-55-57		AOI01-03-SB-20-22		AOI01-03-SB-44-46		AOI01-04-SB-20-22		AOI01-04-SB-39-41		AOI01-05-SB-25-27		AOI01-05-SB-50-52		AOI01-05-SB-50-52-D	
Sample Date	07/08/2020		07/08/2020		07/07/2020		07/07/2020		07/09/2020		07/09/2020		07/08/2020		07/08/2020		07/09/2020		07/09/2020		07/09/2020	
Depth	25 - 27 ft		55 - 57 ft		28 - 30 ft		55 - 57 ft		20 - 22 ft		44 - 46 ft		20 - 22 ft		39 - 41 ft		25 - 27 ft		50 - 52 ft		50 - 52 ft	
Analyte	Result	Qual	Result	Qual	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 5.1 Table B-15 (µg/Kg)																						
PFOS	ND		ND		ND		ND		ND		ND		ND		ND		0.219	J	1.72		2.37	

Interpreted Qualifiers
J = Estimated concentration

Chemical Abbreviations
PFOS perfluorooctanesulfonic acid

Acronyms and Abbreviations
AOI Area of Interest
D Duplicate
ft feet
ID identification
LCMSMS Liquid Chromatography Mass Spectrometry
ND Analyte not detected above the LOD
PFAS per- and polyfluoroalkyl substances
QSM Quality Systems Manual
Qual Interpreted Qualifier
SB Soil boring
µg/Kg micrograms per Kilogram

Table 6-4
PFAS Detections in Groundwater
Site Inspection Report, Helena AASF

	Area of Interest	AOI 1											
	Sample ID	HAASF-MW001		HAASF-MW002		HAASF-MW003		HAASF-MW004		HAASF-MW005		HAASF-MW005-D	
	Sample Date	07/12/2020		07/11/2020		07/12/2020		07/12/2020		07/12/2020		07/12/2020	
Analyte	OSD Screening Level [a]	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual
Water, PFAS by LCMSMS Compliant with QSM 5.1 Table B-15 (ng/L)													
6:2 FTS	-	ND		ND		16.0		ND		13.2		16.8	
PFBA	-	2.84	J	2.24	J	9.11	J	2.91	J	19.6		20.0	
PFBS	40000	3.61	J	ND		1.96	J	3.12	J	1.92	J	1.80	J
PFHpA	-	ND		ND		11.6		ND		11.6		10.5	
PFHxA	-	3.23	J	4.01	J	15.9		7.85	J	30.1		31.1	
PFHxS	-	9.49	J	ND		74.2		26.4		36.7		37.8	
PFNA	-	ND		ND		ND		ND		2.40	J	2.50	J
PFOA	40	1.89	J	ND		9.07	J	ND		9.59	J	10.7	
PFOS	40	ND		ND		175		ND		775		814	
PFPeA	-	ND		3.33	J	4.14	J	6.23	J	21.3		21.7	

Grey Fill — Detected concentration exceeded OSD Screening Levels

References
a. Assistant Secretary of Defense, 2019. Risk Based Screening Levels Calculated for PFOS, PFOA, PFBS 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.

Interpreted Qualifiers

J = Estimated concentration

Chemical Abbreviations

6:2 FTS	6:2 fluorotelomer sulfonate
PFBA	perfluorobutanoic acid
PFBS	perfluorobutanesulfonic acid
PFHpA	perfluoroheptanoic acid
PFHxA	perfluorohexanoic acid
PFHxS	perfluorohexanesulfonic acid
PFNA	perfluorononanoic acid
PFOA	perfluorooctanoic acid
PFOS	perfluorooctanesulfonic acid
PFPeA	perfluoropentanoic acid

Acronyms and Abbreviations

D	Duplicate
HAASF	Helena Army Aviation Support Facility
HQ	Hazard quotient
ID	identification
LCMSMS	Liquid Chromatography Mass Spectrometry
MW	monitoring well
ND	Analyte not detected above the LOD
OSD	Office of the Secretary of Defense
PFAS	per- and polyfluoroalkyl substances
QSM	Quality Systems Manual
Qual	Interpreted Qualifier
USEPA	United States Environmental Protection Agency
ng/L	nanogram per liter
-	Not applicable

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CLIENT	ARNG			
PROJECT	Site Inspection for PFAS at Helena AASF, MT			
REVISED	12/7/2020	GIS BY	MS	12/7/2020
SCALE	1:5,160	CHK BY	AB	12/7/2020
Base Map: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community		PM	CM	12/7/2020

Facility Boundary
Inferred Surface Water Flow Direction
Groundwater Flow Direction

PFOS Results (µg/Kg)
- ND
- >ND - 10
- >10 - 130
- >130 - 1,600
- >1,600

0 215 430 860 Feet

N

PFOS Detections in Soil

AECOM 12420 Milestone Center Drive Germantown, MD 20876

Figure 6-1

CLIENT	ARNG			
PROJECT	Site Inspection for PFAS at Helena AASF, MT			
REVISED	12/7/2020	GIS BY	MS	12/7/2020
SCALE	1:5,160	CHK BY	AB	12/7/2020
Base Map: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community		PM	CM	12/7/2020

Facility Boundary
Inferred Surface Water Flow Direction
Groundwater Flow Direction

PFOA Results (µg/Kg)
- ND
- >ND - 10
- >10 - 130
- >130 - 1,600
- >1,600

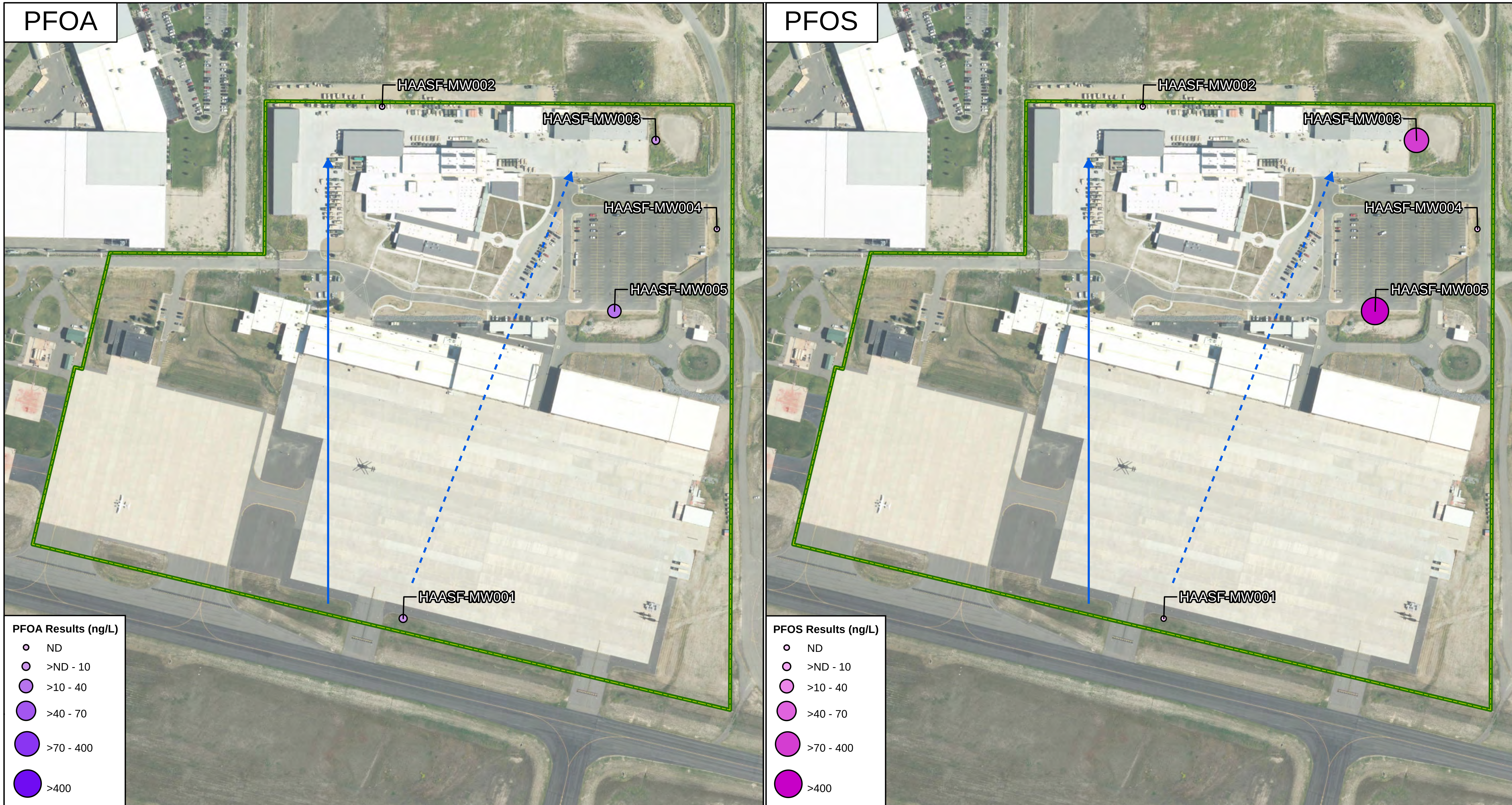
0 215 430 860 Feet

N

PFOA Detections in Soil

AECOM 12420 Milestone Center Drive Germantown, MD 20876

Figure 6-2



CLIENT	ARNG		
PROJECT	Site Inspection for PFAS at Helena AASF, MT		
REVISED 12/7/2020	GIS BY	MS	12/7/2020
SCALE 1:3,360	CHK BY	AB	12/7/2020
Base Map: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community	PM	CM	12/7/2020

Legend

- Facility Boundary
- Inferred Surface Water Flow Direction
- Groundwater Flow Direction

0 140 280 560 Feet

N

PFOA and PFOS Detections in Groundwater

AECOM 12420 Milestone Center Drive Germantown, MD 20876

Figure 6-3

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7. Exposure Pathways

The CSM for AOI 1, revised based on the SI findings, is presented on **Figure 7-1**. 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 figure uses 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 PFAS exposure pathways are ingestion and inhalation. Human exposure via the dermal contact pathway may occur, and current risk practice suggests it is an insignificant pathway compared to ingestion; however, exposure data for dermal pathways are sparse and continue to be the subject of PFAS toxicological study. 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, 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 AOI 1 based on the aforementioned criteria.

7.1.1 AOI 1

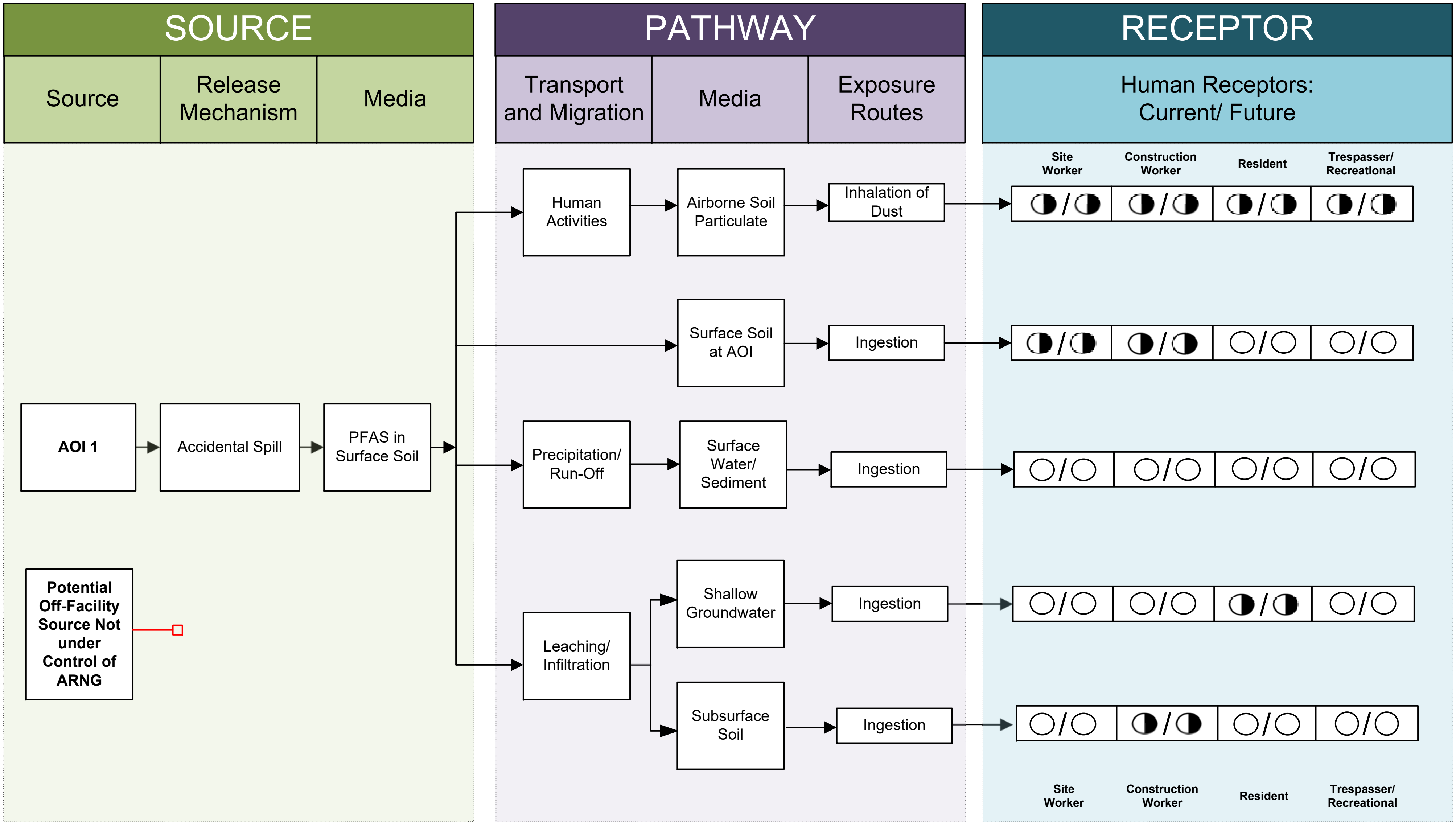
AFFF was released to soil from four separate releases/spills within AOI 1. PFOA and PFBS were not detected in soil. PFOS was detected in soil at AOI 1 and confirms the release of PFAS to soil in AOI 1. Ground-disturbing activities could potentially result in site worker and construction worker exposure to PFOS via inhalation of dust or ingestion of surface soil. Ground-disturbing activities could also potentially result in construction worker exposure to subsurface soil. Additionally, off-facility residents, off-facility recreational users (nearby walking path), and trespassers could potentially be exposed to PFOS via inhalation of dust caused by on-facility ground disturbing activities, although this exposure is likely insignificant. No construction is occurring at AOI 1. The CSM is presented on **Figure 7-1**.

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 at AOI 1 based on the aforementioned criteria.

7.2.1 AOI 1

PFOA, PFOS, and PFBS were detected in groundwater from permanent monitoring wells at AOI 1 and exceeded the SL for PFOS in two permanent monitoring wells (one source location, one facility boundary location). According to the MBMG database, approximately 805 domestic, commercial, or industrial wells exist within 4 miles of the facility in the downgradient direction, with some as close as 0.5 miles away. However, the database did not further classify domestic wells into subcategories for agriculture, ranching, or drinking water use. Due to these uncertainties, five potable wells downgradient of AOI 1 were sampled in 2021. PFOA, PFOS, and PFBS were detected in groundwater, but were below SLs. Therefore, the ingestion exposure pathway for groundwater is considered potentially complete for offsite residents. The facility is on city water, which has been tested and confirmed to be PFAS-free (see **Section 2.2.2**); therefore, the ingestion pathway is incomplete for site workers. Further, due to the depth of groundwater, the ingestion pathway for construction workers, off-facility recreational users, and trespassers is also considered incomplete. The CSM is presented on **Figure 7-1**.



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.

Figure 7-1
Conceptual Site Model
AOI 1

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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 extracted 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 conducted from 6 to 13 July 2020 and included soil sampling, permanent groundwater monitoring well installation, development, and low-flow groundwater sampling. Field activities were conducted in accordance with the SI QAPP Addendum (AECOM, 2020b), except as noted in **Section 5.8**.

To fulfill the project DQOs set forth in the approved SI QAPP Addendum (AECOM, 2020b), samples were collected and analyzed for a subset of PFAS by LC/MS/MS compliant with QSM Table B-15, as follows. The 18 PFAS analyzed as part of the ARNG SI program are specified in **Section 5.7** of this Report.

- 17 soil grab samples from 7 boring locations; and
- 5 groundwater samples from 5 permanent monitoring well locations.

The information gathered during this investigation was used to determine if PFOA, PFOS, and/or PFBS were present at or above SLs. Additionally, the CSM was refined to assess whether potentially complete pathways, which are described in **Section 7,** exist between the source and potential receptors for potential exposure to PFOA, PFOS, and PFBS at AOI 1.

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, PFOS, and PFBS were detected at the facility in soil and groundwater; however, only PFOS in groundwater exceeded the SL. PFOS was detected both at the source area, as well as at the facility boundary between source area and potential off-facility drinking water receptors. The detected concentrations of PFOA and PFBS in groundwater samples, as well as, PFOA, PFOS, and PFBS in soil samples from AOI 1 were below the 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.*

   PFOA, PFOS, and PFBS were detected in groundwater and PFOS exceeded the SL at the source area and facility boundary. The exceedance at the facility boundary is immediately downgradient of the AOI 1 source area. As a result, no release area can be eliminated from further consideration at this point in the investigation.

3. *Determine the potential need for a removal action.*

   As described in **Section 2.4**, in 2021, the offsite wells were sampled due to exceedances of SLs observed in groundwater in monitoring wells at the AASF during the SI. Five properties were selected to be sampled due to their proximity to the facility. PFOA, PFOS, and PFBS were detected in groundwater, but were below SLs. A removal action is not needed at this time because the potable water sample results were below the SLs.

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

   The geological data collected as part of the SI indicate the facility is underlain by unconsolidated, heterogeneous valley fill deposits, dominated by well-graded sand with thin lenses of silt and clay and thin beds of small gravel.

   The observations from the borings advanced during the SI are consistent with the surficial geology of the area. The Helena Valley consists of material eroded from the surrounding mountains and hills. The sands, silts, and clays are yellow to brown, well-graded, and mixed with subangular gravel. Most of these deposits originate from the surrounding sedimentary bedrock. The interlayering of these lenses provides communication from the ground surface to the top of the valley aquifer.

   Depth to water at the facility ranged from approximately 40.71 to 56.78 feet bgs. Groundwater flow direction is north-northeast, towards Lake Helena and the Missouri River. These geologic and hydrogeologic observations inform development of technical approach for the RI.

5. *Identify within 4 miles of the installation other potential PFAS sources (fire stations, major manufacturers, other DoD facilities) and receptors, including both groundwater and surface water receptors, to determine whether the ARNG is the likely source of PFAS, or whether there is an off-facility source of PFAS responsible for installation detections of PFAS (USEPA, 2005).*

   Based upon the evaluation of groundwater and soil results in comparison to SLs, in combination with the 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. The two locations with PFOS exceedances in groundwater were found at the identified source area and immediately downgradient. Results of the PA did not find any other adjacent source that could have contributed to these groundwater results. Furthermore, the upgradient (HAASF-MW001) and cross-gradient (HAASF-MW004) monitoring wells installed did not suggest any adjacent contributing PFAS source potentially migrating within the boundaries of the facility. As such, ARNG will evaluate AOI 1 further in an RI.

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

   As described in **Section 2.4**, in 2021, offsite potable wells were sampled due to the exceedance of SLs observed in groundwater during the SI. Five properties were selected to be sampled due to their proximity to the facility. PFOA, PFOS, and PFBS were detected in groundwater, but were below SLs. A removal action is not needed at this time because the potable sample results were below the SLs. Based on these results, a potentially complete pathway exists to potential receptors.

8.3 Outcome

Based on the CSM developed and revised in light of the SI findings, there is potential for exposure to drinking water receptors from sources on the facility resulting from historical DoD activities at AOI 1. Sample chemical analytical concentrations collected during and after 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:

- PFOA, PFOS, and PFBS were detected in groundwater at AOI 1 and PFOS exceeded the individual SL of 40 ng/L, with maximum concentrations of 775 ng/L (814 ng/L duplicate) and 175 ng/L at locations HAASF-MW005 and HAASF-MW003; respectively. Based on the results of the SI, further evaluation of AOI 1 is warranted in the RI.

- Offsite wells were sampled due to exceedances of SLs observed in groundwater in monitoring wells at the AASF during the SI and well information from the MBMG database, a potentially complete pathway exits to off-facility residential wells.

- The detected concentrations of PFOA, PFOS, and PFBS in soil samples from AOI 1 were below the SLs.

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 exposure to drinking water receptors caused by DoD activities at or adjacent to 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 in the RI for AOI 1: 60 and 47 Hangar Fire Suppression System Release and Tri-Max™ Spill/Release Area.

Table 8-1: Summary of Site Inspection Findings

AOI	Potential PFAS Release Area	Soil – Source Area	Groundwater – Source Area	Groundwater – Facility Boundary
1	60 and 47 Hangar Fire Suppression System Release and Tri-Max™ Spill/Release Area	◐	●	●

Legend:

● = 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	60 and 47 Hangar Fire Suppression System Release and Tri-Max™ Spill/Release Area	Exceedances of SLs in groundwater at source area and downgradient facility boundary. No exceedances of SLs in soil.	Proceed to RI

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