FINAL
Site Inspection Report
Camp Ripley
Little Falls, Minnesota

Site Inspection for Perfluorooctanoic acid (PFOA), Perfluorooctanesulfonic acid (PFOS), Perfluorohexanesulfonic acid (PFHxS), Perfluorononanoic acid (PFNA), Hexafluoropropylene oxide dimer acid (HFPO-DA), and Perfluorobutanesulfonic acid (PFBS) at ARNG Installations, Nationwide

September 2023

Prepared for:

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

UNCLASSIFIED

THIS PAGE INTENTIONALLY BLANK

Table of Contents

Appendices

Figures

Tables

THIS PAGE INTENTIONALLY BLANK

Acronyms and Abbreviations

%	percent
°C	degrees Celsius
°F	degrees Fahrenheit
µg/kg	micrograms per kilogram
AASF	Army Aviation Support Facility
ACUB	Army Compatible Use Buffer
AECOM	AECOM Technical Services, Inc.
AFFF	aqueous film-forming foam
amsl	above mean sea level
AOI	Area of Interest
AR-AFFF	alcohol-resistant AFFF
ARNG	Army National Guard
BAL	Bruce A. Liesch Associates, Inc.
bgs	below ground surface
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CMA	Combined Maintenance Area
CoC	chain of custody
CSM	conceptual site model
CSMS	Combined Support Maintenance Shop
DA	Department of the Army
DHS	Department of Homeland Security
DoD	Department of Defense
DO	dissolved oxygen
DPT	direct push technology
DQO	data quality objective
DUA	data usability assessment
EDR™	Environmental Data Resources, Inc.™
ELAP	Environmental Laboratory Accreditation Program
EM	Engineer Manual
EMTC	Emergency Management Training Center
FedEx	Federal Express
FTA	Fire Training Area
ft/day	feet per day
GPS	Global positioning system
GPRS	Ground Penetrating Radar Systems
HDPE	high-density polyethylene
HFPO-DA	hexafluoropropylene oxide dimer acid
IDW	investigation-derived waste
ITRC	Interstate Technology Regulatory Council
LC/MS/MS	liquid chromatography with tandem mass spectrometry
MIL-SPEC	military specification
MNARNG	Minnesota Army National Guard
n.d.	no date

NELAP	National Environmental Laboratory Accreditation Program
ng/L	nanograms per liter
ORP	oxidation-reduction potential
OSD	Office of the Secretary of Defense
PA	Preliminary Assessment
PCE	Progressive Consulting Engineers
PFAS	per- and polyfluoroalkyl substances
PFBS	perfluorobutanesulfonic acid
PFHxS	perfluorohexanesulfonic acid
PFNA	perfluorononanoic acid
PFOA	perfluorooctanoic acid
PFOS	perfluorooctanesulfonic acid
PID	photoionization detector
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
SI	Site Inspection
SL	screening level
SOP	standard operating procedure
TOC	total organic carbon
TPP	Technical Project Planning
UFP	Uniform Federal Policy
UMD	University of Minnesota Duluth
US	United States
USACE	United States Army Corps of Engineers
USAEHA	United States Army Environmental Hygiene Agency
USAF	United States Air Force
USASCHPPM	United States Army Center for Health Promotion and Preventative Medicine
USCS	Unified Soil Classification System
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service
USPFO	United States Property and Fiscal Office
WWTP	wastewater treatment plant

Executive Summary

The Army National Guard (ARNG) G-9 is performing Preliminary Assessments (PAs) and Site Inspections (SIs) on the current or potential historical use of per- and polyfluoroalkyl substances (PFAS) with a focus on the six compounds presented in the memorandum from the Office of the Secretary of Defense (OSD) dated 6 July 2022 (Assistant Secretary of Defense, 2022). The six compounds listed in the OSD memorandum include perfluorooctanesulfonic acid (PFOS), perfluorooctanoic acid (PFOA), perfluorononanoic acid (PFNA), perfluorohexanesulfonic acid (PFHxS), hexafluoropropylene oxide dimer acid (HFPO-DA)[1], and perfluorobutanesulfonic acid (PFBS). These compounds are collectively referred to as "relevant compounds" throughout the document, and the applicable screening levels (SLs) are provided in **Table ES-1**.

The PA identified six Areas of Interest (AOIs) with seven potential release areas where PFAS-containing materials may have been used, disposed, or released historically. However, since the Final PA Report was issued, ARNG adopted a more conservative policy to investigate aqueous film-forming foam storage and use areas where no previous releases were reported; thus, seven additional potential release areas (constituting expansion of AOI 1 and AOI 4, as well as adding two additional AOIs (see **Table ES-2** for AOI locations). The objective of the SI is to identify whether there has been a release to the environment from the identified AOIs and determine whether further investigation is warranted, a removal action is required to address immediate threats, or no further action is required based on SLs for relevant compounds. This SI was completed at Camp Ripley in Little Falls, Minnesota under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). Further evaluation at Camp Ripley is warranted for AOI 1, AOI 2, AOI 4, AOI 5-Wastewater Treatment Plant (WWTP), AOI 6, AOI 7, and AOI 8; no further evaluation is warranted for AOI 3 and AOI 5-Sludge Spread Site at this time. Camp Ripley will also be referred to as the "facility" throughout this document.

Camp Ripley is in Morrison County in central Minnesota, near the City of Little Falls. The State of Minnesota purchased 12,000 acres of land from the Northwestern Improvement Company in 1931, formally establishing Camp Ripley. Since 1951, the State of Minnesota has purchased additional land that has expanded Camp Ripley to a total of 53,000 acres. Camp Ripley is currently a maneuver and training center owned by the State of Minnesota and managed by the Minnesota Department of Military Affairs. In addition, the Department of Natural Resources provides technical support to the facility (AECOM Technical Services, Inc., 2022a).

The PA identified six AOIs for investigation during the SI phase; however, two additional AOIs were added after the Final PA was issued. SI sampling results from the eight AOIs were compared to OSD SLs. **Table ES-2** summarizes the SI results for each AOI. Based on the results of this SI, further evaluation under CERCLA is warranted in a Remedial Investigation (RI) for AOI 1, AOI 2, AOI 4, AOI 5-WWTP, AOI 6, AOI 7, and AOI 8; no further evaluation is warranted for AOI 3 or AOI 5-Sludge Spread Site at this time.

[1] Of the six PFAS compounds presented in the 6 July 2022 OSD memorandum, HFPO-DA (commonly referred to as GenX) was not included as an analyte at the time of this SI. Based on the conceptual site model (CSM) developed during the PA and revised based on SI findings, the presence of HFPO-DA is not anticipated at the facility because HFPO-DA is generally not a component of military specification (MIL-SPEC) aqueous film forming foam (AFFF) and based on its history including distribution limitations that restricted use of GenX, it is generally not a component of other products the military used. In addition, it is unlikely that GenX would be an individual chemical of concern in the absence of other PFAS

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

Analyte[b]	Residential (Soil) (µg/kg)[a] 0-2 feet bgs	Industrial/ Commercial Composite Worker (Soil) (µg/kg)[a] 2-15 feet bgs	Tap Water (Groundwater) (ng/L)[a]
PFOA	19	250	6
PFOS	13	160	4
PFBS	1,900	25,000	601
PFHxS	130	1,600	39
PFNA	19	250	6

Notes:
bgs = below ground surface; µg/kg = micrograms per kilogram; ng/L = nanograms per liter

a.) Assistant Secretary of Defense, 2022. Risk Based Screening Levels in Groundwater and Soil using United States Environmental Protection Agency's (USEPA's) Regional Screening Level Calculator. Hazard Quotient (HQ) = 0.1. 6 July 2022.

b.) Of the six PFAS compounds presented in the 6 July 2022 OSD memorandum, HFPO-DA (commonly referred to as GenX) was not included as an analyte at the time of this SI. Based on the CSM developed during the PA and revised based on SI findings, the presence of HFPO-DA is not anticipated at the facility because HFPO-DA is generally not a component of MIL-SPEC AFFF and based on its history including distribution limitations that restricted use of GenX, it is generally not a component of other products the military used. In addition, it is unlikely that GenX would be an individual chemical of concern in the absence of other PFAS.

Table ES-2: Summary of Site Inspection Findings and Recommendations

AOI	Potential Release Area	Soil – Source Area	Groundwater – Source Area	Future Action
1	TriMax™ Discharge Area and Building 8-197	●	●	Proceed to RI
2	Burn Pit Fire Training Area	◐	●	Proceed to RI
3	DHS Demonstration	◐	◐	No Further Action
4	USPFO Warehouse, CMA Shop, and CMA Discharge Area	◐	●	Proceed to RI
5	WWTP	◐	●	Proceed to RI
	Sludge Spread Site	◐	◐	No Further Action
6	Stormwater Infiltration Basin	◐	●	Proceed to RI
7	Buildings 2-166, 2-203, 2-223, and 2-272	◐	●	Proceed to RI
8	Building 8-195	◐	●	Proceed to RI

Legend:
CMA = Combined Maintenance Activity
DHS = Department of Homeland Security
FTA = fire training area
RI = Remedial Investigation
USPFO = United States Property and Fiscal Office
WWTP = wastewater treatment plant

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

1. Introduction

1.1 Project Authorization

The Army National Guard (ARNG) G-9 is the lead agency in performing Preliminary Assessments (PAs) and Site Inspections (SIs) on the current or potential historical use of per- and polyfluoroalkyl substances (PFAS) with a focus on the six compounds presented in the memorandum from the Office of the Secretary of Defense (OSD) dated 6 July 2022 (Assistant Secretary of Defense, 2022). The six compounds listed in the OSD memorandum will be referred to as "relevant compounds" throughout this document and include perfluorooctanoic acid (PFOA), perfluorooctanesulfonic acid (PFOS), perfluorohexanesulfonic acid (PFHxS), perfluorononanoic acid (PFNA), hexafluoropropylene oxide dimer acid (HFPO-DA)[1], and perfluorobutanesulfonic acid (PFBS) at ARNG facilities nationwide. The ARNG performed this SI at Camp Ripley in Little Falls, Minnesota. Camp Ripley is also referred to as the "facility" throughout this document.

The SI project elements were performed in compliance with Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA; United States [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.

1.2 SI Purpose

A PA was performed at Camp Ripley (AECOM Technical Services, Inc. [AECOM], 2019) that identified seven potential release areas grouped into six Areas of Interest (AOIs) where PFAS-containing materials may have been used, disposed, or released historically. However, since the Final PA Report was issued, ARNG adopted a more conservative policy to investigate AFFF storage and use areas where no previous releases were reported; thus, seven additional potential release areas warranted expansion of AOI 1 and AOI 4 as well as creating two additional AOIs. The objective of the SI is to identify whether there has been a release to the environment from the eight AOIs and determine whether further investigation is warranted, a removal action is required to address immediate threats, or no further action is required based on screening levels (SLs) for the relevant compounds.

[1] Of the six PFAS compounds presented in the 6 July 2022 OSD memorandum, HFPO-DA (commonly referred to as GenX) was not included as an analyte at the time of this SI. Based on the conceptual site model (CSM) developed during the PA and revised based on SI findings, the presence of HFPO-DA is not anticipated at the facility because HFPO-DA is generally not a component of military specification (MIL-SPEC) aqueous film forming foam (AFFF) and based on its history including distribution limitations that restricted use of GenX, it is generally not a component of other products the military used. In addition, it is unlikely that GenX would be an individual chemical of concern in the absence of other PFAS.

THIS PAGE INTENTIONALLY BLANK

2. Facility Background

2.1 Facility Location and Description

Camp Ripley is in Morrison County in central Minnesota, near the City of Little Falls, and approximately 20 miles southwest of Brainerd (**Figure 2-1**). The State of Minnesota purchased 12,000 acres of land from the Northwestern Improvement Company in 1931, formally establishing Camp Ripley. Since 1951, the State of Minnesota has purchased additional land that has expanded Camp Ripley to a total of 53,000 acres. The facility is bordered by the Crow Wing River to the north and the Mississippi River to the east.

Camp Ripley is currently a maneuver and training center owned by the State of Minnesota and managed by the Minnesota Department of Military Affairs. In addition, the Department of Natural Resources provides technical support to the facility. The missions of Camp Ripley are to provide realistic joint and combined arms training, provide support for state emergencies, and provide resources that add value to the community. A cantonment area is located in the southeast part of the facility, which contains barracks and two full-time occupied residences: the Post Commander's house and the Command Sergeant Major's house.

2.2 Facility Environmental Setting

Camp Ripley is on the western Lake Section of the Central Lowland physiographic province (**Figure 2-2**). The level to slightly rolling topography of Camp Ripley is a result of glacial drift during the Pleistocene Epoch (US Army Environmental Hygiene Agency [USAEHA], 1994). Ground-surface elevations range from 1,140 to 1,550 feet above mean sea level. Regionally, topography slopes to the east-southeast, toward the Mississippi River, where the elevations at Camp Ripley are lowest. The most prominent geomorphologic feature at Camp Ripley is the St. Croix moraine. This moraine occupies most of the facility, forming a rough belt of uneven hummocky topography containing numerous hills, associated depressions, lakes, and wetlands (University of Minnesota Duluth [UMD], no date [n.d.]). These higher-relief landforms cover about half of Camp Ripley; lower-relief landforms, such as outwash plain, old lakebeds, and alluvium, cover about 40 percent (%). The remaining areas consist of level terrain and water features (USAEHA, 1994).

2.2.1 Geology

Surficial deposits at Camp Ripley consist of ice-contact and outwash deposits of the St. Croix moraine system (**Figure 2-3**). The outwash deposits were created by glacial meltwaters that flowed through the Mississippi [River] and Crow Wing River valleys, depositing the poorly sorted sands and gravels in a band a few miles wide along both sides of the rivers (US Army Center for Health Promotion and Preventative Medicine [USACHPPM], 2000). The moraine is composed primarily of a heterogeneous mixture of glacial sediment consisting predominantly of sandy deposits laid down as flow tills, outwash, and lacustrine sediment by the Rainy and Superior lobes during the St. Croix glaciation of the Late Wisconsin Period. These deposits overlie the Hewitt till, a loamy glacial deposit laid down by the Wadena lobe during an earlier glacial advance (UMD, n.d.). Thicknesses of these unconsolidated deposits vary considerably across Camp Ripley, ranging from 20 feet to more than 200 feet (USACHPPM, 2000).

Bedrock at Camp Ripley consists of Precambrian age metamorphic rocks (USAEHA, 1994). Slate, schist, and metamorphosed mafic and intermediate volcanics compose the bedrock under Camp Ripley. Depth to bedrock at Camp Ripley varies and can be 150 feet or greater (USACHPPM, 2000).

During the SI, medium to high-permeability sands were observed as the dominant lithology of the unconsolidated sediments below Camp Ripley. The borings were completed at depths between 9 and 25 feet below ground surface (bgs). A majority of borings contained poorly graded sand, with frequent layers of well-graded sand. Occasional silt layers were observed in thicknesses ranging from 0.75 to 6 feet in thickness. Varying quantities of gravel were noted in several borings and ranged from 0.1 to 4 feet thick. Many of the logs also reported varying percentages (ranging from <5% to 45%) of gravel included in the sand packages. A sample for grain size analysis was collected at one location, AOI05-02, and analyzed via American Society for Testing and Materials (ASTM) Method D-422. The results indicate that the soil sample was comprised of gravel (2.96%), coarse-grained sand (3.69%), fine- to medium-grained sand (61.24%), silt (22.91%), and clay (9.19%). These results and facility observations are consistent with the understood regional depositional history, which is characterized by glacial moraine and outwash facies. Boring logs are presented in **Appendix E**, and grain size results are presented in **Appendix F**.

2.2.2 Hydrogeology

In the region surrounding Camp Ripley, the main water-bearing units are composed of heterogeneous glacial sediments and lacustrine sandy deposits (Progressive Consulting Engineers, [PCE] n.d.; Quinn, 2006). Occasional sand and gravel components are intercepted at some well locations (Bruce A. Liesch Associates, Inc [BAL], 1987). Clay layers have been encountered throughout Camp Ripley, but no laterally extensive confining layers exist within the unconsolidated deposits (PCE, n.d.).

As reported in the *Groundwater Atlas of Morrison County, Minnesota*, the water table elevation across the facility generally follows topography and ranges from approximately 1,125 to 1,500 feet; a water table is defined as the surface at which water pressure is equal to atmospheric pressure (Baratta, 2019). The highest-elevation landforms on the facility are found in training areas to the northwest of the cantonment area, while the lowest are found in the cantonment area near the Mississippi River. The water table elevation in the cantonment area, which includes the AOIs, post commander's house, and command sergeant major's house, ranges from approximately 1,125 to 1,175 feet (Baratta, 2019). As such, surficial groundwater was anticipated at or shallower than 35 feet bgs (Foth and Van Dyke, 1997). Additionally, the potential for localized perched groundwater conditions was anticipated due to the presence of discontinuous low-permeability lacustrine clay and fine-grained till deposits across the site (Quinn, 2006).

The regional groundwater flow is east-southeast toward the Mississippi River and is defined by a drainage divide located several miles west of Camp Ripley (UMD, n.d.). Groundwater originating east of this divide, which encompasses the facility, follows the east-southeast flow path to the discharge boundaries of Little Elk River to the southwest and the Crow Wing and Mississippi Rivers to the north and east (UMD, n.d.). The complex glacial topography creates localized variations in the groundwater flow paths, where recharge occurs at topographic highs and discharge occurs in adjacent topographic lows. In some areas, the shallow groundwater is thought to be in communication with the many kettle lakes and wetland areas (USACHPPM, 2000).

The geologic makeup of the Camp Ripley area aquifer consists primarily of coarse-grained glacial and lacustrine deposits; therefore, the permeability is considered high. Groundwater studies and flow modeling have characterized the hydraulic conductivity of the glacial deposits at Camp Ripley from well pump tests and grain size analyses. Calculated hydraulic conductivities from the grain size analyses vary widely and range from 9.7 feet per day (ft/day) for dense clay loam till to 334 ft/day for coarse sand and gravel deposits (Quinn, 2006). A pumping test that was performed at an on-facility groundwater supply well in the cantonment area exhibited very rapid recharge. The hydraulic conductivity of sediments near this well was calculated to be 408 ft/day (PCE, n.d.).

Natural recharge to the groundwater aquifer system in the Camp Ripley area is primarily through surface infiltration through the glacial outwash deposits east of the drainage divide (Quinn 2006). Groundwater level results from the Argonne National Labs 2003 groundwater flow model suggest that Lake Alexander may contribute to the groundwater recharge (UMD n.d.). Groundwater discharges primarily to the Mississippi River, creating a hydrogeologic boundary along the eastern side of Camp Ripley (UMD, n.d.). Secondary discharge includes pumping for irrigation and drinking water consumption.

The City of Little Falls utilizes eight wells, two elevated storage tanks, and two ground storage tanks to supply drinking water to the residents in the area. The well field for Little Falls is located about 6-miles south of Camp Ripley on the opposite side of the Mississippi River (Baratta, 2019). There are no public wells near the facility; however, numerous private domestic wells in the surrounding communities lie within a 4-mile radius to the facility (**Figure 2-3**). Camp Ripley is located within several watersheds with the depth to water at the southwestern portion of the facility for the SI range from 0 to 30 feet bgs. 19 potable water wells and one public water supply well are located within the boundary of Camp Ripley (**Figure 2-3**). Four drinking water supply wells (H Well, L Well, N Well, and Well 641304) are located within the southeastern cantonment area of the facility in proximity to one or more AOIs (**Table 2-1**). Drinking water for Camp Ripley's cantonment area is supplied from three wells ranging from 70 to 102 feet deep. The groundwater is extracted from an unconfined aquifer lying under the Camp Ripley cantonment area and extending to the northwest (MNARNG, 2021).

Table 2-1: Drinking Water Supply Wells near Camp Ripley Cantonment

Well ID	Total Well Depth (feet bgs)	Screen Interval (feet bgs)	Pumping Rate[1] gpm	Use as listed in the MWI
H Well (permit ID # 224577)	70	50-70 (Records indicate 12-foot screen, exact interval uncertain)	600-1,000	Public Supply
L Well (permit ID # 470668)	93	73-98 (Records indicate 12-foot screen, exact interval uncertain)	1,106	Public Supply
N Well (permit ID # 622775)	102	75-102	1,000	Public Supply
Well 641304	60	52-60	20	Public Supply

Notes:
bgs = below ground surface; µg/kg = micrograms per kilogram; ng/L = nanograms per liter
gpm = gallons per minute
MWI = Minnesota Well Index
1). Construction information collected from the Minnesota Department of Health Well Index ([MWI], 2023).

Depths to water measured in June 2022 during the SI ranged from 3.04 to 24.85 feet bgs. Groundwater elevation contours from the SI are presented on **Figure 2-4** and indicate the groundwater flow direction at the facility is primarily to the east-southeast towards the Mississippi

River. It must be noted that one existing permanent well (AOI05-536846) is located over 1.5 miles away from the rest of the wells sampled during the SI. Temporary wells at the AOI 5-Sludge Spread Site were also excluded from contouring because: 1) two temporary wells, AOI05-01 and AOI05-02, were dry during the synoptic gauging on 15 June 2022, and 2) the depths to groundwater observed at AOI05-03 and AOI05-04 were much shallower than the rest of the cantonment area relative to elevation, and along with the lithology, are believed to represent a perched groundwater zone. Thus, AOI05-536846 and AOI05-01 through AOI05-04 were excluded from groundwater contouring to avoid a misrepresentation of localized groundwater flow between AOI 5-Sludge Spread Site and the remaining AOIs.

2.2.3 Hydrology

Camp Ripley has abundant surface water as a result of the glacial processes that shaped the landscape including small inland lakes, wetlands, and streams (Minnesota ARNG [MNARNG], 2018) (**Figure 2-5**).

Camp Ripley is bordered on the north by the Crow Wing River and on the east by the Mississippi River. The Little Elk River flows west to southeast, approximately 4 miles south of Camp Ripley. Numerous wetlands and lakes exist in the range areas amid the hummocky landforms of the St. Croix moraine and are thought to be in communication with the groundwater. Six surface water bodies originate on Camp Ripley and flow off facility to the Mississippi River, the Crow Wing River, and the Little Elk River. All three of these rivers are used for recreational activities.

The facility boundary of Camp Ripley intersects with several watersheds, as shown on **Figure 2-5**. However, the two primary watersheds containing the cantonment area of and the subsequent AOIs are the City of Little Falls-Mississippi River Watershed and the Broken Bow Creek-Mississippi River Watershed, both of which drain to the Mississippi River. The City of Little Falls-Mississippi River Watershed covers 6.1 square miles within the facility boundary and encompasses AOIs 1, 2, 4, and the AOI 5-Sludge Spread Site. The Broken Bow Creek-Mississippi River Watershed covers 21.2 square miles within the facility boundary, although much of that is located well north of the cantonment area. The Broken Bow Creek-Mississippi River Watershed encompasses AOIs 3, 6, 7, and the AOI 5-WWTP.

Stormwater runoff on the cantonment area is collected in a series of infiltration basins located along the Mississippi River. This includes the AOI 6 Stormwater Infiltration Basin which drains stormwater from the northeast portion of the cantonment area. Five infiltration basins were installed between 2009 and 2022 and are shown on **Figure 2-6**. AOI boundaries are shown on this figure for geographic reference only and are discussed in depth in **Section 3**. For ease of discussion in this and subsequent sections, the five new basins have been labelled as Infiltration Basin A through E (**Figure 2-6**). Drainage from the northern part of the cantonment area drains to the northeast for collection in Infiltration Basin A. In the northeastern part of the cantonment area, stormwater drains to eastward to Infiltration Basin B, and may also drain to the older Stormwater Infiltration Basin (AOI 6). Some stormwater in the eastern section of the cantonment area drains east into Infiltration Basin C, while stormwater from the southwestern part of the cantonment area (near AOI 4) and the area south of the airfield drains east toward Infiltration Basin D. Lastly, stormwater drainage from the southern part of the facility (near AOI 7) drains east-southeast for collection in Infiltration Basin E near the WWTP. These basins were installed to reduce point-source discharges of stormwater to the Mississippi River and were designed with capacity to withstand a 100-year rain event and allow stormwater to infiltrate into the subsurface. However, due to the permeable nature of the lithology beneath this part of the facility and known connection between surface water and shallow groundwater at the facility, the stormwater collected in these basins may eventually drain to the Mississippi River.

2.2.4 Climate

The climate at Camp Ripley has wide variations in temperature, ample summer rainfall, and a persistent winter snow cover. Spring, summer, and fall temperatures are temperate, while occasional Arctic outbreaks occur during the winter (MNARNG, 2018). The average temperature is 43.35 degrees Fahrenheit ([°F], World Climate, 2019). The mean annual precipitation at Camp Ripley is 26.26 inches, and the mean annual snowfall is about 44 inches, occurring almost entirely from November through March.

2.2.5 Current and Future Land Use

Camp Ripley is a controlled-access facility for military training supporting maneuver training; weapons familiarization and qualification; aviation and armor gunnery; military occupational specialty producing and leadership provision of a central maintenance facility; direct service support in all classes of supply; provision of personnel services and chaplain services; and military morale, welfare, and recreation activities. The MNARNG is responsible for the protection and management of the natural and cultural resources at Camp Ripley and may restrict public access to the facility when conducting military training; however, many opportunities for public access and use exist including cross country skiing, deer and turkey hunts, fishing, bird watching, walking, and camping (MNARNG, 2018).

In 2004, the MNARNG approved the Camp Ripley Army Compatible Use Buffer (ACUB) Program establishing a 3-mile buffer (110,000 acres) around the facility to combat encroachment concerns, especially noise, and in 2015, Camp Ripley was designated as the first state sentinel landscape in the US to promote natural resource sustainability around the facility. In an effort to expand services to private landowners within the ACUB Program and extend out to a 10-mile radius around the facility, Camp Ripley was designated as a federal Sentinel Landscape in 2016. The federal designation will allow Camp Ripley to more effectively compete for federal funding from agencies beyond the Department of Defense (DoD) and to better align federal, state, and local programs that could support private landowners in a Sentinel Landscape (MNARNG, 2018).

Currently, Camp Ripley is deficient in maneuver area acreage, and improvements to existing lands are planned to meet current and projected training requirements. Planned improvements include upgrading existing roads and trails, constructing new maneuver corridors, and creating new assembly areas. Reasonably anticipated future land use is not expected to change from the current land use described above.

2.2.6 Sensitive Habitat and Threatened/ Endangered Species

The following birds, mammals, and insects are federally endangered, threatened, proposed, and/ or are listed as candidate species in Morrison County, Minnesota (United States Fish and Wildlife Service [USFWS], 2023a).

- **Birds:** Whooping crane, *Grus americana* (experimental population, endangered in some other states)
- **Migratory Birds:** American Golden-plover, *Pluvialis dominica* (breeds elsewhere); Bald Eagle, *Haliaeetus leucocephalus* (breeds December 1 to August 31); Black Tern, *Chlidonias niger* (breeds May 15 to August 20); Black-billed Cuckoo, *Coccyzus erythropthalmus* (breeds May 15 to October 10); Bobolink, *Dolichonyx oryzivorus* (breeds May 20 to July 31); Canada Warbler, *Cardellina canadensis* (breeds May 20 to August 10); Chimney Swift, *Chaetura pelagica* (breeds March 15 to August 25); Common Tern, *Sterna hirundo hirundo* (breeds May 1 to August 31); Connecticut Warbler, *Oporornis agilis* (breeds June 15 to August 10); Eastern Whip-poor-will, *Anstrostomus vociferus* (breeds May 1 to August 20);

Golden Eagle, *Aquila chrysaetos* (breeds January 1 to August 31); Golden-winged Warbler, *Vermivora chrysoptera* (breeds May 1 to July 20); Lesser Yellowlegs, *Tringa flavipes* (breeds elsewhere); Marbled Godwit, *Limosa fedoa* (breeds May 1 to July 31); Olive-sided Flycatcher, *Contopus cooperi* (breeds May 20 to August 31); Red-headed Woodpecker, *Melanerpes erythrocephalus* (breeds May 10 to September 10); Ruddy Turnstone, *Arenaria interpres morinella* (breeds elsewhere); Rusty Blackbird, *Euphagus carolinus* (breeds elsewhere); Short-billed Dowitcher, *Limnodromus griseus* (breeds elsewhere); Western Grebe, *aechmophorus occidentalis* (breeds June 1 to August 31); Wood Thrush, *Hylocichla mustelina (*breeds May 10 to August 31)

- **Insects:** Monarch butterfly, *Danaus plexippus* (candidate)
- **Mammals**: Northern Long-eared Bat, *Myotis septentrionalis* (endangered); Canada Lynx, *Lynx canadensis* (threatened); Gray Wolf, *Canis lupis* (threatened); Tricolored Bat, *Perimyotis subflavus* (proposed endangered)

According to the USFWS, Camp Ripley does not have any registered critical habitats for the above-listed species. However, the facility contains numerous wetland areas, ponds, and streams, which may be used by migratory birds (USFWS, 2023b).

2.3 History of PFAS Use

Fourteen potential release areas were identified and grouped into eight AOIs where AFFF may have been used, stored, disposed, or released historically at Camp Ripley. These potential releases may have occurred during familiarization training, demilitarization, fire training activities, as well as incidental releases, as early as the 1980s. The potential release areas were grouped into eight AOIs based on preliminary data and presumed groundwater flow directions. A description of each AOI is presented in **Section 3**.

2.4 Potable Well Sampling

On 9 May 2023 through 11 May 2023, ARNG conducted drinking water sampling from off-facility private, potable wells due to concentrations of PFOA and PFOS near the southern facility boundary. One property measured PFOS concentrations of that exceed 70 ng/L. As there are no final federal drinking water standards available for PFAS, Army follows DoD guidance to address drinking water containing PFOS or PFOA (individually or combined) at or above 70 ng/L. As a result of the initial sampling, several properties adjacent and downgradient of the exceedance were selected to be resampled on 21 June 2023 (see **Figure 2-7**). The other properties measured a PFOA and PFOS below the 70 ng/L for PFOS and PFOA. The results of the drinking water sampling were provided in letters to the residents and are also provided in **Table 2-2**.

The need for a removal action was determined from the results of the off-facility drinking water sampling. ARNG has prepared a Time-Critical Removal Action (TCRA) Action Memorandum (AM) in response to the presence of PFAS in potable wells. The TCRA AM proposed providing potable water for affected property whose drinking water exceeds the action level of 70 ng/L for PFOS and/or PFOA, until a treatment system can be installed. The selected removal action has been finalized and is being implemented as of the date of this report (AECOM, 2021).

Table 2-2
Residential Drinking Water Results
Site Inspection Report, Camp Ripley

Sample ID		CR-PW-01-050923				CR-PW-01-062123				CR-PW-02-050923				CR-PW-02-050923-D				CR-PW-02-062123				CR-PW-02-062123-D				CR-PW-03-050923			
Sample Date		05/09/2023				06/21/2023				05/09/2023				05/09/2023				06/21/2023				06/21/2023				05/09/2023			
Analyte	USEPA HA[a]	Result	LOD	LOQ	Qual	Result	LOD	LOQ	Qual	Result	LOD	LOQ	Qual	Result	LOD	LOQ	Qual	Result	LOD	LOQ	Qual	Result	LOD	LOQ	Qual	Result	LOD	LOQ	Qual
Water, PFAS by LCMSMS Compliant with QSM 5.3 Table B-15 (ng/L)																													
11Cl-PF3OUdS	-	-	-	-	-	<	2.01	4.01	U	-	-	-	-	-	-	-	-	<	2.09	4.17	U	<	2.04	4.08	U	-	-	-	-
4:2 FTS	-	<	3.7	7.3	U	<	3.01	4.01	U	<	3.8	7.5	U	<	3.7	7.3	U	<	3.13	4.17	U	<	3.06	4.08	U	<	3.5	7.0	U
6:2 FTS	-	<	3.7	7.3	U	<	3.01	4.01	U	<	3.8	7.5	U	<	3.7	7.3	U	<	3.13	4.17	U	<	3.06	4.08	U	<	3.5	7.0	U
8:2 FTS	-	<	3.7	7.3	U	<	3.01	4.01	U	<	3.8	7.5	U	<	3.7	7.3	U	<	3.13	4.17	U	<	3.06	4.08	U	<	3.5	7.0	U
9Cl-PF3ONS	-	-	-	-	-	<	2.01	4.01	U	-	-	-	-	-	-	-	-	<	2.09	4.17	U	<	2.04	4.08	U	-	-	-	-
ADONA	-	-	-	-	-	<	2.01	4.01	U	-	-	-	-	-	-	-	-	<	2.09	4.17	U	<	2.04	4.08	U	-	-	-	-
FOSA	-	<	1.9	3.7	U	<	2.01	4.01	U	<	1.9	3.8	U	<	1.8	3.6	U	<	2.09	4.17	U	<	2.04	4.08	U	<	1.8	3.5	U
HFPO-DA	-	<	3.7	7.3		<	4.01	8.03	U	<	3.8	7.5		<	3.7	7.3		<	4.17	8.35	U	<	4.08	8.17	U	<	3.5	7.0	
NEtFOSA	-	-	-	-	-	<	4.01	8.03	U	-	-	-	-	-	-	-	-	<	4.17	8.35	U	<	4.08	8.17	U	-	-	-	-
NEtFOSAA	-	<	3.7	7.3	U	<	4.01	8.03	U	<	3.8	7.5	U	<	3.7	7.3	U	<	4.17	8.35	U	<	4.08	8.17	U	<	3.5	7.0	U
N-EtFOSE	-	-	-	-	-	<	4.01	8.03	U	-	-	-	-	-	-	-	-	<	4.17	8.35	U	<	4.08	8.17	U	-	-	-	-
NMEFOSA	-	-	-	-	-	<	4.01	8.03	U	-	-	-	-	-	-	-	-	<	4.17	8.35	U	<	4.08	8.17	U	-	-	-	-
NMeFOSAA	-	<	3.7	7.3	U	<	4.01	8.03	U	<	3.8	7.5	U	<	3.7	7.3	U	<	4.17	8.35	U	<	4.08	8.17	U	<	3.5	7.0	U
NMeFOSE	-	-	-	-	-	<	4.01	8.03	U	-	-	-	-	-	-	-	-	<	4.17	8.35	U	<	4.08	8.17	U	-	-	-	-
PFBA	-	7.7	1.9	3.7		4.99	3.51	4.01		11	1.9	3.8		11	1.8	3.6		3.90	3.65	4.17	J	3.86	3.57	4.08	J	5.2	1.8	3.5	
PFBS	-	2.6	1.9	3.7	J	1.91	2.01	4.01	J	5.4	1.9	3.8		5.5	1.8	3.6		4.19	2.09	4.17		4.12	2.04	4.08		3.5	1.8	3.5	
PFDA	-	<	1.9	3.7	U	<	3.01	4.01	U	<	1.9	3.8	U	<	1.8	3.6	U	<	3.13	4.17	U	<	3.06	4.08	U	<	1.8	3.5	U
PFDoA	-	<	1.9	3.7	U	<	3.01	4.01	U	<	1.9	3.8	U	<	1.8	3.6	U	<	3.13	4.17	U	<	3.06	4.08	U	<	1.8	3.5	U
PFDS	-	<	1.9	3.7	U	<	3.01	4.01	U	<	1.9	3.8	U	<	1.8	3.6	U	<	3.13	4.17	U	<	3.06	4.08	U	<	1.8	3.5	U
PFHpA	-	2.0	1.9	3.7	J	1.69	3.01	4.01	J	4.3	1.9	3.8		4.4	1.8	3.6		<	3.13	4.17	U	<	3.06	4.08	U	<	1.8	3.5	U
PFHpS	-	<	1.9	3.7	U	<	3.01	4.01	U	1.8	1.9	3.8	J	1.9	1.8	3.6	J	1.36	3.13	4.17	J	1.41	3.06	4.08	J	5.2	1.8	3.5	
PFHxA	-	4.6	1.9	3.7		4.32	2.01	4.01		12	1.9	3.8		12	1.8	3.6		1.79	2.09	4.17	J	1.65	2.04	4.08	J	2.1	1.8	3.5	J
PFHxS	-	64	1.9	3.7		40.7	3.01	4.01		110	1.9	3.8		110	1.8	3.6		60.1	3.13	4.17		61.9	3.06	4.08		66	1.8	3.5	
PFNA	-	<	1.9	3.7	U	<	2.01	4.01	U	<	1.9	3.8	U	<	1.8	3.6	U	<	2.09	4.17	U	<	2.04	4.08	U	<	1.8	3.5	U
PFNS	-	<	1.9	3.7	U	<	3.51	4.01	U	<	1.9	3.8	U	<	1.8	3.6	U	<	3.65	4.17	U	<	3.57	4.08	U	<	1.8	3.5	U
PFOA	70	6.7	1.9	3.7		6.02	2.01	4.01		11	1.9	3.8		11	1.8	3.6		3.07	2.09	4.17	J	3.09	2.04	4.08	J	5.0	1.8	3.5	
PFOS	70	49	1.9	3.7		34.9	2.01	4.01		54	1.9	3.8		55	1.8	3.6		26.6	2.09	4.17		27.5	2.04	4.08		30	1.8	3.5	
PFPeA	-	3.8	1.9	3.7		3.11	2.01	4.01	J	4.9	1.9	3.8		5.0	1.8	3.6		1.03	2.09	4.17	J	0.962	2.04	4.08	J	0.92	1.8	3.5	J
PFPeS	-	2.6	1.9	3.7	J	3.06	3.01	4.01	J	6.3	1.9	3.8		6.4	1.8	3.6		4.36	3.13	4.17		4.48	3.06	4.08		6.9	1.8	3.5	
PFTeDA	-	<	1.9	3.7	U	<	3.01	4.01	U	<	1.9	3.8	U	<	1.8	3.6	U	<	3.13	4.17	U	<	3.06	4.08	U	<	1.8	3.5	U
PFTrDA	-	<	1.9	3.7	U	<	3.01	4.01	U	<	1.9	3.8	U	<	1.8	3.6	U	<	3.13	4.17	U	<	3.06	4.08	U	<	1.8	3.5	U
PFUnDA	-	<	1.9	3.7	U	<	3.01	4.01	U	<	1.9	3.8	U	<	1.8	3.6	U	<	3.13	4.17	U	<	3.06	4.08	U	<	1.8	3.5	U
Total PFOA+PFOS	70	55.7	1.9			40.92	2.01			65	1.9			66	1.8			29.67	2.09			30.59	2.04			35	1.8		

Table 2-2
Residential Drinking Water Results
Site Inspection Report, Camp Ripley

Sample ID		CR-PW-03-062123				CR-PW-04-050923				CR-PW-05-050923				CR-PW-06-050923				CR-PW-07-050923				CR-PW-08-050923				CR-PW-09-050923			
Sample Date		06/21/2023				05/09/2023				05/09/2023				05/09/2023				05/09/2023				05/09/2023				05/09/2023			
Analyte	USEPA HA[a]	Result	LOD	LOQ	Qual	Result	LOD	LOQ	Qual	Result	LOD	LOQ	Qual	Result	LOD	LOQ	Qual	Result	LOD	LOQ	Qual	Result	LOD	LOQ	Qual	Result	LOD	LOQ	Qual
Water, PFAS by LCMSMS Compliant with QSM 5.3 Table B-15 (ng/L)																													
11Cl-PF3OUdS	-	<	2.06	4.12	U	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4:2 FTS	-	<	3.09	4.12	U	<	3.9	7.8	U	<	3.7	7.3	U	<	3.6	7.2	U	<	3.7	7.4	U	<	3.7	7.4	U	<	3.7	7.3	U
6:2 FTS	-	<	3.09	4.12	U	<	3.9	7.8	U	<	3.7	7.3	U	<	3.6	7.2	U	<	3.7	7.4	U	7.9	3.7	7.4		<	3.7	7.3	U
8:2 FTS	-	<	3.09	4.12	U	<	3.9	7.8	U	<	3.7	7.3	U	<	3.6	7.2	U	<	3.7	7.4	U	<	3.7	7.4	U	<	3.7	7.3	U
9Cl-PF3ONS	-	<	2.06	4.12	U	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ADONA	-	<	2.06	4.12	U	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
FOSA	-	<	2.06	4.12	U	<	2.0	3.9	U	<	1.9	3.7	U	<	1.8	3.6	U	<	1.9	3.7	U	<	1.9	3.7	U	<	1.9	3.7	U
HFPO-DA	-	<	4.12	8.24	U	<	3.9	7.8		<	3.7	7.3		<	3.6	7.2		<	3.7	7.4		<	3.7	7.4		<	3.7	7.3	
NEtFOSA	-	<	4.12	8.24	U	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
NEtFOSAA	-	<	4.12	8.24	U	<	3.9	7.8	U	<	3.7	7.3	U	<	3.6	7.2	U	<	3.7	7.4	U	<	3.7	7.4	U	<	3.7	7.3	U
N-EtFOSE	-	<	4.12	8.24	U	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
NMEFOSA	-	<	4.12	8.24	U	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
NMeFOSAA	-	<	4.12	8.24	U	<	3.9	7.8	U	<	3.7	7.3	U	<	3.6	7.2	U	<	3.7	7.4	U	<	3.7	7.4	U	<	3.7	7.3	U
NMeFOSE	-	<	4.12	8.24	U	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PFBA	-	5.08	3.60	4.12		6.5	2.0	3.9		2.0	1.9	3.7	J	20	1.8	3.6	J+	9.2	1.9	3.7		5.9	1.9	3.7		3.6	1.9	3.7	J
PFBS	-	3.08	2.06	4.12	J	<	2.0	3.9	U	<	1.9	3.7	U	<	1.8	3.6	U	3.7	1.9	3.7		1.2	1.9	3.7	J	<	1.9	3.7	U
PFDA	-	<	3.09	4.12	U	<	2.0	3.9	U	<	1.9	3.7	U	<	1.8	3.6	U	<	1.9	3.7	U	<	1.9	3.7	U	<	1.9	3.7	U
PFDoA	-	<	3.09	4.12	U	<	2.0	3.9	U	<	1.9	3.7	U	<	1.8	3.6	U	<	1.9	3.7	U	<	1.9	3.7	U	<	1.9	3.7	U
PFDS	-	<	3.09	4.12	U	<	2.0	3.9	U	<	1.9	3.7	U	<	1.8	3.6	U	<	1.9	3.7	U	<	1.9	3.7	U	<	1.9	3.7	U
PFHpA	-	<	3.09	4.12	U	<	2.0	3.9	U	<	1.9	3.7	U	<	1.8	3.6	U	3.0	1.9	3.7	J	1.5	1.9	3.7	J	<	1.9	3.7	U
PFHpS	-	5.17	3.09	4.12		<	2.0	3.9	U	<	1.9	3.7	U	<	1.8	3.6	U	<	1.9	3.7	U	<	1.9	3.7	U	<	1.9	3.7	U
PFHxA	-	2.55	2.06	4.12	J	<	2.0	3.9	U	<	1.9	3.7	U	<	1.8	3.6	U	1.8	1.9	3.7	J	7.1	1.9	3.7		<	1.9	3.7	U
PFHxS	-	60.4	3.09	4.12		<	2.0	3.9	U	<	1.9	3.7	U	<	1.8	3.6	U	<	1.9	3.7	U	8.1	1.9	3.7		<	1.9	3.7	U
PFNA	-	<	2.06	4.12	U	<	2.0	3.9	U	<	1.9	3.7	U	<	1.8	3.6	U	<	1.9	3.7	U	<	1.9	3.7	U	<	1.9	3.7	U
PFNS	-	<	3.60	4.12	U	<	2.0	3.9	U	<	1.9	3.7	U	<	1.8	3.6	U	<	1.9	3.7	U	<	1.9	3.7	U	<	1.9	3.7	U
PFOA	70	4.03	2.06	4.12	J	<	2.0	3.9	U	<	1.9	3.7	U	1.1	1.8	3.6	J	10	1.9	3.7		0.92	1.9	3.7	J	<	1.9	3.7	U
PFOS	70	20.5	2.06	4.12		<	2.0	3.9	U	<	1.9	3.7	U	<	1.8	3.6	U	<	1.9	3.7	U	2.3	1.9	3.7	J	<	1.9	3.7	U
PFPeA	-	1.05	2.06	4.12	J	<	2.0	3.9	U	<	1.9	3.7	U	0.93	1.8	3.6	J	<	1.9	3.7	U	12	1.9	3.7		<	1.9	3.7	U
PFPeS	-	6.16	3.09	4.12		<	2.0	3.9	U	<	1.9	3.7	U	<	1.8	3.6	U	<	1.9	3.7	U	1.2	1.9	3.7	J	<	1.9	3.7	U
PFTeDA	-	<	3.09	4.12	U	<	2.0	3.9	U	<	1.9	3.7	U	<	1.8	3.6	U	<	1.9	3.7	U	<	1.9	3.7	U	<	1.9	3.7	U
PFTrDA	-	<	3.09	4.12	U	<	2.0	3.9	U	<	1.9	3.7	U	<	1.8	3.6	U	<	1.9	3.7	U	<	1.9	3.7	U	<	1.9	3.7	U
PFUnDA	-	<	3.09	4.12	U	<	2.0	3.9	U	<	1.9	3.7	U	<	1.8	3.6	U	<	1.9	3.7	U	<	1.9	3.7	U	<	1.9	3.7	U
Total PFOA+PFOS	70	24.53	2.06			<	2		U	<	1.9		U	1.1	1.8			10	1.9			3.22	1.9			<	1.9		U

Table 2-2
Residential Drinking Water Results
Site Inspection Report, Camp Ripley

Sample ID		CR-PW-10-050923				CR-PW-11-050923				CR-PW-11-050923-D				CR-PW-12-050923				CR-PW-13-050923				CR-PW-13-062123				CR-PW-14-051023			
Sample Date		05/09/2023				05/09/2023				05/09/2023				05/09/2023				05/09/2023				06/21/2023				05/10/2023			
Analyte	USEPA HA[a]	Result	LOD	LOQ	Qual	Result	LOD	LOQ	Qual	Result	LOD	LOQ	Qual	Result	LOD	LOQ	Qual	Result	LOD	LOQ	Qual	Result	LOD	LOQ	Qual	Result	LOD	LOQ	Qual
Water, PFAS by LCMSMS Compliant with QSM 5.3 Table B-15 (ng/L)																													
11Cl-PF3OUdS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<	1.98	3.96	U	-	-	-	-
4:2 FTS	-	<	3.7	7.3	U	<	3.8	7.5	U	<	3.7	7.3	U	<	3.7	7.4	U	<	3.7	7.4	U	<	2.97	3.96	U	<	3.8	7.5	U
6:2 FTS	-	<	3.7	7.3	U	<	3.8	7.5	U	<	3.7	7.3	U	6.7	3.7	7.4	J	150	3.7	7.4		30.4	2.97	3.96		<	3.8	7.5	U
8:2 FTS	-	<	3.7	7.3	U	<	3.8	7.5	U	<	3.7	7.3	U	<	3.7	7.4	U	<	3.7	7.4	U	<	2.97	3.96	U	<	3.8	7.5	U
9Cl-PF3ONS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<	1.98	3.96	U	-	-	-	-
ADONA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<	1.98	3.96	U	-	-	-	-
FOSA	-	<	1.9	3.7	U	1.0	1.9	3.8	J	<	1.8	3.6	UJ	0.99	1.9	3.7	J	<	1.9	3.7	U	<	1.98	3.96	U	<	1.9	3.7	U
HFPO-DA	-	<	3.7	7.3		<	3.8	7.5		<	3.7	7.3		<	3.7	7.4		<	3.7	7.4		<	3.96	7.91	U	<	3.8	7.5	
NEtFOSA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<	3.96	7.91	U	-	-	-	-
NEtFOSAA	-	<	3.7	7.3	U	<	3.8	7.5	U	<	3.7	7.3	U	<	3.7	7.4	U	<	3.7	7.4	U	<	3.96	7.91	U	<	3.8	7.5	U
N-EtFOSE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<	3.96	7.91	U	-	-	-	-
NMEFOSA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<	3.96	7.91	U	-	-	-	-
NMeFOSAA	-	<	3.7	7.3	U	<	3.8	7.5	U	<	3.7	7.3	U	<	3.7	7.4	U	<	3.7	7.4	U	<	3.96	7.91	U	<	3.8	7.5	U
NMeFOSE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<	3.96	7.91	U	-	-	-	-
PFBA	-	1.5	1.9	3.7	J	3.5	1.9	3.8	J	3.7	1.8	3.6		23	1.9	3.7		16	1.9	3.7		7.26	3.46	3.96		4.6	1.9	3.7	
PFBS	-	<	1.9	3.7	U	<	1.9	3.8	U	<	1.8	3.6	U	11	1.9	3.7		7.5	1.9	3.7		5.25	1.98	3.96		<	1.9	3.7	U
PFDA	-	<	1.9	3.7	U	<	1.9	3.8	U	<	1.8	3.6	U	<	1.9	3.7	U	<	1.9	3.7	U	<	2.97	3.96	U	<	1.9	3.7	U
PFDoA	-	<	1.9	3.7	U	<	1.9	3.8	U	<	1.8	3.6	U	<	1.9	3.7	U	<	1.9	3.7	U	<	2.97	3.96	U	<	1.9	3.7	U
PFDS	-	<	1.9	3.7	U	<	1.9	3.8	U	<	1.8	3.6	U	<	1.9	3.7	U	<	1.9	3.7	U	<	2.97	3.96	U	<	1.9	3.7	U
PFHpA	-	<	1.9	3.7	U	<	1.9	3.8	U	<	1.8	3.6	U	27	1.9	3.7		8.5	1.9	3.7		2.79	2.97	3.96	J	<	1.9	3.7	U
PFHpS	-	<	1.9	3.7	U	<	1.9	3.8	U	<	1.8	3.6	U	9.7	1.9	3.7		1.0	1.9	3.7	J	<	2.97	3.96	U	<	1.9	3.7	U
PFHxA	-	<	1.9	3.7	U	<	1.9	3.8	U	<	1.8	3.6	U	93	1.9	3.7		41	1.9	3.7		13.0	1.98	3.96		<	1.9	3.7	U
PFHxS	-	<	1.9	3.7	U	<	1.9	3.8	U	<	1.8	3.6	U	350	9.0	18		52	1.9	3.7		34.0	2.97	3.96		<	1.9	3.7	U
PFNA	-	<	1.9	3.7	U	<	1.9	3.8	U	<	1.8	3.6	U	<	1.9	3.7	U	<	1.9	3.7	U	<	1.98	3.96	U	<	1.9	3.7	U
PFNS	-	<	1.9	3.7	U	<	1.9	3.8	U	<	1.8	3.6	U	<	1.9	3.7	U	<	1.9	3.7	U	<	3.46	3.96	U	<	1.9	3.7	U
PFOA	70	<	1.9	3.7	U	<	1.9	3.8	U	<	1.8	3.6	U	47	1.9	3.7		4.7	1.9	3.7		2.67	1.98	3.96	J	<	1.9	3.7	U
PFOS	70	<	1.9	3.7	U	<	1.9	3.8	U	<	1.8	3.6	U	350	9.0	18		24	1.9	3.7		18.6	1.98	3.96		<	1.9	3.7	U
PFPeA	-	<	1.9	3.7	U	<	1.9	3.8	U	<	1.8	3.6	U	82	1.9	3.7		66	1.9	3.7		18.9	1.98	3.96		<	1.9	3.7	U
PFPeS	-	<	1.9	3.7	U	<	1.9	3.8	U	<	1.8	3.6	U	20	1.9	3.7		8.8	1.9	3.7		5.73	2.97	3.96		<	1.9	3.7	U
PFTeDA	-	<	1.9	3.7	U	<	1.9	3.8	U	<	1.8	3.6	U	<	1.9	3.7	U	<	1.9	3.7	U	<	2.97	3.96	U	<	1.9	3.7	U
PFTrDA	-	<	1.9	3.7	U	<	1.9	3.8	U	<	1.8	3.6	U	<	1.9	3.7	U	<	1.9	3.7	U	<	2.97	3.96	U	<	1.9	3.7	U
PFUnDA	-	<	1.9	3.7	U	<	1.9	3.8	U	<	1.8	3.6	U	<	1.9	3.7	U	<	1.9	3.7	U	<	2.97	3.96	U	<	1.9	3.7	U
Total PFOA+PFOS	70	<	1.9		U	<	1.9		U	<	1.8		U	397	9			28.7	1.9			21.27	1.98			<	1.9		U

Table 2-2
Residential Drinking Water Results
Site Inspection Report, Camp Ripley

Sample ID		CR-PW-15-051023				CR-PW-16-051023				CR-PW-17-051023				CR-PW-17-062123				CR-PW-18-051023				CR-PW-19-051023				CR-PW-20-051023			
Sample Date		05/10/2023				05/10/2023				05/10/2023				06/21/2023				05/10/2023				05/10/2023				05/10/2023			
Analyte	USEPA HA[a]	Result	LOD	LOQ	Qual	Result	LOD	LOQ	Qual	Result	LOD	LOQ	Qual	Result	LOD	LOQ	Qual	Result	LOD	LOQ	Qual	Result	LOD	LOQ	Qual	Result	LOD	LOQ	Qual
Water, PFAS by LCMSMS Compliant with QSM 5.3 Table B-15 (ng/L)																													
11Cl-PF3OUdS	-	-	-	-	-	-	-	-	-	-	-	-	-	<	1.99	3.98	U	-	-	-	-	-	-	-	-	-	-	-	-
4:2 FTS	-	<	3.7	7.4	U	<	3.7	7.3	U	<	3.9	7.8	U	<	2.99	3.98	U	<	3.6	7.2	U	<	3.6	7.2	U	<	3.7	7.3	U
6:2 FTS	-	<	3.7	7.4	U	55	3.7	7.3		<	3.9	7.8	U	<	2.99	3.98	U	<	3.6	7.2	U	<	3.6	7.2	U	<	3.7	7.3	U
8:2 FTS	-	<	3.7	7.4	U	<	3.7	7.3	U	<	3.9	7.8	U	<	2.99	3.98	U	<	3.6	7.2	U	<	3.6	7.2	U	<	3.7	7.3	U
9Cl-PF3ONS	-	-	-	-	-	-	-	-	-	-	-	-	-	<	1.99	3.98	U	-	-	-	-	-	-	-	-	-	-	-	-
ADONA	-	-	-	-	-	-	-	-	-	-	-	-	-	<	1.99	3.98	U	-	-	-	-	-	-	-	-	-	-	-	-
FOSA	-	<	1.9	3.7	U	<	1.8	3.6	U	<	2.0	3.9	U	<	1.99	3.98	U	<	1.8	3.6	U	<	1.8	3.6	U	<	1.8	3.6	U
HFPO-DA	-	<	3.7	7.4		<	3.7	7.3		<	3.9	7.8		<	3.98	7.96	U	<	3.6	7.2		<	3.6	7.2		<	3.7	7.3	
NEtFOSA	-	-	-	-	-	-	-	-	-	-	-	-	-	<	3.98	7.96	UJ	-	-	-	-	-	-	-	-	-	-	-	-
NEtFOSAA	-	<	3.7	7.4	U	<	3.7	7.3	U	<	3.9	7.8	U	<	3.98	7.96	U	<	3.6	7.2	U	<	3.6	7.2	U	<	3.7	7.3	U
N-EtFOSE	-	-	-	-	-	-	-	-	-	-	-	-	-	<	3.98	7.96	U	-	-	-	-	-	-	-	-	-	-	-	-
NMEFOSA	-	-	-	-	-	-	-	-	-	-	-	-	-	<	3.98	7.96	UJ	-	-	-	-	-	-	-	-	-	-	-	-
NMeFOSAA	-	<	3.7	7.4	U	<	3.7	7.3	U	<	3.9	7.8	U	<	3.98	7.96	U	<	3.6	7.2	U	<	3.6	7.2	U	<	3.7	7.3	U
NMeFOSE	-	-	-	-	-	-	-	-	-	-	-	-	-	<	3.98	7.96	U	-	-	-	-	-	-	-	-	-	-	-	-
PFBA	-	18	1.9	3.7		19	1.8	3.6		7.2	2.0	3.9		6.18	3.48	3.98		1.5	1.8	3.6	J	3.5	1.8	3.6	J	6.9	1.8	3.6	J+
PFBS	-	0.98	1.9	3.7	J	7.1	1.8	3.6		21	2.0	3.9		20.6	1.99	3.98		<	1.8	3.6	U	<	1.8	3.6	U	<	1.8	3.6	U
PFDA	-	<	1.9	3.7	U	<	1.8	3.6	U	<	2.0	3.9	U	<	2.99	3.98	U	<	1.8	3.6	U	<	1.8	3.6	U	<	1.8	3.6	U
PFDoA	-	<	1.9	3.7	U	<	1.8	3.6	U	<	2.0	3.9	U	<	2.99	3.98	U	<	1.8	3.6	U	<	1.8	3.6	U	<	1.8	3.6	U
PFDS	-	<	1.9	3.7	U	<	1.8	3.6	U	<	2.0	3.9	U	<	2.99	3.98	U	<	1.8	3.6	U	<	1.8	3.6	U	<	1.8	3.6	U
PFHpA	-	<	1.9	3.7	U	6.1	1.8	3.6		4.3	2.0	3.9		3.58	2.99	3.98	J	<	1.8	3.6	U	<	1.8	3.6	U	<	1.8	3.6	U
PFHpS	-	<	1.9	3.7	U	<	1.8	3.6	U	1.8	2.0	3.9	J	1.67	2.99	3.98	J	<	1.8	3.6	U	<	1.8	3.6	U	<	1.8	3.6	U
PFHxA	-	<	1.9	3.7	UJ	34	1.8	3.6		18	2.0	3.9		16.5	1.99	3.98		<	1.8	3.6	U	<	1.8	3.6	U	<	1.8	3.6	U
PFHxS	-	<	1.9	3.7	U	29	1.8	3.6		100	2.0	3.9		95.9	2.99	3.98		<	1.8	3.6	U	<	1.8	3.6	U	<	1.8	3.6	U
PFNA	-	<	1.9	3.7	U	<	1.8	3.6	U	<	2.0	3.9	U	<	1.99	3.98	U	<	1.8	3.6	U	<	1.8	3.6	U	<	1.8	3.6	U
PFNS	-	<	1.9	3.7	U	<	1.8	3.6	U	<	2.0	3.9	U	<	3.48	3.98	U	<	1.8	3.6	U	<	1.8	3.6	U	<	1.8	3.6	U
PFOA	70	<	1.9	3.7	U	2.5	1.8	3.6	J	6.8	2.0	3.9		5.96	1.99	3.98		<	1.8	3.6	U	<	1.8	3.6	U	2.5	1.8	3.6	J
PFOS	70	<	1.9	3.7	U	11	1.8	3.6		61	2.0	3.9		52.1	1.99	3.98		<	1.8	3.6	U	<	1.8	3.6	U	<	1.8	3.6	U
PFPeA	-	<	1.9	3.7	U	62	1.8	3.6		12	2.0	3.9		10.4	1.99	3.98		<	1.8	3.6	U	<	1.8	3.6	U	<	1.8	3.6	U
PFPeS	-	<	1.9	3.7	U	5.5	1.8	3.6		25	2.0	3.9		22.4	2.99	3.98		<	1.8	3.6	U	<	1.8	3.6	U	<	1.8	3.6	U
PFTeDA	-	<	1.9	3.7	U	<	1.8	3.6	U	<	2.0	3.9	U	<	2.99	3.98	U	<	1.8	3.6	U	<	1.8	3.6	U	<	1.8	3.6	U
PFTrDA	-	<	1.9	3.7	U	<	1.8	3.6	U	<	2.0	3.9	U	<	2.99	3.98	U	<	1.8	3.6	U	<	1.8	3.6	U	<	1.8	3.6	U
PFUnDA	-	<	1.9	3.7	U	<	1.8	3.6	U	<	2.0	3.9	U	<	2.99	3.98	U	<	1.8	3.6	U	<	1.8	3.6	U	<	1.8	3.6	U
Total PFOA+PFOS	70	<	1.9		U	13.5	1.8			67.8	2			58.06	1.99			<	1.8		U	<	1.8		U	2.5	1.8		

Table 2-2
Residential Drinking Water Results
Site Inspection Report, Camp Ripley

Sample ID		CR-PW-21-051023				CR-PW-22-051023				CR-PW-22-051023-D				CR-PW-23-051123				CR-PW-24-051123				CR-PW-25-051123				CR-PW-26-051123			
Sample Date		05/10/2023				05/10/2023				05/10/2023				05/11/2023				05/11/2023				05/11/2023				05/11/2023			
Analyte	USEPA HA[a]	Result	LOD	LOQ	Qual	Result	LOD	LOQ	Qual	Result	LOD	LOQ	Qual	Result	LOD	LOQ	Qual	Result	LOD	LOQ	Qual	Result	LOD	LOQ	Qual	Result	LOD	LOQ	Qual
Water, PFAS by LCMSMS Compliant with QSM 5.3 Table B-15 (ng/L)																													
11Cl-PF3OUdS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4:2 FTS	-	<	3.7	7.3	U	<	3.7	7.4	U	<	3.7	7.3	U	<	3.7	7.4	U	<	3.7	7.4	U	<	3.6	7.2	U	<	3.6	7.1	U
6:2 FTS	-	<	3.7	7.3	U	<	3.7	7.4	U	<	3.7	7.3	U	<	3.7	7.4	U	<	3.7	7.4	U	<	3.6	7.2	U	<	3.6	7.1	U
8:2 FTS	-	<	3.7	7.3	U	<	3.7	7.4	U	<	3.7	7.3	U	<	3.7	7.4	U	<	3.7	7.4	U	<	3.6	7.2	U	<	3.6	7.1	U
9Cl-PF3ONS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ADONA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
FOSA	-	<	1.9	3.7	U	<	1.9	3.7	U	<	1.9	3.7	U	<	1.9	3.7	U	<	1.9	3.7	U	<	1.8	3.6	U	<	1.8	3.6	U
HFPO-DA	-	<	3.7	7.3		<	3.7	7.4		<	3.7	7.3		<	3.7	7.4	U	<	3.7	7.4	U	<	3.6	7.2	U	<	3.6	7.1	U
NEtFOSA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
NEtFOSAA	-	<	3.7	7.3	U	<	3.7	7.4	U	<	3.7	7.3	U	<	3.7	7.4	U	<	3.7	7.4	U	<	3.6	7.2	U	<	3.6	7.1	U
N-EtFOSE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
NMEFOSA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
NMeFOSAA	-	<	3.7	7.3	U	<	3.7	7.4	U	<	3.7	7.3	U	<	3.7	7.4	U	<	3.7	7.4	U	<	3.6	7.2	U	<	3.6	7.1	U
NMeFOSE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PFBA	-	7.1	1.9	3.7		4.8	1.9	3.7	J+	4.9	1.9	3.7	J+	<	1.9	3.7	U	0.97	1.9	3.7	J	<	1.8	3.6	U	1.2	1.8	3.6	J
PFBS	-	<	1.9	3.7	U	<	1.9	3.7	U	<	1.9	3.7	U	0.95	1.9	3.7	J	<	1.9	3.7	U	<	1.8	3.6	U	<	1.8	3.6	U
PFDA	-	<	1.9	3.7	U	<	1.9	3.7	U	<	1.9	3.7	U	<	1.9	3.7	U	<	1.9	3.7	U	<	1.8	3.6	U	<	1.8	3.6	U
PFDoA	-	<	1.9	3.7	U	<	1.9	3.7	U	<	1.9	3.7	U	<	1.9	3.7	U	<	1.9	3.7	U	<	1.8	3.6	U	<	1.8	3.6	U
PFDS	-	<	1.9	3.7	U	<	1.9	3.7	U	<	1.9	3.7	U	<	1.9	3.7	U	<	1.9	3.7	U	<	1.8	3.6	U	<	1.8	3.6	U
PFHpA	-	<	1.9	3.7	U	<	1.9	3.7	U	<	1.9	3.7	U	<	1.9	3.7	U	<	1.9	3.7	U	<	1.8	3.6	U	<	1.8	3.6	U
PFHpS	-	<	1.9	3.7	U	<	1.9	3.7	U	<	1.9	3.7	U	<	1.9	3.7	U	<	1.9	3.7	U	<	1.8	3.6	U	<	1.8	3.6	U
PFHxA	-	<	1.9	3.7	U	<	1.9	3.7	U	<	1.9	3.7	U	<	1.9	3.7	U	<	1.9	3.7	U	<	1.8	3.6	U	<	1.8	3.6	U
PFHxS	-	0.95	1.9	3.7	J	<	1.9	3.7	U	<	1.9	3.7	U	<	1.9	3.7	U	<	1.9	3.7	U	<	1.8	3.6	U	<	1.8	3.6	U
PFNA	-	<	1.9	3.7	U	<	1.9	3.7	U	<	1.9	3.7	U	<	1.9	3.7	U	<	1.9	3.7	U	<	1.8	3.6	U	<	1.8	3.6	U
PFNS	-	<	1.9	3.7	U	<	1.9	3.7	U	<	1.9	3.7	U	<	1.9	3.7	U	<	1.9	3.7	U	<	1.8	3.6	U	<	1.8	3.6	U
PFOA	70	2.4	1.9	3.7	J	<	1.9	3.7	U	<	1.9	3.7	U	<	1.9	3.7	U	0.92	1.9	3.7	J	<	1.8	3.6	U	<	1.8	3.6	U
PFOS	70	<	1.9	3.7	U	<	1.9	3.7	U	<	1.9	3.7	U	<	1.9	3.7	U	<	1.9	3.7	U	<	1.8	3.6	U	<	1.8	3.6	U
PFPeA	-	<	1.9	3.7	U	<	1.9	3.7	U	<	1.9	3.7	U	<	1.9	3.7	U	<	1.9	3.7	U	<	1.8	3.6	U	<	1.8	3.6	U
PFPeS	-	<	1.9	3.7	U	<	1.9	3.7	U	<	1.9	3.7	U	<	1.9	3.7	U	<	1.9	3.7	U	<	1.8	3.6	U	<	1.8	3.6	U
PFTeDA	-	<	1.9	3.7	U	<	1.9	3.7	U	<	1.9	3.7	U	<	1.9	3.7	U	<	1.9	3.7	U	<	1.8	3.6	U	<	1.8	3.6	U
PFTrDA	-	<	1.9	3.7	U	<	1.9	3.7	U	<	1.9	3.7	U	<	1.9	3.7	U	<	1.9	3.7	U	<	1.8	3.6	U	<	1.8	3.6	U
PFUnDA	-	<	1.9	3.7	U	<	1.9	3.7	U	<	1.9	3.7	U	<	1.9	3.7	U	<	1.9	3.7	U	<	1.8	3.6	U	<	1.8	3.6	U
Total PFOA+PFOS	70	2.4	1.9			<	1.9		U	<	1.9		U	<	1.9		U	0.92	1.9			<	1.8		U	<	1.8		U

Table 2-2
Residential Drinking Water Results
Site Inspection Report, Camp Ripley

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

J+ = Estimated concentration, biased high

U = The analyte was not detected at a level greater than or equal to the LOD

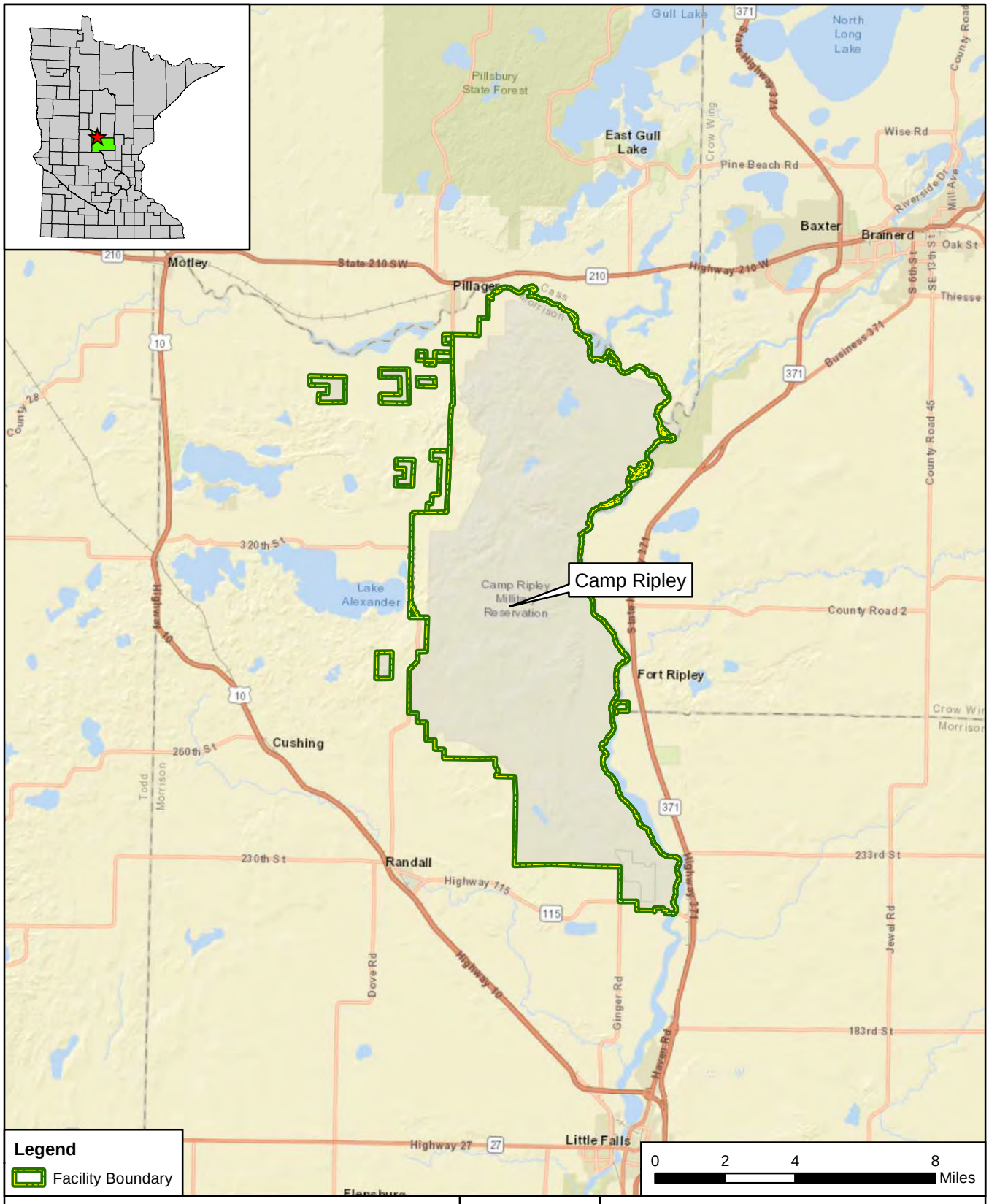
UJ = The analyte was not detected at a level greater than or equal to the adjusted LOD. However, the reported adjusted LOD is approximate and may be inaccurate or imprecise.

Acronyms and Abbreviations

CR	Camp Ripley
D	Duplicate
HA	Health Advisory
ID	identification
LCMSMS	Liquid Chromatography Mass Spectrometry
LOD	Limit of Detection
LOQ	Limit of Quantitation
PFAS	per- and polyfluoroalkyl substances
PW	potable well
QSM	Quality Systems Manual
Qual	Interpreted Qualifier
USEPA	United States Environmental Protection Agency
ng/l	nanogram per liter
-	Not applicable
<	analyte not detected above the LOD

Chemical Abbreviations

11Cl-PF3OUdS	11-Chloroeicosafluoro-3-oxaundecane-1-sulfonic acid
4:2 FTS	4:2 fluorotelomer sulfonate
6:2 FTS	6:2 fluorotelomer sulfonate
8:2 FTS	8:2 fluorotelomer sulfonate
9Cl-PF3ONS	9-Chlorohexadecafluoro-3-oxanonane-1-sulfonic acid
ADONA	4,8-dioxa-3H-perfluorononanoate
FOSA	Perfluorooctane sulfonamide
HFPO-DA	Hexafluoropropylene oxide dimer acid
NEtFOSA	N-ethyl perfluorooctane sulfonamide
NEtFOSAA	2-(N-Ethylperfluorooctanesulfonamido) acetic acid
N-EtFOSE	N-ethyl perfluorooctane sulfonamido ethanol
NMEFOSA	N-methyl perfluorooctane sulfonamide
NMeFOSAA	N-methyl perfluorooctanesulfonamidoacetic acid
NMeFOSE	N-methyl perfluorooctane sulfonamido ethanol
PFBA	perfluorobutanoic acid
PFBS	perfluorobutanesulfonic acid
PFDA	perfluorodecanoic acid
PFDoA	perfluorododecanoic acid
PFDS	perfluorodecanesulfonic acid
PFHpA	perfluoroheptanoic acid
PFHpS	perfluoroheptanesulfonic 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
PFTeDA	perfluorotetradecanoic acid
PFTrDA	perfluorotridecanoic acid
PFUnDA	perfluoro-n-undecanoic acid

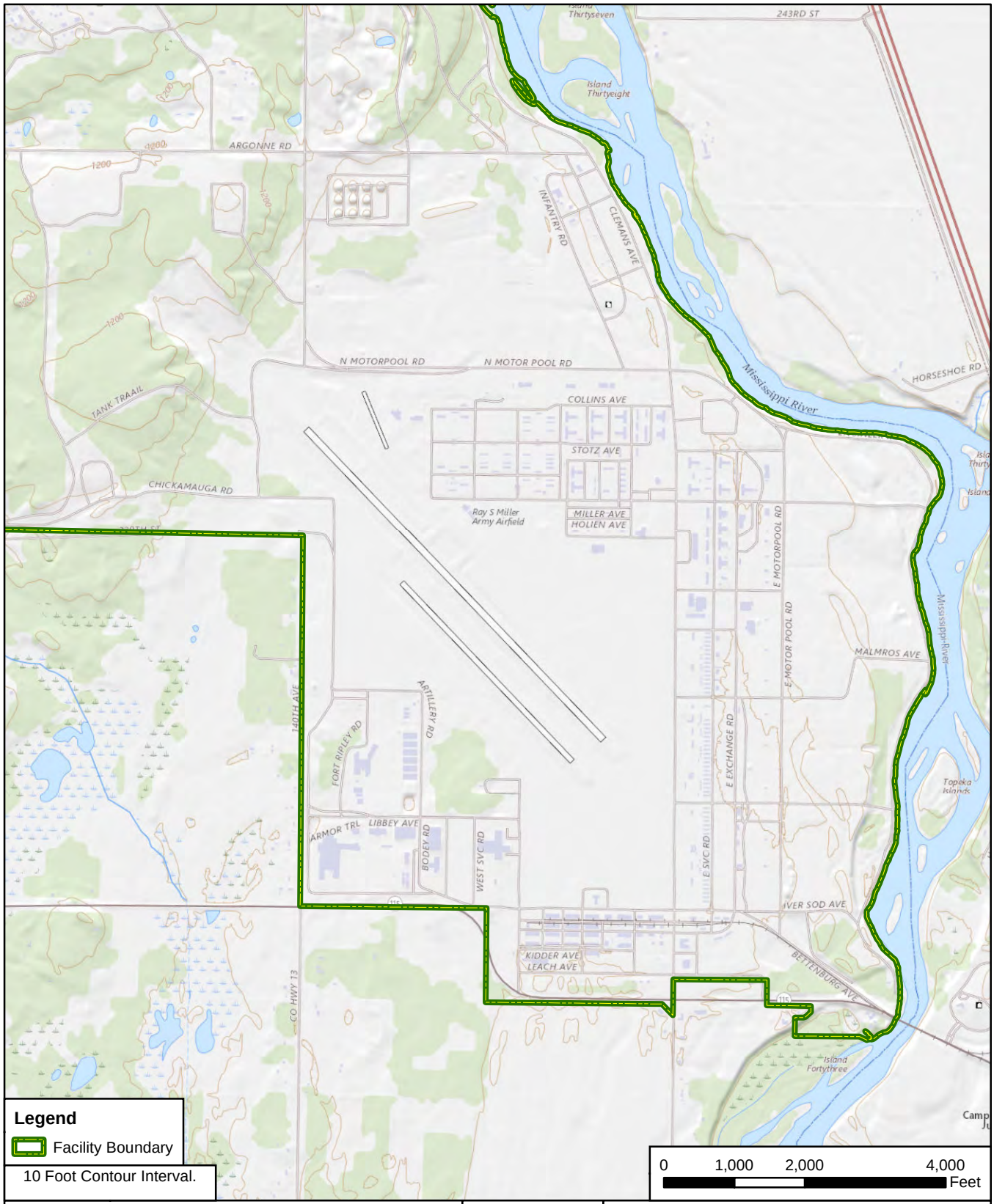


CLIENT	ARNG			
PROJECT	Site Inspection at Camp Ripley, MN			
REVISED	11/1/2022	GIS BY	MS	11/1/2022
SCALE	1:253,440	CHK BY	GR	11/1/2022
Base Map: Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI,		PM	CM	11/1/2022

Facility Location

AECOM
12420 Milestone Center Drive
Germantown, MD 20876

Figure 2-1

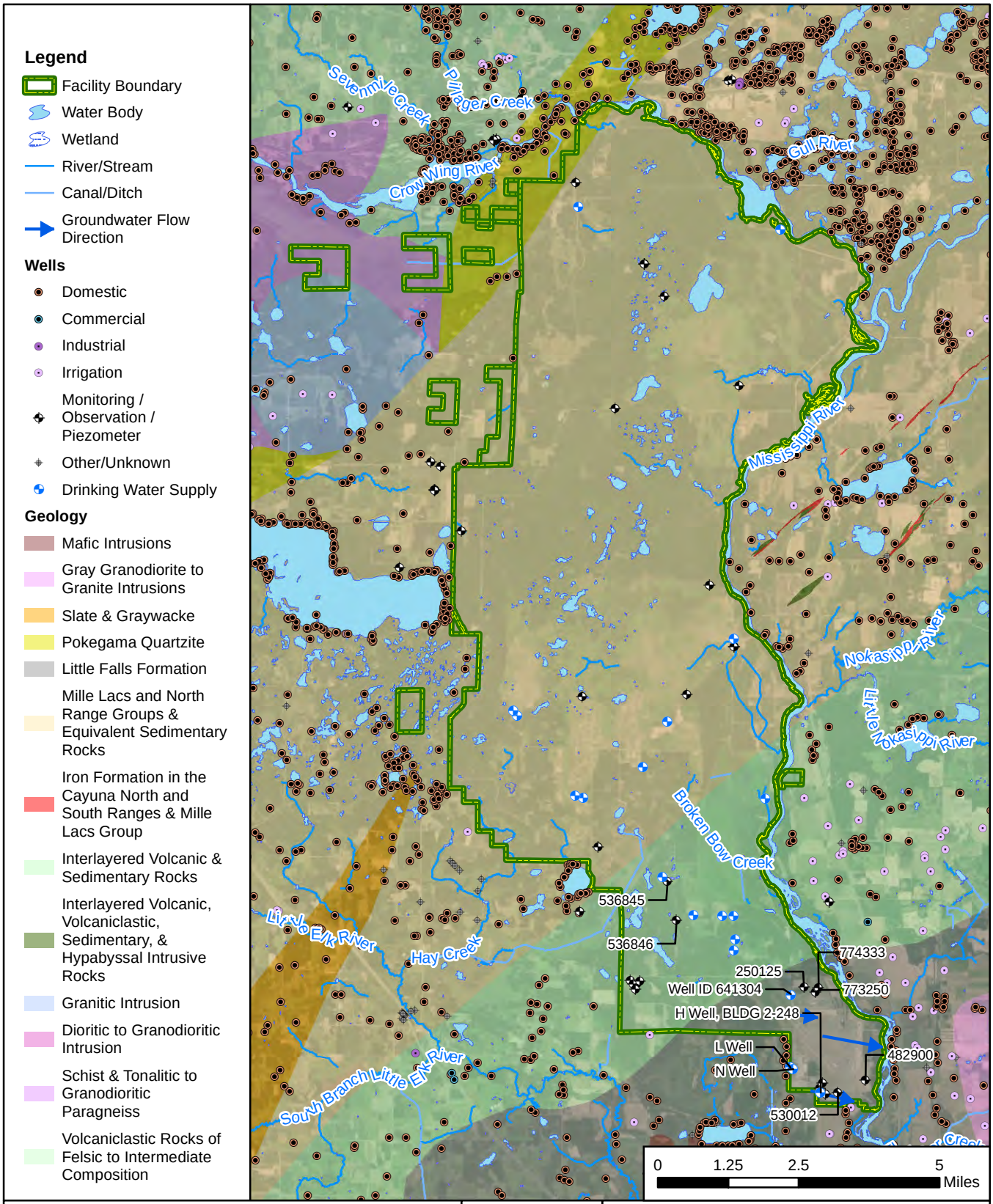


CLIENT	ARNG			
PROJECT	Site Inspection at Camp Ripley, MN			
REVISED	9/1/2023	GIS BY	MS	9/1/2023
SCALE	1:24,000	CHK BY	GR	9/1/2023
Base Map: USGS The National Map: National Boundaries Dataset, 3DEP Elevation Program,		PM	CM	9/1/2023

Facility Topography

AECOM
12420 Milestone Center Drive
Germantown, MD 20876

Figure 2-2



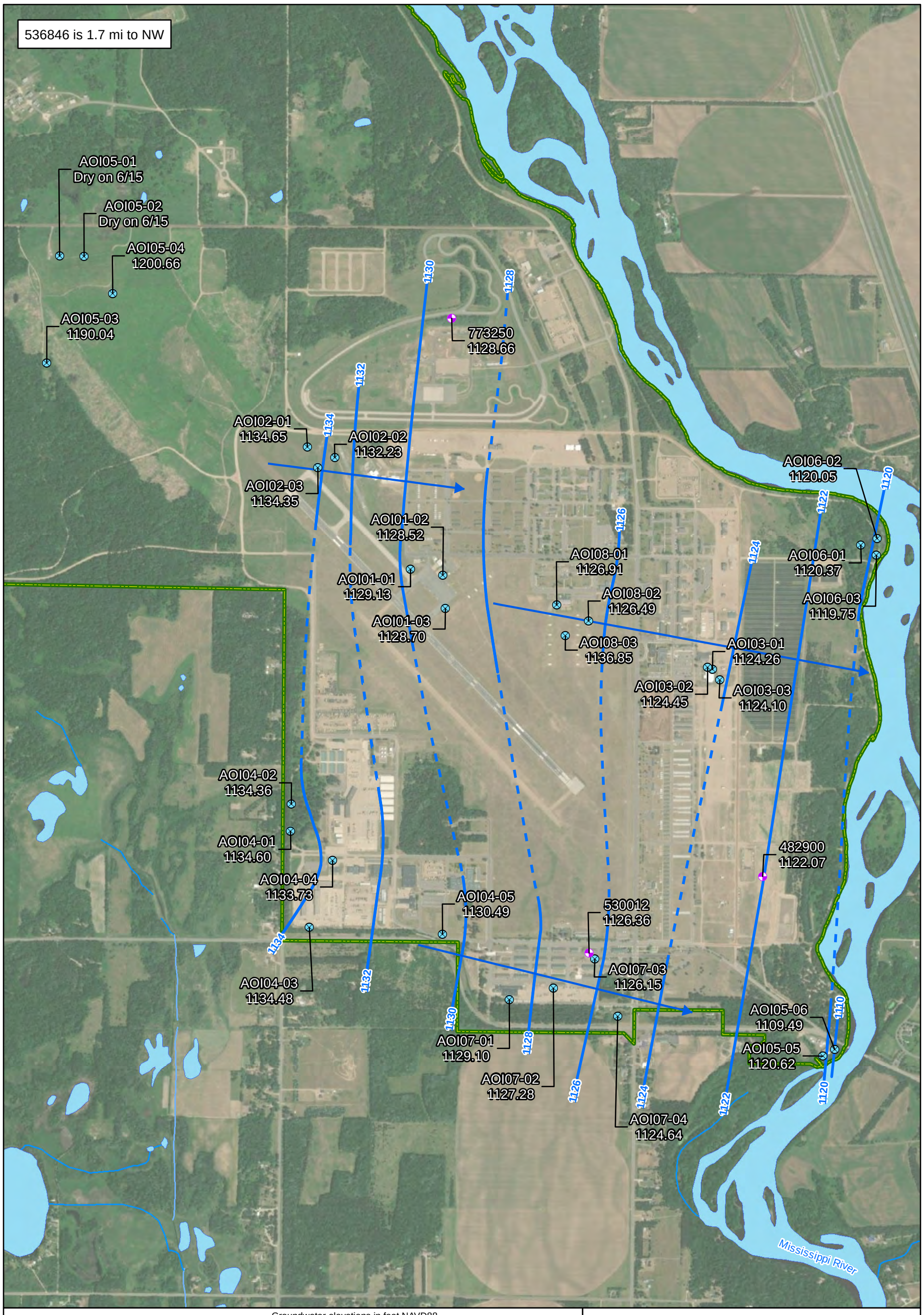
CLIENT	ARNG			
PROJECT	Site Inspection at Camp Ripley, MN			
REVISED	6/16/2023	GIS BY	MS	6/16/2023
SCALE	1:158,400	CHK BY	GR	6/16/2023
Base Map: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community		PM	CM	6/16/2023

N

Groundwater Features

AECOM
12420 Milestone Center Drive
Germantown, MD 20876

Figure 2-3



Groundwater elevations in feet NAVD88.

Existing permanent well AOI05-536846 is located a significant distance from the rest of the wells and thus was not included in groundwater contours.

Wells AOI05-01 and AOI05-02 were dry during the synoptic gauging event on 15 June 2022 and thus were not included.

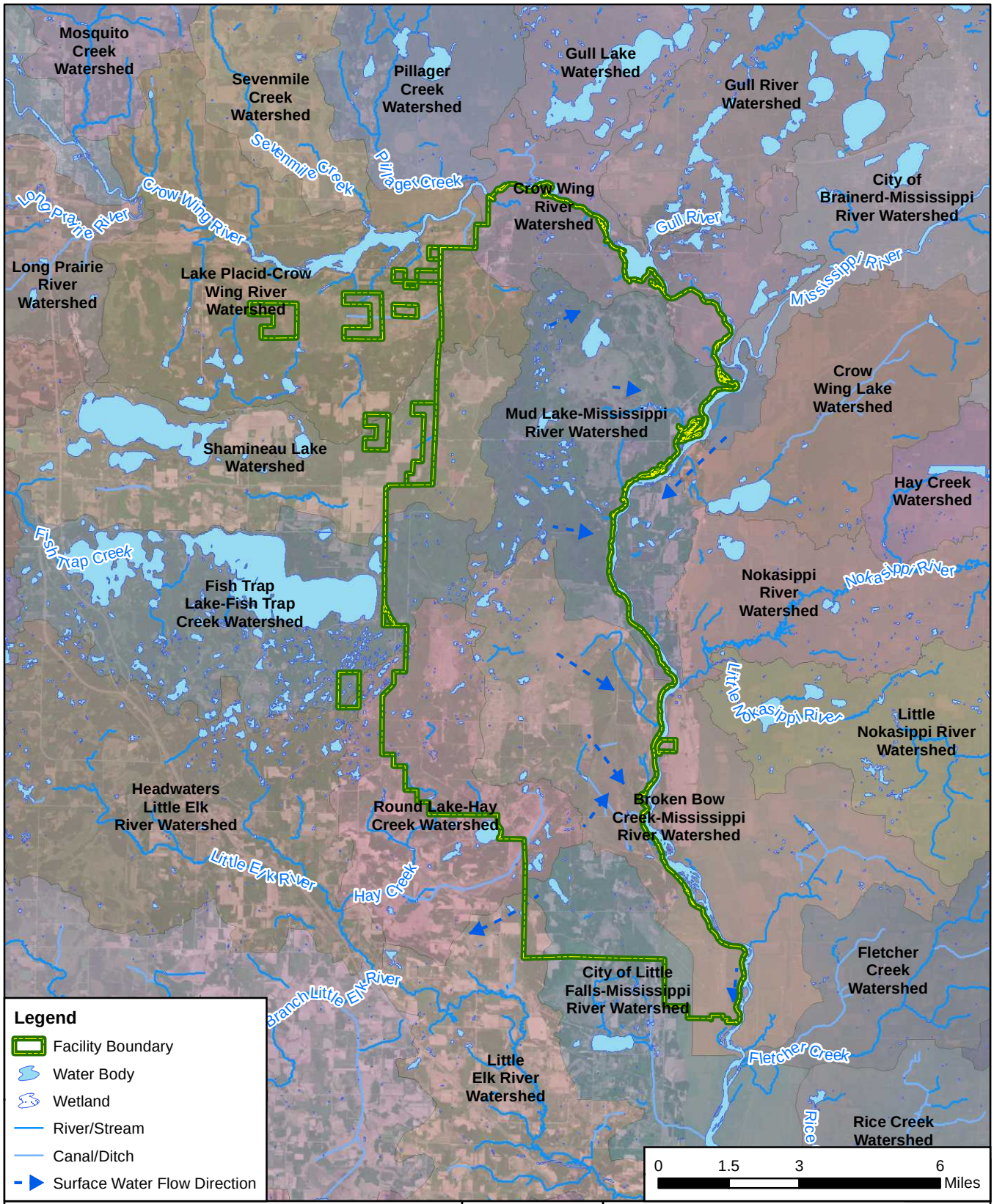
Wells AOI05-01 and AOI05-02 were dry during the synoptic gauging event on 15 June 2022 and thus are not shown. Depth to water measurements collected at AOI 5 were much shallower than the rest of the cantonment area, so AOI 5 was interpreted to be in a zone of perched groundwater. Additionally, there are not enough data points in AOI 5 to establish separate contours for this area.

Groundwater Elevations, June 2022

CLIENT	ARNG			
PROJECT	Site Inspection at Camp Ripley, MN			
REVISED	5/17/2023	GIS BY	MS	5/17/2023
SCALE	1:17,400	CHK BY	EB	5/17/2023
Base Map: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community		PM	CM	5/17/2023

AECOM
12420 Milestone Center Drive
Germantown, MD 20876

Figure 2-4



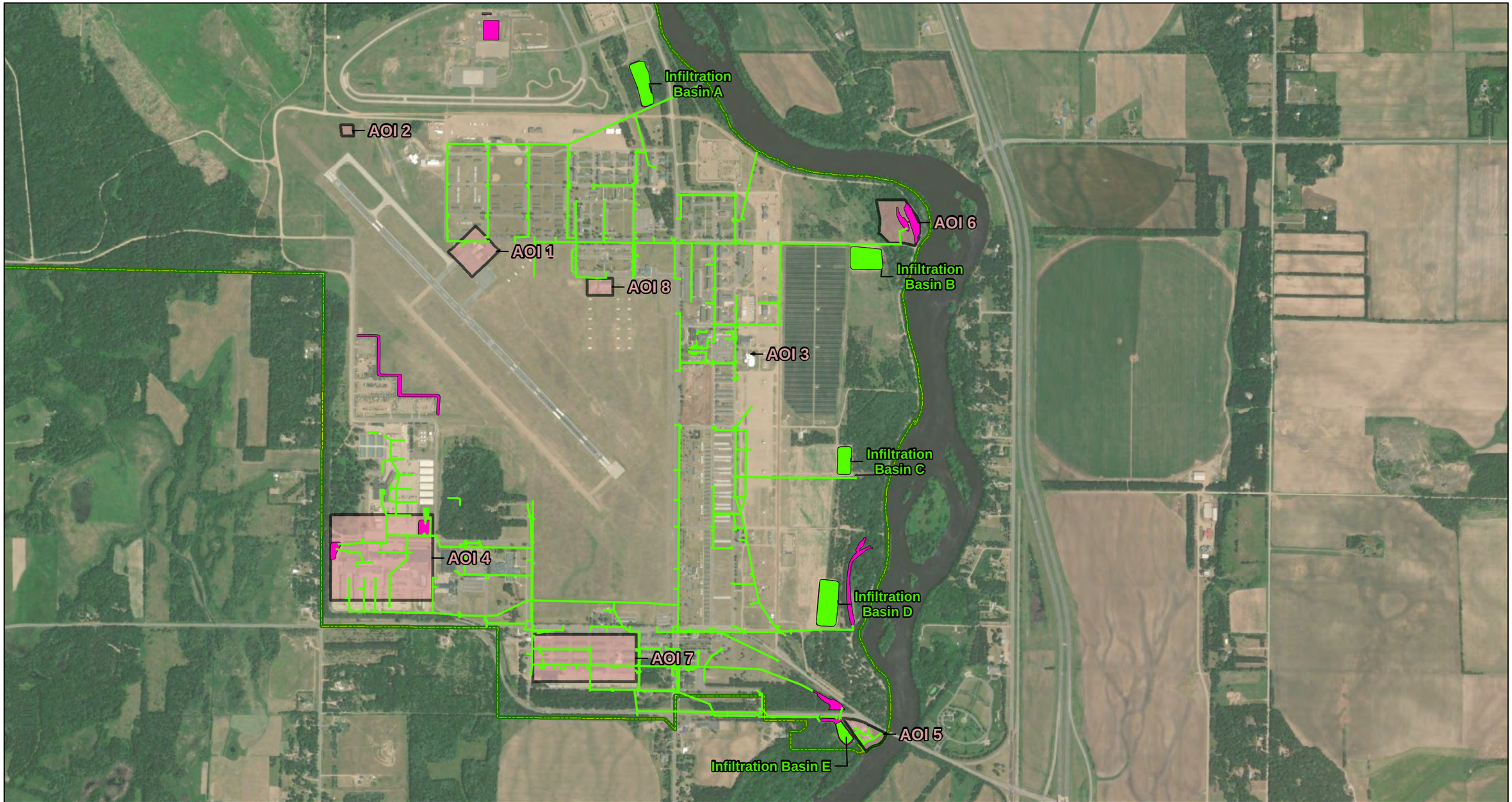
CLIENT	ARNG			
PROJECT	Site Inspection at Camp Ripley, MN			
REVISED	11/1/2022	GIS BY	MS	11/1/2022
SCALE	1:190,080	CHK BY	GR	11/1/2022
Base Map: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community		PM	CM	11/1/2022

N

Surface Water Features

AECOM
12420 Milestone Center Drive
Germantown, MD 20876

Figure 2-5



CLIENT	ARNG			
PROJECT	Site Inspection at Camp Ripley, MN			
REVISED	6/14/2023	GIS BY	MS	6/14/2023
SCALE	1:17,416	CHK BY	EB	6/14/2023
Base Map: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community		PM	CM	6/14/2023

Area of Interest
Facility Boundary
Stormwater Drainage Network
Existing Stormwater Retention Basin
Stormwater Infiltration Basin installed after 2009

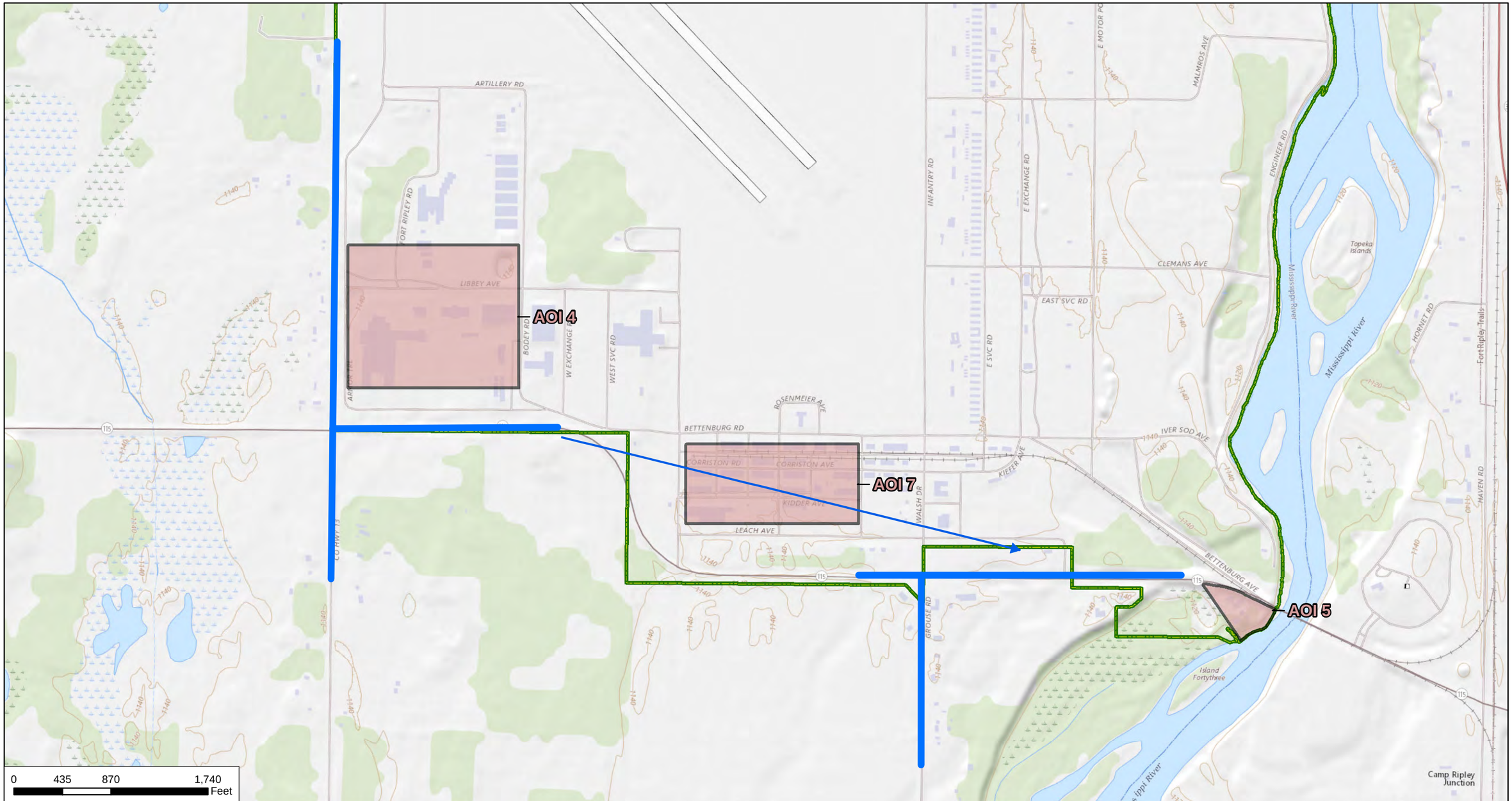
AOI 5 Sludge Spread Site not visible within map extent
All Stormwater Infiltration Basins depicted are approximate locations of drainage areas. Please do not use them for any types of calculations

N

Stormwater Drainage Network

AECOM
12420 Milestone Center Drive
Germantown, MD 20876

Figure 2-6



CLIENT	ARNG			
PROJECT	Site Inspection at Camp Ripley, MN			
REVISED	9/12/2023	GIS BY	MS	9/12/2023
SCALE	1:10,440	CHK BY	GR	9/12/2023
Base Map: USGS The National Map: National Boundaries Dataset, 3DEP Elevation Program, Geographic Names Information System, National Hydrography Dataset,		PM	CM	9/12/2023

Legend

- Drinking Water Sampling Area
- Area of Interest
- Facility Boundary
- Groundwater Flow Direction

N

Drinking Water Results

AECOM
12420 Milestone Center Drive
Germantown, MD 20876

Figure 2-7

THIS PAGE INTENTIONALLY BLANK

3. Summary of Areas of Interest

The PA evaluated areas where PFAS-containing materials may have been used, disposed, or released historically. After the Final PA Report was issued, ARNG adopted a more conservative policy to investigate AFFF storage and use areas where no previous releases were reported; thus, two additional AOIs were added after the PA. A total of 14 potential release areas were identified at Camp Ripley and grouped into eight AOIs (AECOM, 2022a). The potential release areas are shown on **Figure 3-1**.

3.1 AOI 1 TriMax™ Discharge Area and Building 8-197

AOI 1 is the TriMax™ Discharge Area and the Fire Station (Building 8-197). A potential PFAS release to soil occurred in the early 2000s, when a TriMax™-30 fire extinguisher was discharged to the ground. Interviewees were unsure whether the fire extinguisher that was discharged contained AFFF or was a training fire extinguisher.

Camp Ripley Fire and Emergency Services has three firetrucks and three all-terrain vehicles, all with AFFF capability in the Fire Station (Building 8-197). Nozzle testing has not been conducted at Camp Ripley, and the firetrucks are washed at the current Fire Station (Building 8-197). Wash water is discharged to a stormwater drain. No information regarding the concentration or type of AFFF potentially discharged was available.

3.2 AOI 2 Burn Pit Fire Training Area

AOI 2 is the Burn Pit fire training area (FTA). A single coordinated fire training event was identified during the PA. The event occurred at the Burn Pit FTA, in the late 1980s, between the MNARNG and the US Air Force (USAF) 133rd Airlift Wing from Minneapolis. The burn pit may have been used for coordinated fire training exercises on multiple occasions; however, additional uses were not confirmed during the PA process.

3.3 AOI 3 DHS Demonstration

AOI 3 is the Department of Homeland Security (DHS) Demonstration at the Emergency Management Training Center (EMTC). A coordinated fire training event between DHS, MNARNG, and local municipalities occurred in November 2014 using approximately one gallon of AFFF concentrate and 100 gallons of water. Camp Ripley Fire and Emergency Services personnel indicated that not all the foam mixture was used during the event; however, the final disposition of the remaining foam mixture could not be determined during the PA process.

3.4 AOI 4 USFPO Warehouse, CMA Shop, and CMA Discharge Area

AOI 4 consists of the US Property and Fiscal Office (USPFO) warehouse, Combined Maintenance Activity (CMA) Shop, and CMA Discharge Area. Unused or expired fire equipment from MNARNG facilities is shipped to the USPFO warehouse at Camp Ripley. At the time of the PA, the fire equipment, including TriMax™ fire extinguishers, was stored and/or processed at the USPFO prior to reutilization or disposition. According to USPFO warehouse personnel interviews conducted during the PA, TriMax™ fire extinguishers have been returned to the warehouse for disposition. Seven TriMax™ fire extinguishers from the Holman Field Army Aviation Support Facility (AASF) in St. Paul, Minnesota were received empty, nine TriMax™ fire extinguishers from the St. Cloud AASF containing AFFF were received full and are at the warehouse, and six to

seven units from Camp Ripley were received, but it was unknown if the units were received full or emptied at the airfield.

Due to the presence of compressed gas cylinders, TriMax™ fire extinguishers must be demilitarized prior to final disposition. Demilitarization of the TriMax™ fire extinguishers requires the equipment to be physically destroyed by the CMA Shop. For demilitarization, the USPFO equipment specialist furnishes special instructions regarding the degree of physical destruction of the equipment to the CMA. According to CMA interviewees, AFFF was dispensed and allowed to dissipate to the ground surface by the MNARNG during demilitarization of a TriMax™-30 fire extinguisher in approximately 2010. The discharge area is in proximity to up-and side-gradient onsite drinking water supply wells L Well and N Well, as well as downgradient onsite drinking water supply well H Well. These drinking water supply wells are in operation. As of June 2021, the facility processes the TriMax™ units by draining and triple rinsing. The solution and rinsate are handled and managed in accordance with Camp Ripley/Defense Logistics Agency guidelines and stored in the CMA Shop hazardous waste storage room.

3.5 AOI 5 Wastewater Treatment Plant and Sludge Spread Site

AOI 5 consists of two related but non-collocated areas: the WWTP located in the southeast of the facility adjacent to the Mississippi River and the Sludge Spread Site northwest of the cantonment area. These two areas were grouped as AOI 5 due to a shared source of potential PFAS impacts. Camp Ripley has been permitted to perform land application of sludge from the WWTP at the Sludge Spread Site since 1987. Because the WWTP does not contain a treatment system for PFAS, it is possible that land application of sludge containing PFAS occurred at the Sludge Spread Site. The Sludge Spread Site is located upgradient at an elevation approximately 60 feet above AOI 1.

3.6 AOI 6 Stormwater Infiltration Basin

AOI 6 is a stormwater infiltration basin located in the northeast portion of the facility adjacent to the Mississippi River. AOI 6 receives stormwater from the northeast portion of the cantonment area to include stormwater from the practical fire training exercises that occurred at the EMTC (AOI 3) in November 2014. Camp Ripley Fire and Emergency Services personnel indicated that not all of the foam mixture was used during the exercises; however, the final disposition of the remaining foam mixture was likely disposed of in the stormwater sewer system, which drains to a stormwater infiltration basin. The EMTC fire training exercise area (AOI 3), stormwater sewer, and stormwater infiltration basin are all located within the cantonment area.

3.7 AOI 7 Buildings 2-166, 2-203, 2-223, and 2-272

AOI 7 consists of four potential release areas, as described below.

3.7.1 Building 2-166

The MNARNG 434th Support Maintenance Company, established in 2010, trains with Camp Ripley Fire and Emergency Services and assists in fire emergency response at Camp Ripley. The 434th stores three firetrucks with AFFF capacity at the old Combined Support Maintenance Shop (CSMS) (Building 2-166). Additionally, significant vehicle maintenance for current or previous fire support vehicles would have been performed at Building 2-166. Details regarding the type of AFFF were not available for review; however, the AFFF is being considered as PFAS-containing.

3.7.2 Building 2-203

The City of Randall, approximately 8 miles west of Camp Ripley, provided fire emergency response for structural fires in the cantonment area at Camp Ripley from the 1970s until 2010. From the 1970s until the 1980s, in the event of a fire emergency at the facility, the City of Randall utilized two firetrucks owned by Camp Ripley and stored at Building 2-203 for firefighting. No information was available regarding whether the firetrucks stored at Building 2-203 were washed or whether the firetrucks had maintenance issues; however, it was noted that nozzle testing was not conducted with AFFF. Building 2-203 had floor drains plumbed to an oil-water separator, which routed to the sanitary sewer and the WWTP at Camp Ripley.

3.7.3 Building 2-223

At the time of the PA, Bulk AFFF was stored in the State Warehouse (Building 2-223) and transferred to Camp Ripley firetrucks at the Fire Station (Building 8-197, AOI 1) on an as-needed basis. According to the purchasing supervisor, AFFF was last ordered in 2011. During the PA site visit in 2018, approximately 300- gallons of Ansul® 3% AFFF and 55 gallons of Phos-Chek® Class A foam were observed at Building 2-223.

3.7.4 Building 2-272

According to the retired City of Randall Fire Chief, Camp Ripley did not start using or storing AFFF until the 1980s. Bulk AFFF and the crash rescue truck were stored in the west bay of Building 2-272 to support operations. At the time of the PA, the roads and grounds supervisor at Building 2-272 did not recall training with AFFF, truck washing, or maintenance issues with the USAF's firetruck. The crash rescue truck was returned to Minneapolis along with USAF's 133rd Airlift Wing each spring; however, the bulk AFFF, which belonged to Camp Ripley, remained stored in Building 2-272. No information was available on the amount, type, or concentration of AFFF stored in Building 2-272 at the time of the PA. Floor drains in Building 2-272 are connected to the sanitary sewer.

3.8 AOI 8 Building 8-195

AOI 8 is Building 8-195. A large crash rescue truck was brought to the facility by the Airfield Fire Chief and stored in the old hangar (Building 8-195) following airfield re-paving in 1986-1987. Additionally, during winter operations, volunteers would standby with this crash rescue truck at Building 8-195 during incoming flights. The lead mechanic at the old hangar (Building 8-195) did not recall any maintenance issues with this crash rescue firetruck; however, he did indicate that any serious maintenance issues would have required repair at the CSMS (Building 2-166). It is unclear if the truck had AFFF capability. Building 8-195 was renovated in 2010 and is currently a Morale Welfare Recreation facility.

3.9 Adjacent Sources

Four off-facility, potential sources were identified adjacent to Camp Ripley during the PA and are not associated with MNARNG activities. The adjacent potential sources are shown on **Figure 3-1** and described in the following sections for informational purposes only and will not be investigated as part of this SI.

3.9.1 Coal Train Collision

On 14 June 1984 two Burlington Northern Railroad Company coal trains collided head-on in a wooded area near Motley, Minnesota, approximately one mile south of the intersection of Highway

210 and Bridgeman Road in May Township. The geographic coordinates of the collision are 46°19'22.1"N and 94°34'46.9"W (**Figure 3-1**). A massive fire resulted from the collision, and approximately 100 gallons of AFFF concentrate were taken from Camp Ripley by firefighters from the Cities of Motley, Staples, and Pillager to extinguish the fire. Motley is approximately 30 miles north of Camp Ripley.

3.9.2 Fuel Tanker Accident

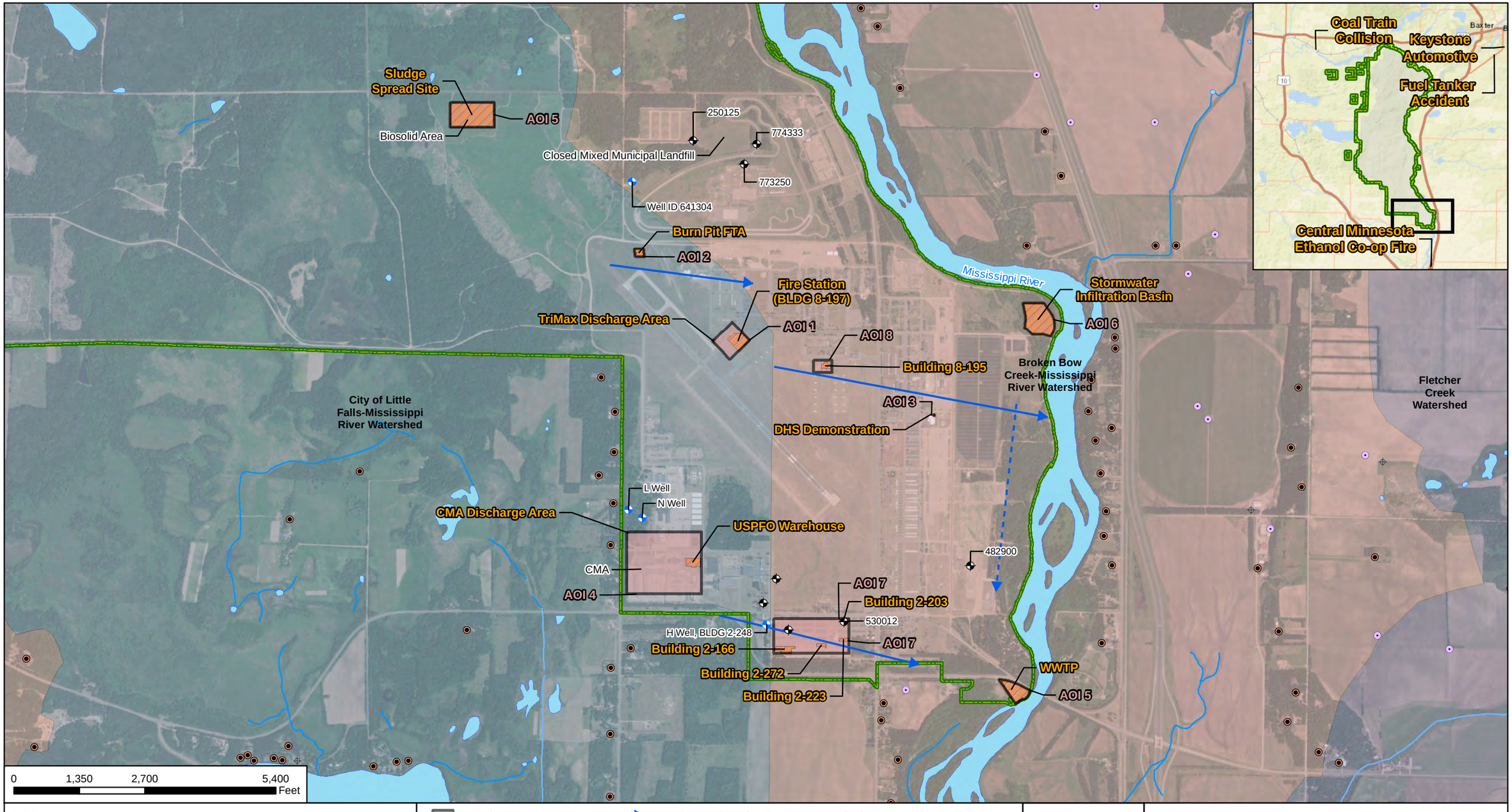
According to interviewees, a fuel tanker rolled over on Highway 371 near Brainerd, Minnesota sometime in the 1990s. The fuel tanker did not catch fire; however, AFFF was dispensed to smother the fuel vapors. Approximately 100 gallons of AFFF concentrate were taken from Camp Ripley for this emergency event. The exact location of the fuel tanker rollover could not be determined. Brainerd is approximately 25 miles north of Camp Ripley.

3.9.3 Central Minnesota Ethanol Cooperative Fire

On 29 October 2007, smoldering wood chips in a gasification silo at the Central Minnesota Ethanol Cooperative (also referred to as “Co-op”) caused the roof of the silo to explode and collapse. Approximately 300 gallons of alcohol-resistant AFFF (AR-AFFF) concentrate were taken from Camp Ripley by the Little Falls Fire Department to respond to the emergency event. The Central Minnesota Ethanol Co-op is about 5 miles south of Camp Ripley. The geographic coordinates are 46°01'16.0"N; 94°20'20.8"W (**Figure 3-1**).

3.9.4 Keystone Automotive

One additional source of PFAS was identified in a report by Delta Consultants titled *Perfluorocarbon-Containing Firefighting Foams and Their Use in Minnesota: Keystone Automotive* (Delta Consultants, 2010). Keystone Automotive is a chrome plating operation in nearby Brainerd, Minnesota (**Figure 3-1**). Historically, Keystone Automotive used Fumetrol™ 140 Mist Suppressant to reduce surface tension in chrome plating baths and reduce emissions of hexavalent chromium from the plating solution. Fumetrol™ 140 Mist Suppressant contains PFAS between 1% and 7% by weight. The company reportedly used approximately 30 gallons per year of the solution before switching to a different mist suppressant in September 2007 (US Health and Human Services, 2008). Brainerd is approximately 25 miles north of Camp Ripley.



CLIENT	ARNG			
PROJECT	Site Inspection at Camp Ripley, MN			
REVISED	5/15/2023	GIS BY	MS	5/15/2023
SCALE	1:24,000	CHK BY	GR	5/15/2023
Base Map: Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c)		PM	CM	5/15/2023

Areas of Interest

AECOM
12420 Milestone Center Drive
Germantown, MD 20876

Figure 3-1

THIS PAGE INTENTIONALLY BLANK

4. Project Data Quality Objectives

As identified during the Data Quality Objective (DQO) process and outlined in the Final SI Uniform Federal Policy Quality Assurance Project Plan (UFP-QAPP) Addendum (AECOM, 2022a), the objective of the SI is to identify whether there has been a release to the environment at the AOIs identified in the PA. For each AOI, ARNG determines if further investigation is warranted, a removal action is required to address immediate threats, or whether no further action is warranted. This SI evaluated groundwater and soil for presence or absence of relevant compounds at each of the sampled AOIs.

4.1 Problem Statement

ARNG will recommend an AOI for Remedial Investigation (RI) if related soil and groundwater samples have concentrations of the relevant compounds above the OSD risk-based SLs. The SLs are presented in **Section 6.1** of this report.

4.2 Information Inputs

Primary information inputs included:

- The PA for Camp Ripley (AECOM, 2019);
- Analytical data from groundwater and soil samples collected as part of this SI in accordance with the site-specific UFP-QAPP Addendum (AECOM, 2022a); and
- Field data collected during the SI, including groundwater elevation and water quality parameters measured at the time of sampling.

4.3 Study Boundaries

The scope of the SI was bounded by the property limits of the facility (**Figure 2-2**). Off-facility sampling was not included in the scope of this SI. If future off-facility sampling is required, the proper stakeholders will be notified, and necessary rights of entry will be obtained by ARNG with property owner(s). The scope of the SI was vertically bounded by depth to groundwater, with a maximum drilled depth of 25 feet bgs. Temporal boundaries were limited to the summer season due to climate and field resource availability.

4.4 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 within this document and decision rules as defined in the SI QAPP Addendum (AECOM, 2022a).

4.5 Data Usability Assessment

The Data Usability Assessment (DUA), which includes the Data Validation Report (DVR), is provided as **Appendix A.** The 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, 2017).

Based on the DUA, the environmental data collected during the SI were found to be acceptable and usable for this SI evaluation with the qualifications documented in the DUA and its associated data validation reports. These data are of sufficient quality to meet the objectives and requirements of the SI QAPP Addendum (AECOM, 2022a).

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 Site Inspection Programmatic Uniform Federal Policy-Quality Assurance Project Plan (PQAPP)* dated March 2018 (AECOM, 2018a);
- *Final Programmatic Accident Prevention Plan* dated July 2018 (AECOM, 2018b);
- *Final Preliminary Assessment Report, Camp Ripley, Little Falls, Minnesota* dated November 2019 (AECOM, 2019);
- *Final Site Inspection Uniform Federal Policy-Quality Assurance Project Plan Addendum, Camp Ripley, Little Falls, Minnesota* dated March 2022 (AECOM, 2022a); and
- *Final Site Safety and Health Plan, Camp Ripley, Little Falls, Minnesota* dated June 2022 (AECOM, 2022b).

The SI field activities were conducted from 6 to 17 June 2022 and consisted of utility clearance, direct push boring, soil sample collection, temporary monitoring well installation, grab groundwater sample collection, synoptic gauging, temporary well abandonment, and land surveying. Field activities were conducted in accordance with the SI QAPP Addendum (AECOM, 2022a), except as noted in **Section 5.9**.

The following samples were collected during the SI and analyzed for a subset of 18 compounds by liquid chromatography with tandem mass spectrometry (LC/MS/MS) compliant with Quality Systems Manual (QSM) 5.3 Table B-15 to fulfill the project DQOs:

- Eighty-eight (88) soil samples from 32 boring locations;
- Twenty-nine (29) grab groundwater samples from 30 temporary well locations;
- Four (4) grab groundwater samples from four existing permanent wells;
- Thirty-five (35) quality assurance (QA)/quality control (QC) samples.

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**. Sampling forms are provided in **Appendix B2**, Field Change Request forms are provided in **Appendix B3**, land survey data are provided in **Appendix B4**, and investigation-derived waste (IDW) polygons are provided in **Appendix B5**. 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 US Army Corps of Engineers (USACE) TPP Process, Engineer Manual (EM) 200-1-2 (USACE, 2016) defines four phases to project planning: 1.) defining the project phase; 2.)

determining data needs; 3.) developing data collection strategies; and 4.) finalizing the data collection plan. The process encourages stakeholder involvement in the SI, beginning with defining overall project objectives, including DQOs, and formulating a sampling approach to address the AOIs identified in the PA.

A combined TPP Meeting 1 and 2 was held on 17 December 2021, prior to SI field activities. The combined TPP Meeting 1 and 2 was conducted in general accordance with EM 200-1-2. The stakeholders for this SI include the ARNG G-9, MNARNG, USACE, Minnesota Pollution Control Agency, AECOM, and representatives familiar with the facility, the regulations, and the community. 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, 2022a).

A TPP Meeting 3 was held on 4 August 2023 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

AECOM's drilling subcontractor, Cascade Technical Services, LLC. placed a ticket with the USA north 811 "Gopher State One Call" Minnesota utility clearance provider to notify them of intrusive work on 1 June 2022. Additionally, AECOM contracted Ground Penetrating Radar Systems (GPRS), a private utility location service, to perform utility clearance. GPRS performed utility clearance of the proposed boring locations on 6 and 7 June 2022 with input from the AECOM field team and Camp Ripley facility staff. General locating services and ground-penetrating radar were used to complete the clearance. Additionally, the first 5 feet of each boring were pre-cleared using a hand auger to verify utility clearance in shallow subsurface where utilities would typically be encountered.

5.1.3 Source Water and Sampling Equipment Acceptability

One potable water source at Camp Ripley was sampled on 12 January 2022 to assess usability for decontamination of drilling equipment. Results of the sample collected at the wastewater treatment building tap (CR-DECON) confirmed this source to be acceptable for use in this investigation; therefore, it was used throughout the field activities. Specifically, the samples were analyzed by LC/MS/MS compliant with QSM 5.3 Table B-15. The results of the decontamination water sample associated with the wastewater building tap source used during the SI are provided in **Appendix F**. A discussion of the results is presented in the DUA (**Appendix A**).

Materials that were used within the sampling zone were confirmed as acceptable for use in the sampling environment. The checklist of acceptable materials for use in the sampling environment was provided in the Standard Operating Procedures (SOPs) appendix to the SI QAPP Addendum (AECOM, 2022a). Prior to the start of field work each day, a 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

Borings were installed in grass areas, where possible, to avoid disturbing concrete or asphalt surfaces. Soil samples were collected via direct push technology (DPT), in accordance with the SI QAPP Addendum (AECOM, 2022a). A GeoProbe® 7822DT dual-tube sampling system was used to collect continuous soil cores to the target depth. A hand auger was used to collect soil from the top five feet of the boring, in accordance with AECOM utility clearance procedures. The soil boring locations are shown on **Figure 5-1** and depths are provided **Table 5-2**. Several boring

locations were adjusted within a 50-feet offset for reasons including drill rig access, utility avoidance and bias toward sampling within observed drainage features.

In general, three discrete soil samples were collected from the vadose zone for chemical analysis from each soil boring: one surface soil sample (0 to 2 feet bgs), one subsurface soil sample approximately 2 feet above the groundwater table, and one subsurface soil sample at the mid-point between the surface and the groundwater table. In instances where groundwater was encountered at or above 5 feet bgs, only two soil samples were collected (one from surface and a second above water table).

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

During the SI, medium to high-permeability sands were observed as the dominant lithology of the unconsolidated sediments below Camp Ripley. The borings were completed at depths between 9 and 25 feet bgs. A majority of borings contained poorly graded sand, with frequent layers of well-graded sand. Occasional silt layers were observed in thicknesses ranging from 0.75 to 6 feet in thickness. Varying quantities of gravel were noted in several borings, ranging from 0.1 to 4 feet thick. Many of the logs also reported varying percentages (ranging from <5% to 45%) of gravel included in the sand layers. A sample for grain size analysis was collected at one location, AOI05-02 and analyzed via ASTM Method D-422. The results indicate that the soil sample was comprised of gravel (2.96%), coarse-grained sand (3.69%), fine- to medium-grained sand (61.24%), silt (22.91%), and clay (9.19%). Grain size results are presented in **Appendix F**. These results and facility observations are consistent with the understood regional depositional history, which is characterized by glacial moraine and outwash facies.

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 by LC/MS/MS compliant with QSM 5.3 Table B-15, total organic carbon (TOC) (USEPA Method 9060A), pH (USEPA Method 9045D), and grain size (ASTM Method D-422) in accordance with the SI QAPP Addendum (AECOM, 2022a).

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

DPT borings were converted to temporary wells (described below in **Section 5.3**).Borings were installed in grass areas, where possible, to avoid disturbing concrete or asphalt surfaces. Borings were abandoned in accordance with the SI QAPP Addendum (AECOM, 2022a) by backfilling the borehole with bentonite chips; however, for borings that were advanced through asphalt or concrete, boreholes were backfilled with bentonite chips to six inches bgs with the upper six inches replaced in kind to match the surrounding surface area (i.e., asphalt cold patch or concrete).

5.3 Temporary Well Installation and Groundwater Grab Sampling

Temporary wells were installed using a GeoProbe® 7822DT dual-tube sampling system. Once the borehole was advanced to the desired depth, a temporary well was constructed of a 5-foot section of 1-inch Schedule 40 poly-vinyl chloride (PVC) screen with sufficient casing to reach ground surface. New PVC pipe and screen were used to avoid cross contamination between locations; no additional well construction material (i.e., filter sand) was used during the temporary well installation. Details regarding deviations during temporary well installation at AOI05-01 are discussed in **Section 5.9**. Additionally, temporary well AOI05-02 was dry after installation, so an offset temporary well was installed in an attempt to collect a groundwater sample. A groundwater sample was collected from AOI05-02A and soil samples were collected at the original location, AOI05-02. The screen intervals for the temporary wells are provided in **Table 5-2**.

Groundwater samples were collected after a period of time following well installation to allow groundwater to infiltrate and recharge the temporary well screen intervals. After the recharge period, groundwater samples were collected using a peristaltic pump with PFAS-free HDPE tubing. The temporary wells were purged at a rate determined in the field to reduce turbidity and draw down prior to sampling. Water quality parameters (e.g., temperature, specific conductance, pH, dissolved oxygen [DO], and oxidation-reduction potential [ORP]) were measured using a water quality meter and recorded on the field sampling form (**Appendix B2**) before each grab sample was collected. Additionally, a subsample of each groundwater sample was collected in a separate container, and a shaker test was completed to identify if there were any foaming. No foaming was noted in any of the groundwater samples.

Each sample was collected into laboratory-supplied PFAS-free HDPE bottles and labeled using a PFAS-free marker or pen. Samples were packaged on ice and transported via FedEx under standard CoC procedures to the laboratory and analyzed by LC/MS/MS compliant with QSM 5.3 Table B-15 in accordance with the SI QAPP Addendum (AECOM, 2022a).

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 PQAPP (AECOM, 2018a). A temperature blank was placed in each cooler to ensure that samples were preserved at or below 6°C during shipment.

Following well surveying (described below in **Section 5.6**), temporary wells were abandoned in accordance with the SI QAPP Addendum (AECOM, 2022a) by removing the PVC and backfilling the borehole with bentonite chips. Upon completion of well abandonment, the ground surface at each location was restored to match existing conditions. For borings that had to be advanced through asphalt or concrete, boreholes were backfilled with bentonite chips to six inches bgs with the upper six inches replaced in kind to match the surrounding surface area (i.e., asphalt cold patch or concrete).

5.4 Existing Permanent Well Groundwater Sampling

During the SI, four existing permanent monitoring wells were sampled for groundwater. The intent for sampling these four wells was to identify potential connection between the two AOI 5 release areas: the WWTP in the southeast of the cantonment area, and the Sludge Spread Site to the northwest of the cantonment area, as well as any potential upgradient sources (AOI05-536846). Due to the existing wells' locations, these wells should be considered independent from the two AOI 5 release areas. The locations of the wells are shown on **Figure 5-1**. Available well construction information such as screen intervals, depths to water, and groundwater elevation data are presented on **Table 5-3**.

Samples were collected via low-flow sampling methods using a peristaltic pump with disposable PFAS-free, HDPE tubing. New tubing was used at each well and the all down-hole equipment was 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, DO, and ORP) were measured using a water quality meter and recorded on the field sampling form (**Appendix B2**). Water levels were measured to the nearest 0.01 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 by LC/MS/MS compliant with QSM 5.3 Table B-15 in accordance with the SI QAPP Addendum (AECOM, 2022a).

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 PQAPP (AECOM, 2018a). A temperature blank was placed in each cooler to ensure that samples were preserved at or below 6°C during shipment.

5.5 Synoptic Water Level Measurements

A synoptic groundwater gauging event was performed on 15 June 2022. Groundwater elevation measurements were collected from 28 of the 30 new temporary monitoring wells. Water level measurements were taken from the northern side of the well casing. A groundwater flow contour map is provided in **Figure 2-4**. Temporary wells AOI05-01 and AOI05-02 were dry after installation and during the synoptic gauging. The day of the gauging, AOI05-02A was installed in an attempt to reach groundwater and was also dry. The day after the gauging, both AOI05-01 and AOI05-02A were gauged and a small amount of recharge had been observed; however, as these measurements were not collected within the same 24-hour period as the rest of the wells, they were not used for groundwater contouring shown on **Figure 2-4**. Additionally, existing permanent well AOI05-536846 was located a significant distance from the AOIs and thus was also excluded from groundwater contours. Groundwater elevation data are provided in **Table 5-2**.

5.6 Surveying

The northern side of each well casing was surveyed by Minnesota-licensed land surveyors following guidelines provided in the SOPs provided in the SI QAPP Addendum (AECOM, 2022a). Survey data from the newly installed wells on the facility were collected from 14 to 17 June 2022 in the applicable North American Datum 1983 State Plane (horizontal) and North American Vertical Datum 1988 (vertical). The surveyed well data are provided in **Appendix B4**.

5.7 Investigation-Derived Waste

As of the date of this report, the disposal of IDW is not regulated federally. IDW generated during the SI is considered non-hazardous waste and was managed in accordance with the SI QAPP Addendum (AECOM, 2022a) and with the DA Guidance for Addressing Releases of PFAS, Q18 (DA, 2018).

Soil IDW (i.e., soil cuttings) generated during the SI activities were left in place at the point of the source. The soil cuttings were distributed on the downgradient side of the borehole. The IDW was not sampled and assumes the PFAS characteristics of the associated soil samples collected from the source location.

Liquid IDW generated during SI activities (i.e., purge water, development water, and decontamination fluids) were discharged directly to the ground surface slightly downgradient of the source of generation in accordance with USEPA Management of IDW (USEPA, 2014). The IDW was not sampled and assumes the PFAS characteristics of the associated groundwater samples collected from the source location.

Geographic coordinates were collected using a global positioning system (GPS) around each location where IDW was placed (i.e., an IDW polygon). The IDW polygons are displayed on the figure in **Appendix B5**.

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

5.8 Laboratory Analytical Methods

Samples were analyzed by LC/MS/MS compliant with QSM 5.3 Table B-15 at Pace Analytical Gulf Coast in Baton Rouge, Louisiana, a DoD ELAP and NELAP certified laboratory. Soil samples were also analyzed for TOC using USEPA Method 9060A and pH by USEPA Method 9045D.

5.9 Deviations from SI QAPP Addendum

Two deviations from the SI QAPP Addendum were identified during review of the field documentation. The deviations are noted below and documented in Field Change Request Forms (**Appendix B3**):

- While performing utility clearing at AOI 5, soil boring AOI05-04 was determined to be inaccessible to vehicles. The access roads were blocked with immovable tree debris, large track vehicle ruts, or otherwise abandoned. The new location for soil boring AOI05-04 was proposed approximately 500 feet from soil boring AOI05-02 and approximately 2,000 feet from the location proposed in the QAPP. This area was vehicle-accessible, and the proposed location was cleared of subsurface utilities by GPRS. During field locating and clearing at soil boring AOI06-01, the location was approximately 70 feet from the intended location - proximal to the infiltration basin culvert. The boring was moved to its intended location and cleared of subsurface utilities by GPRS. This action was documented in a field change request provided in **Appendix B3**.
- During the installation of a temporary well at soil boring AOI05-01, shallow refusal was encountered at 13 feet bgs; however, groundwater was encountered and a temporary well was installed. During the synoptic gauging, this well was dry. Three attempts were made to drill an adjacent temporary well to increase the screen interval in the water bearing zone. Two of the three attempts encountered refusal at 8 feet bgs, and the third hit refusal at 12 feet bgs. As such, an additional or replacement temporary well was not installed. During the purging and sampling (after the synoptic gauging), the temporary well had an insufficient water column to collect groundwater parameters and laboratory sample; the temporary well was abandoned. This action was documented in a field change request provided in **Appendix B3**.

Table 5-1
Site Inspection Samples by Medium
Site Inspection Report, Camp Ripley, Little Falls, Minnesota

Sample Identification	Sample Collection Date/Time	Sample Depth (feet bgs)	PFAS by LC/MS/MS compliant with QSM 5.3 Table B-15	TOC (USEPA Method 9060A)	pH (USEPA Method 9045D)	Grain Size (ASTM D-422)	Comments
Soil Samples							
AOI01-01-SB-00-02	6/8/2022 9:05	00-02	x				
AOI01-01-SB-06-08	6/8/2022 9:20	06-08	x				
AOI01-01-SB-10.5-12.5	6/8/2022 9:30	10.5-12.5	x				
AOI01-02-SB-00-02	6/8/2022 15:25	00-02	x				
AOI01-02-SB-6.5-8.5	6/8/2022 15:35	6.5-8.5	x	x	x		
AOI01-02-SB-6.5-8.5-D	6/8/2022 15:35	6.5-8.5	x	x	x		Duplicate
AOI01-02-SB-11.3-13.3	6/8/2022 15:45	11.3-13.3	x				
AOI01-03-SB-00-02	6/8/2022 7:45	00-02	x				
AOI01-03-SB-00-02-MS	6/8/2022 7:45	00-02	x				MS/MSD
AOI01-03-SB-00-02-MSD	6/8/2022 7:45	00-02	x				MS/MSD
AOI01-03-SB-07-09	6/8/2022 7:55	07-09	x				
AOI01-03-SB-15-17	6/8/2022 8:30	15-17	x				
AOI01-03-SB-15-17-D	6/8/2022 8:30	15-17	x				Duplicate
AOI02-01-SB-00-02	6/8/2022 12:00	00-02	x				
AOI02-01-SB-04-06	6/8/2022 12:05	04-06	x				
AOI02-01-SB-08-10	6/8/2022 12:15	08-10	x				
AOI02-02-SB-00-02	6/8/2022 14:45	00-02	x				
AOI02-02-SB-05-07	6/8/2022 14:55	05-07	x				
AOI02-02-SB-10-12	6/8/2022 15:05	10-12	x				
AOI02-03-SB-00-02	6/8/2022 10:55	00-02	x				
AOI02-03-SB-03-05	6/8/2022 11:00	03-05	x	x	x		
AOI02-03-SB-06-08	6/8/2022 11:10	06-08	x				
AOI03-01-SB-00-02	6/9/2022 10:50	00-02	x				
AOI03-01-6.3-8.3	6/9/2022 11:25	6.3-8.3	x				
AOI03-01-6.3-8.3-MS	6/9/2022 11:25	6.3-8.3	x				MS/MSD
AOI03-01-6.3-8.3-MSD	6/9/2022 11:25	6.3-8.3	x				MS/MSD
AOI03-01-SB-15-17	6/9/2022 11:45	15-17	x				
AOI03-02-SB-00-02	6/9/2022 9:00	00-02	x	x	x		
AOI03-02-SB-05-07	6/9/2022 9:55	05-07	x				
AOI03-02-SB-05-07-D	6/9/2022 9:55	05-07	x				Duplicate
AOI03-02-SB-10-11.5	6/9/2022 10:00	10-11.5	x				
AOI03-03-SB-00-02	6/9/2022 13:55	00-02	x				
AOI03-03-SB-10-12	6/9/2022 14:10	10-12	x				
AOI03-03-SB-15-16	6/9/2022 14:30	15-16	x				
AOI04-01-SB-00-02	6/13/2022 10:40	00-02	x				
AOI04-01-SB-03-05	6/13/2022 10:45	03-05	x				
AOI04-01-SB-5.5-7.5	6/13/2022 10:50	5.5-7.5	x				
AOI04-01-SB-5.5-7.5-D	6/13/2022 10:50	5.5-7.5	x				Duplicate
AOI04-020SB-00-02	6/13/2022 11:40	00-02	x				
AOI04-02-SB-07-09	6/13/2022 11:50	07-09	x				
AOI04-02-SB-11.5-13.5	6/13/2022 12:00	11.5-13.5	x				
AOI04-02-SB-11.5-13.5-MS	6/13/2022 12:00	11.5-13.5	x				MS/MSD
AOI04-02-SB-11.5-13.5-MSD	6/13/2022 12:00	11.5-13.5	x				MS/MSD
AOI04-03-SB-00-02	6/13/2022 10:15	00-02	x				
AOI04-03-SB-03-05	6/13/2022 10:20	03-05	x				
AOI04-03-SB-5.5-6.5	6/13/2022 10:25	5.5-6.5	x				
AOI04-03-SB-5.5-6.5-D	6/13/2022 10:25	5.5-6.5	x				Duplicate
AOI04-04-SB-01-03	6/13/2022 13:10	01-03	x				

Table 5-1
Site Inspection Samples by Medium
Site Inspection Report, Camp Ripley, Little Falls, Minnesota

Sample Identification	Sample Collection Date/Time	Sample Depth (feet bgs)	PFAS by LC/MS/MS compliant with QSM 5.3 Table B-15	TOC (USEPA Method 9060A)	pH (USEPA Method 9045D)	Grain Size (ASTM D-422)	Comments
AOI04-04-SB-03-05	6/13/2022 13:15	03-05	x				
AOI04-04-SB-5.5-7.5	6/13/2022 13:20	5.5-7.5	x				
AOI04-05-SB-00-02	6/11/2022 8:55	00-02	x				
AOI04-05-SB-00-02-D	6/11/2022 8:55	00-02	x				Duplicate
AOI04-05-SB-05-07	6/11/2022 9:05	05-07	x	x	x		
AOI04-05-SB-10.5-12.5	6/11/2022 9:15	10.5-12.5	x				
AOI04-05-SB-10.5-12.5-MS	6/11/2022 9:15	10.5-12.5	x				MS/MSD
AOI04-05-SB-10.5-12.5-MSD	6/11/2022 9:15	10.5-12.5	x				MS/MSD
AOI05-01-SB-00-02	6/14/2022 11:25	00-02	x				
AOI05-01-SB-04-06	6/14/2022 11:40	04-06	x				
AOI05-01-SB-08-10	6/14/2022 11:45	08-10	x				
AOI05-02-SB-00-02	6/14/2022 13:15	00-02	x				
AOI05-02-SB-03-05	6/14/2022 13:20	03-05	x				
AOI05-02-SB-05-07	6/14/2022 13:25	05-07	x				
AOI05-02-SB-07-09	6/15/2022 10:25	07-09				x	
AOI05-03-SB-00-02	6/14/2022 10:10	00-02	x				
AOI05-03-SB-00-02-D	6/14/2022 10:10	00-02	x				Duplicate
AOI05-03-SB-03-05	6/14/2022 10:15	03-05	x				
AOI05-04-SB-00-02	6/14/2022 14:40	00-02	x				
AOI05-04-SB-03-05	6/14/2022 14:45	03-05	x				
AOI05-05-SB-00-02	6/10/2022 9:00	00-02	x				
AOI05-05-SB-02-04	6/10/2022 9:05	02-04	x				
AOI05-06-SB-00-02	6/10/2022 9:45	00-02	x				
AOI05-06-SB-05-07	6/10/2022 9:55	05-07	x				
AOI05-06-SB-11-13	6/10/2022 10:05	11-13	x				
AOI05-07-SB-00-02	6/10/2022 8:25	00-02	x				
AOI05-08-SB-00-02	6/10/2022 8:10	00-02	x				
AOI05-08-SB-00-02-D	6/10/2022 8:10	00-02	x				Duplicate
AOI05-09-SB-00-02	6/10/2022 8:00	00-02	x	x	x		
AOI06-01-SB-00-02	6/14/2022 7:45	00-02	x				
AOI06-01-SB-03-05	6/14/2022 7:50	03-05	x				
AOI06-02-SB-00-02	6/13/2022 16:45	00-02	x				
AOI06-02-SB-03-05	6/13/2022 16:55	03-05	x				
AOI06-03-SB-00-02	6/15/2022 15:55	00-02	x	x	x		
AOI06-03-SB-03-05	6/15/2022 16:00	03-05	x				
AOI06-03-SB-05-07	6/15/2022 16:05	05-07	x				
AOI07-01-SB-00-02	6/10/2022 13:40	00-02	x				
AOI07-01-SB-03-05	6/10/2022 13:45	03-05	x				
AOI07-01-SB-06-08	6/10/2022 13:50	06-08	x				
AOI07-02-SB-00-02	6/10/2022 12:00	00-02	x				
AOI07-02-SB-00-02-D	6/10/2022 12:00	00-02	x				Duplicate
AOI07-02-SB-05-07	6/10/2022 12:15	05-07	x	x	x		
AOI07-02-SB-10-12	6/10/2022 12:25	10-12	x				
AOI07-02-SB-10-12-MS	6/10/2022 12:25	10-12	x				MS/MSD
AOI07-02-SB-10-12-MSD	6/10/2022 12:25	10-12	x				MS/MSD
AOI07-03-SB-00-02	6/13/2022 14:25	00-02	x				
AOI07-03-SB-06-08	6/13/2022 14:35	06-08	x				
AOI07-03-SB-11-13	6/13/2022 14:40	11-13	x				
AOI07-04-SB-00-02	6/10/2022 15:15	00-02	x				

Table 5-1
Site Inspection Samples by Medium
Site Inspection Report, Camp Ripley, Little Falls, Minnesota

Sample Identification	Sample Collection Date/Time	Sample Depth (feet bgs)	PFAS by LC/MS/MS compliant with QSM 5.3 Table B-15	TOC (USEPA Method 9060A)	pH (USEPA Method 9045D)	Grain Size (ASTM D-422)	Comments
AOI07-04-SB-06-08	6/10/2022 15:30	06-08	x				
AOI07-04-SB-15-17	6/10/2022 15:55	15-17	x				
AOI08-01-SB-00-02	6/7/2022 9:05	00-02	x	x	x		
AOI08-01-SB-00-02-MS	6/7/2022 9:05	00-02		x	x		MS/MSD
AOI08-01-SB-00-02-MSD	6/7/2022 9:05	00-02		x	x		MS/MSD
AOI08-01-SB-7.5-8.5	6/7/2022 9:15	7.5-8.5	x				
AOI08-01-SB-15-16.5	6/7/2022 9:50	15-16.5	x				
AOI08-02-SB-00-02	6/7/2022 11:35	00-02	x				
AOI08-02-SB-00-02-D	6/7/2022 11:35	00-02	x				Duplicate
AOI08-02-SB-05-07	6/7/2022 11:55	05-07	x				
AOI08-02-SB-10-12	6/7/2022 12:05	10-12	x				
AOI08-03-SB-00-02	6/7/2022 13:40	00-02	x				
AOI08-03-SB-05-07	6/7/2022 13:50	05-07	x				
AOI08-03-SB-11.5-12.5	6/7/2022 14:10	11.5-12.5	x				

Table 5-1
Site Inspection Samples by Medium
Site Inspection Report, Camp Ripley, Little Falls, Minnesota

Sample Identification	Sample Collection Date/Time	Sample Depth (feet bgs)	PFAS by LC/MS/MS compliant with QSM 5.3 Table B-15	TOC (USEPA Method 9060A)	pH (USEPA Method 9045D)	Grain Size (ASTM D-422)	Comments
Groundwater Samples							
AOI01-01-GW	6/8/2022 15:08	NA	x				
AOI01-02-GW	6/7/2022 13:20	NA	x				
AOI01-03-GW	6/8/2022 16:34	NA	x				
AOI01-03-GW-D	6/8/2022 16:34	NA	x				Duplicate
AOI02-01-GW	6/9/2022 12:42	NA	x				
AOI02-01-GW-D	6/9/2022 12:42	NA	x				Duplicate
AOI02-01-GW-MS	6/9/2022 12:42	NA	x				MS/MSD
AOI02-01-GW-MSD	6/9/2022 12:42	NA	x				MS/MSD
AOI02-02-GW	6/9/2022 11:12	NA	x				
AOI02-03-GW	6/9/2022 9:58	NA	x				
AOI03-01-GW	6/10/2022 9:52	NA	x				
AOI03-02-GW	6/10/2022 8:40	NA	x				
AOI03-03-GW	6/10/2022 11:20	NA	x				
AOI04-01-GW	6/13/2022 13:12	NA	x				
AOI04-02-GW	6/14/2022 11:15	NA	x				
AOI04-03-GW	6/11/2022 14:30	NA	x				
AOI04-04-GW	6/14/2022 8:15	NA	x				
AOI04-05-GW	6/11/2022 12:42	NA	x				
AOI05-530012-GW	6/11/2022 9:22	NA	x				
AOI05-530012-GW-D	6/11/2022 9:22	NA	x				Duplicate
AOI05-482900-GW	6/13/2022 11:25	NA	x				
AOI05-02-GW	6/16/2022 11:15	NA	x				
AOI05-03-GW	6/15/2022 9:00	NA	x				
AOI05-04-GW	6/14/2022 16:25	NA	x				
AOI05-05-GW	6/10/2022 12:32	NA	x				
AOI05-06-GW	6/10/2022 13:45	NA	x				
AOI05-773250-GW	6/8/2022 11:50	NA	x				
AOI05-536846-GW	6/8/2022 9:20	NA	x				
AOI06-01-GW	6/14/2022 12:55	NA	x				
AOI06-02-GW	6/14/2022 14:56	NA	x				
AOI06-03-GW	6/14/2022 14:16	NA	x				
AOI07-01-GW	6/13/2022 9:55	NA	x				
AOI07-02-GW	6/10/2022 14:55	NA	x				
AOI07-02-GW-D	6/10/2022 14:55	NA	x				Duplicate
AOI07-02-GW-MS	6/10/2022 14:55	NA	x				MS/MSD
AOI07-02-GW-MSD	6/10/2022 14:55	NA	x				MS/MSD
AOI07-03-GW	6/14/2022 9:50	NA	x				
AOI07-04-GW	6/11/2022 11:28	NA	x				
AOI08-01-GW	6/7/2022 13:05	NA	x				
AOI08-02-GW	6/7/2022 14:15	NA	x				
AOI08-03-GW	6/7/2022 15:34	NA	x				
Quality Control Samples							
CR-FRB-01	6/7/2022 15:30	NA	x				FRB
CR-ERB-01	6/13/2022 16:00	NA	x				Hand Auger
CR-ERB-02	6/13/2022 16:30	NA	x				Drill Shoe
CR-ERB-03	6/14/2022 12:00	NA	x				Hand Auger
CR-ERB-04	6/14/2022 12:30	NA	x				Drill Shoe
CR-ERB-05	6/15/2022 12:00	NA	x				Drill Shoe

Table 5-1
Site Inspection Samples by Medium
Site Inspection Report, Camp Ripley, Little Falls, Minnesota

Sample Identification	Sample Collection Date/Time	Sample Depth (feet bgs)	PFAS by LC/MS/MS compliant with QSM 5.3 Table B-15	TOC (USEPA Method 9060A)	pH (USEPA Method 9045D)	Grain Size (ASTM D-422)	Comments
CR-DECON-01	1/12/2022 10:10	NA	x				Decon Spigot prior to SI activities

Notes:
ASTM = American Society for Testing and Materials
bgs = below ground surface
ERB = equipment rinsate blank
FRB = field reagent blank
LC/MS/MS = Liquid Chromatography Mass Spectrometry
MS/MSD = matrix spike/ matrix spike duplicate
NA = not applicable
PFAS = per- and polyfluoroalkyl substances
QSM = Quality Systems Manual
SI = Site Investigation
TOC = total organic carbon
USEPA = United States Environmental Protection Agency

THIS PAGE INTENTIONALLY BLANK

Table 5-2
Soil Boring Depths, Temporary Well Screen Intervals, and Groundwater Elevations
Site Inspection Report, Camp Ripley, Little Falls, Minnesota

Area of Interest	Boring Location	Soil Boring Depth (feet bgs)	Temporary Well Screen Interval (feet bgs)	Top of Casing Elevation (feet NAVD88)	Ground Surface Elevation (feet NAVD88)	Depth to Water[1,2] (feet btoc)	Depth to Water (feet bgs)	Groundwater Elevation (feet NAVD88)
1	AOI01-01	20.00	15.00 - 20.00	1147.51	1147.15	18.38	18.01	1129.13
	AOI01-02	20.00	15.00 - 20.00	1147.52	1147.26	19.00	18.74	1128.52
	AOI01-03	22.00	17.00 - 22.00	1150.17	1146.95	21.47	18.25	1128.70
2	AOI02-01	15.00	8.00 - 15.00	1146.41	1145.19	11.76	10.55	1134.65
	AOI02-02	17.00	12.00 - 17.00	1148.17	1144.75	15.94	12.52	1132.23
	AOI02-03	15.00	8.00 - 15.00	1146.11	1145.73	11.76	11.38	1134.35
3	AOI03-01	22.00	17.00 - 22.00	1144.55	1141.73	20.29	17.47	1124.26
	AOI03-02	20.00	15.00 - 20.00	1140.46	1140.17	16.01	15.72	1124.45
	AOI03-03	21.00	16.00 - 21.00	1144.89	1140.78	20.79	16.67	1124.10
4	AOI04-01	15.00	10.00 - 15.00	1145.30	1145.02	10.70	10.42	1134.60
	AOI04-02	20.00	15.00 - 20.00	1151.40	1151.11	17.04	16.75	1134.36
	AOI04-03	15.00	10.00 - 15.00	1144.00	1142.60	9.52	8.12	1134.48
	AOI04-04	15.00	10.00 - 15.00	1144.50	1144.17	10.77	10.44	1133.73
	AOI04-05	20.00	15.00 - 20.00	1146.63	1146.30	16.14	15.81	1130.49
5	AOI05-01	15.00	5.00 - 15.00	1207.23	1206.65	14.64	14.06	1192.59
	AOI05-02	14.00	5.00 - 14.00	1206.99	1206.10	DRY	--	--
	AOI05-02A[3]	23.00	13.00 - 23.00	1208.14	1206.10	24.42	22.38	1183.72
	AOI05-03	10.00	5.00 - 10.00	1194.18	1193.71	4.14	3.67	1190.04
	AOI05-04	10.00	5.00 - 10.00	1207.94	1205.01	7.28	4.34	1200.66
	AOI05-05	9.00	4.00 - 9.00	1129.27	1128.88	8.65	8.26	1120.62
	AOI05-06	20.00	15.00 - 20.00	1123.76	1122.39	14.27	12.90	1109.49
6	AOI06-01	10.00	5.00 - 10.00	1126.28	1126.00	5.91	5.64	1120.37
	AOI06-02	10.00	5.00 - 10.00	1123.42	1123.09	3.37	3.04	1120.05
	AOI06-03	12.00	5.00 - 12.00	1129.23	1125.62	9.48	5.87	1119.75
7	AOI07-01	15.00	10.00 - 15.00	1141.06	1140.79	11.96	11.69	1129.10
	AOI07-02	17.00	12.00 - 17.00	1143.85	1140.73	16.57	13.45	1127.28
	AOI07-03	20.00	15.00 - 20.00	1141.75	1141.46	15.60	15.31	1126.15
	AOI07-04	22.00	17.00 - 22.00	1145.41	1142.53	20.77	17.89	1124.64
8	AOI08-01	25.00	15.00 - 25.00	1146.23	1145.80	19.32	18.88	1126.91
	AOI08-02	20.00	15.00 - 20.00	1144.37	1144.17	17.88	17.68	1126.49
	AOI08-03	20.00	15.00 - 20.00	1144.33	1144.02	17.48	17.17	1126.85

Table 5-2
Soil Boring Depths, Temporary Well Screen Intervals, and Groundwater Elevations
Site Inspection Report, Camp Ripley, Little Falls, Minnesota

Notes:

1. Synoptic gauging event occurred on 15 June 2022.
2. Both AOI05-01 and AOI05-02 were dry during the synoptic gauging. As a result, these two locations were excluded from the groundwater contour map (Figure 2-4). Depth to groundwater listed for AOI05-01 was measured on 16 June 2022, but is not shown on Figure 2-4 as it was not collected within 24 hours of the synoptic gauging event.
3. Well AOI05-02A was installed after the synoptic gauging as an offset loction to AOI05-02 in an attempt to collect a groundwater sample. Depth to water shown was measured on 16 June 2022.

bgs = below ground surface

btoc = below top of casing

NAVD88 = North American Vertical Datum 1988

Table 5-3
Permanent Monitoring Well Groundwater Elevations
Site Inspection Report, Camp Ripley, Little Falls, Minnesota

Area of Interest	Monitoring Well ID	Well Total Depth (ft btoc)[1]	Screen Interval (feet bgs)[1]	Top of Casing Elevation (feet NAVD88)	Ground Surface Elevation (feet NAVD88)	Depth to Water[2] (feet btoc)	Depth to Water (feet bgs)	Groundwater Elevation (feet NAVD88)
5	AOI05-482900	30.38	--	1141.20	1139.59	19.13	17.52	1122.07
	AOI05-530012	25.41	12-22	1144.18	1141.14	17.82	14.79	1126.36
	AOI05-536846[3]	22.23	11-21	1221.77	1219.55	11.92	9.70	1209.85
	AOI05-773250	40.27	26-36	1156.40	1153.50	27.74	24.85	1128.66

Notes:

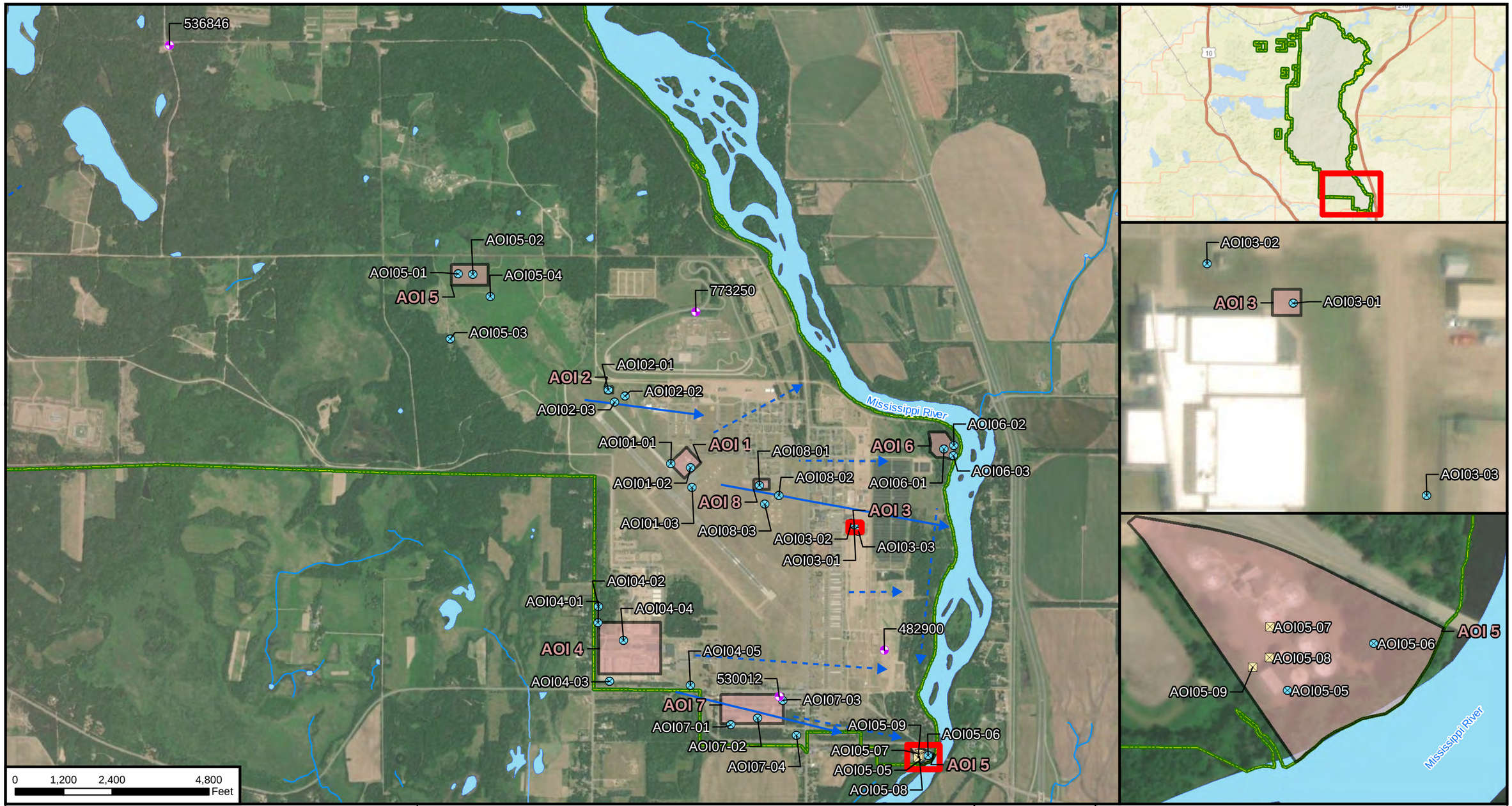
1. Well screen interval data unavailable for existing permanent well AOI05-482900. Well screen interval was estimated using the depth of casing and depth of borehole.
2. Synoptic gauging event occurred on 15 June 2022.
3. Existing permanent well AOI05-536846 is located a significant distance from the AOIs and thus was not included in the groundwater contours.

bgs = below ground surface

btoc = below top of casing

NAVD88 = North American Vertical Datum 1988

THIS PAGE INTENTIONALLY BLANK



CLIENT	ARNG			
PROJECT	Site Inspection at Camp Ripley, MN			
REVISED	5/17/2023	GIS BY	MS	5/17/2023
SCALE	1:28,800	CHK BY	EB	5/17/2023
Base Map: Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c)		PM	CM	5/17/2023

Legend

- Existing Facility Well
- Soil Boring Location
- Surface Soil Sample
- Area of Interest
- Facility Boundary
- Water Body
- River/Stream
- Canal/Ditch
- Surface Water Flow Direction
- Groundwater Flow Direction

N

Site Inspection Sample Locations

AECOM
12420 Milestone Center Drive
Germantown, MD 20876

Figure 5-1

THIS PAGE INTENTIONALLY BLANK

6. Site Inspection Results

This section presents the analytical results of the SI. The SLs used in this evaluation are presented in **Section 6.1**. A discussion of the results for each AOI is provided in **Section 6.3** through **Section 6.5**. **Table 6-2** through **Table 6-5** present results in soil or groundwater for the relevant compounds. 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 6 July 2022 (Assistant Secretary of Defense, 2022). The ARNG program under which this SI was performed follows this DoD policy. Should the maximum facility concentration for sampled media exceed the SLs established in the OSD memorandum, the AOI will proceed to the next phase under CERCLA. The SLs established in the OSD memorandum apply to the five compounds presented on **Table 6-1** below.

Table 6-1: Screening Levels (Soil and Groundwater)

Analyte[b]	Residential (Soil) (µg/kg)[a] 0-2 feet bgs	Industrial/ Commercial Composite Worker (Soil) (µg/kg)[a] 2-15 feet bgs	Tap Water (Groundwater) (ng/L)[a]
PFOA	19	250	6
PFOS	13	160	4
PFBS	1,900	25,000	601
PFHxS	130	1,600	39
PFNA	19	250	6

Notes:
bgs = below ground surface; µg/kg = micrograms per kilogram; ng/L = nanograms per liter

a.) Assistant Secretary of Defense, 2022. Risk Based Screening Levels in Groundwater and Soil using United States Environmental Protection Agency's (USEPA's) Regional Screening Level Calculator. Hazard Quotient (HQ) = 0.1. 6 July 2022.

b.) Of the six PFAS compounds presented in the 6 July 2022 OSD memorandum, HFPO-DA (commonly referred to as GenX) was not included as an analyte at the time of this SI. Based on the CSM developed during the PA and revised based on SI findings, the presence of HFPO-DA is not anticipated at the facility because HFPO-DA is generally not a component of MIL-SPEC AFFF and based on its history including distribution limitations that restricted use of GenX, it is generally not a component of other products the military used. In addition, it is unlikely that GenX would be an individual chemical of concern in the absence of other PFAS.

The data in the subsequent sections are compared against the SLs presented in **Table 6-1**. The SLs for groundwater are based on direct ingestion. The SLs for soil are based on incidental ingestion and are applied to the depth intervals reasonably anticipated to be encountered by the receptors identified at the facility: the residential scenario is applied to surface soil results (0 to 2 feet bgs) and the industrial/commercial worker scenario is applied to shallow subsurface soil results (2 to 15 feet bgs). The SLs are not applied to deep subsurface soil results (>15 feet bgs) because 15 feet is the anticipated limit of construction activities.

Soil sample depths shown in subsequent tables and figures are grouped into shallow, intermediate, and deep categories, which refer to the relative depth at which a sample was collected in a given borehole. As such, these categories are not intended to correspond to the exposure scenario depths specified above for the OSD SLs.

6.2 Soil Physicochemical Analyses

To provide basic soil parameter information, eight soil samples were analyzed for TOC and pH, and one soil sample was analyzed for grain size (AOI05-02-SB-07-09), which are important for evaluating transport through the soil medium. **Appendix F** contains the results of the TOC, pH, and grain size sampling.

The TOC, pH, and grain size data collected in this investigation will be used in subsequent investigations, where appropriate, to assess fate and transport. According to the Interstate Technology Regulatory Council (ITRC), several important 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: TriMax™ Discharge Area and Building 8-197. The soil and groundwater results are summarized on **Table 6-2** through **Table 6-5**. Soil and groundwater results are presented on **Figure 6-1** through **Figure 6-13**.

6.3.1 AOI 1 Soil Analytical Results

Figure 6-1, **Figure 6-3**, **Figure 6-5**, **Figure 6-7**, and **Figure 6-9** present the ranges of detections in soil at AOI 1. **Table 6-2** through **Table 6-4** summarize the soil results.

Soil was sampled from surface soil (0 to 2 feet bgs) from boring locations AOI01-01 through AOI01-03. Soil was also sampled from shallow subsurface soil (between 6 and 13.3 feet bgs) from boring locations AOI01-01 through AOI01-03, and deep subsurface soil intervals (15 to 17 feet bgs) from boring location AOI01-03. PFOA, PFHxS, and PFNA were detected in surface soil, with the maximum concentration of 0.232 micrograms per kilogram (µg/kg) observed at AOI01-02. PFOS was detected above the surface soil SL of 13 µg/kg at soil boring location AOI01-02, with a concentration of 33.6 µg/kg. PFBS was not detected in surface soil at AOI 1.

PFHxS, PFOS, and PFNA were detected in shallow subsurface soil at concentrations below their respective SLs. PFHxS was detected at two of the three locations, with concentrations ranging from 0.039 J µg/kg to 0.126 J µg/kg. PFOS was detected in both shallow subsurface samples collected from AOI01-02, with a maximum concentration of 4.45 J µg/kg. PFNA was also detected at AOI01-02, with the highest concentration of 0.028 J µg/kg. PFOA and PFBS were not detected in shallow subsurface soil at AOI 1. There were no detections in deep subsurface soil.

6.3.2 AOI 1 Groundwater Analytical Results

Figure 6-11 and **Figure 6-13** present the ranges of detections in groundwater at AOI 1. **Table 6-5** summarizes the groundwater results.

Groundwater was sampled from temporary monitoring wells AOI01-01 through AOI01-03. The following exceedances of the SLs were measured:

- PFOS was detected above the SL of 4 nanograms per liter (ng/L) in AOI01-02 and AOI01-03, with concentrations of 1500 ng/L and 15.4 ng/L, respectively.
- PFOA was detected above the SL of 6 ng/L at AOI01-01 and AOI01-02, with concentrations of 6.16 ng/L to 56.0 ng/L, respectively.
- PFNA was detected above the SL of 6 ng/L at AOI01-02, with a concentration of 34.9 ng/L.
- PFHxS was detected above the SL of 39 ng/L at AOI01-02, with a concentration of 216 ng/L.

PFBS was detected below the SL of 601 ng/L in all three wells, with the maximum concentration of 10.8 ng/L observed at AOI01-02.

6.3.3 AOI 1 Conclusions

Based on the results of the SI, PFOS was detected in soil above the surface soil SL. PFOA, PFOS, PFNA, and PFHxS were detected in groundwater at concentrations above their SLs. Based on the exceedances of the SLs in soil and groundwater, further evaluation at AOI 1 is warranted.

6.4 AOI 2

This section presents the analytical results for soil and groundwater in comparison to SLs for AOI 2: Burn Pit Fire Training Area. The results in soil and groundwater are summarized on **Table 6-2** through **Table 6-5**. Soil and groundwater results are presented on **Figure 6-1** through **Figure 6-13**.

6.4.1 AOI 2 Soil Analytical Results

Figure 6-1, **Figure 6-3**, **Figure 6-5**, **Figure 6-7**, and **Figure 6-9** present the ranges of detections in soil at AOI 2. **Table 6-2** through **Table 6-4** summarize the soil results.

Soil was sampled from surface soil (0 to 2 feet bgs) and shallow subsurface soil (between 4 and 12 feet bgs) at all three borings in AOI 2. In surface soil, PFOS and PFNA were detected below their SLs at all three locations, with a maximum concentration of 0.195 J µg/kg observed at AOI02-03. PFHxS was detected below the SL at one location, AOI02-03, with a concentration of 0.041 J µg/kg. PFOA and PFBS were not detected in surface soil. PFOA, PFOS, PFHxS, PFNA, and PFBS were not detected in shallow subsurface soil. No deep subsurface soil samples (>15 feet bgs) were collected at AOI 2.

6.4.2 AOI 2 Groundwater Analytical Results

Figure 6-11 and **Figure 6-13** present the ranges of detections in groundwater at AOI 2. **Table 6-5** summarizes the groundwater results.

Groundwater was sampled from temporary monitoring wells AOI2-01 through AOI2-03. PFOA and PFOS were detected above their respective SLs at AOI02-01, with concentrations of 8.92 ng/L and 20.5 ng/L, respectively. PFBS and PFHxS were detected below their SLs, with a maximum concentration of 23.0 ng/L for PFHxS at AOI02-03, and a maximum of 0.972 J ng/L for PFBS at AOI02-02. PFNA was not detected in any of the wells.

6.4.3 AOI 2 Conclusions

Based on the results of the SI, PFOS, PFHxS, and PFNA were detected below their respective SLs in soil at AOI 2. PFOA and PFOS were detected in groundwater at concentrations above their SLs. Based on the exceedances of the SLs in groundwater, further evaluation at AOI 2 is warranted.

6.5 AOI 3

This section presents the analytical results for soil and groundwater in comparison to SLs for AOI 3: DHS Demonstration. The results in soil and groundwater are presented in **Table 6-2** through **Table 6-5**. Soil and groundwater results are presented on **Figure 6-1** through **Figure 6-13**.

6.5.1 AOI 3 Soil Analytical Results

Figure 6-1, **Figure 6-3**, **Figure 6-5**, **Figure 6-7**, and **Figure 6-9** present the ranges of detections in soil at AOI 3. **Table 6-2** through **Table 6-4** summarize the soil results.

Soil was sampled from surface soil (0 to 2 feet bgs) from boring locations AOI03-01 through AOI03-03. Soil was also sampled from shallow subsurface soil (between 5 and 12 feet bgs) from all boring locations, and deep subsurface soil (15-17 feet bgs) from AOI03-01 and AOI03-03. PFOA, PFOS, and PFNA were detected at concentrations below their SLs in surface soil, with a maximum concentration of 0.326 J µg/kg observed at AOI03-02 for PFOS. PFHxS and PFBS were not detected in surface soil. PFOA, PFOS, PFHxS, PFNA, and PFBS were not detected in either shallow or deep subsurface soil.

6.5.2 AOI 3 Groundwater Analytical Results

Figure 6-11 and **Figure 6-13** present the ranges of detections in groundwater at AOI 3. **Table 6-5** summarizes the groundwater results.

Groundwater was sampled from temporary monitoring wells AOI03-01, AOI03-02, and AOI03-03. PFOA, PFOS, and PFBS were detected below their SLs in groundwater:

- PFOA was detected below the SL of 6 ng/L in all three wells, with concentrations ranging from 1.32 J ng/L to 3.76 J ng/L at AOI03-02.
- PFOS was detected below the SL of 4 ng/L at all three wells, with concentrations ranging from 1.32 J ng/L to 2.80 J ng/L at AOI03-02.
- PFBS was detected below the SL of 601 ng/L at all three wells, with a concentration ranging from 1.26 J ng/L to 1.48 J ng/L at AOI03-03.

PFHxS and PFNA were not detected in any of the wells.

6.5.3 AOI 3 Conclusions

Based on the results of the SI, PFOA, PFOS, PFNA, and PFBS were detected in soil and groundwater at concentrations below their SLs. Therefore, further evaluation at AOI 3 is not warranted.

6.6 AOI 4

This section presents the analytical results for soil and groundwater in comparison to SLs for AOI 4: USPFO Warehouse, CMA Shop, and CMA Discharge Area. The results in soil and groundwater are presented in **Table 6-2** through **Table 6-5**. Soil and groundwater results are presented on **Figure 6-1** through **Figure 6-13**.

6.6.1 AOI 4 Soil Analytical Results

Figure 6-2, **Figure 6-4**, **Figure 6-6**, **Figure 6-8**, and **Figure 6-10** present the ranges of detections in soil at AOI 4. **Table 6-2** through **Table 6-4** summarize the soil results.

Soil was sampled from surface soil (0 to 3 feet bgs) from boring locations AOI04-01 through AOI04-05. Soil was also sampled from shallow subsurface soil (between 3 and 13.5 feet bgs) from boring locations AOI04-01 through AOI04-05. Deep subsurface soil samples (>15 feet bgs) were not collected at AOI 4.

PFBS was not detected in any surface soil samples. Detections of PFOA, PFOS, PFHxS, and PFNA in surface soil were all below their SLs. Surface soil collected at AOI04-04 was non-detect for all relevant compounds; surface soil at this location was collected from 1 to 3 feet bgs due to concrete. PFOA was detected below the SL of 19 µg/kg at locations AOI04-01 and AOI04-03 with concentrations of 0.123 J µg/kg and 0.154 J µg/kg, respectively. PFOS was detected below the SL of 13 µg/kg in all locations except AOI04-04, with concentrations ranging from 0.587J µg/kg to 1.79 µg/kg at AOI04-01. PFHxS was detected below the SL of 130 µg/kg at locations AOI04-01 through AOI04-03, with concentrations ranging from 0.034 J µg/kg to 0.091 J µg/kg at AOI04-02. PFNA was detected below the SL of 19 µg/kg at all locations except AOI04-04, with concentrations ranging from 0.039 J µg/kg to 0.136 J µg/kg at AOI04-03.

PFOS, PFHxS, and PFNA were detected in shallow subsurface soil at concentrations below their SLs. PFOS was detected in three of the five locations, with concentrations ranging from 0.208 J+ µg/kg to 0.684 J µg/kg observed at AOI04-03. PFHxS was detected samples from AOI04-02, with concentrations of 0.054 J µg/kg and 0.066 J µg/kg observed at AOI04. PFNA was detected in samples from AOI04-03, with concentrations of 0.082 J µg/kg and 0.108 J µg/kg. PFOA and PFBS were not detected in shallow subsurface soil.

6.6.2 AOI 4 Groundwater Analytical Results

Figure 6-12 and **Figure 6-13** present the ranges of detections in groundwater at AOI 4. **Table 6-5** summarizes the groundwater results.

Groundwater was sampled from temporary monitoring wells AOI04-01 through AOI04-05. The following detections and exceedances of the SLs were measured:

- PFOA was detected above the SL of 6 ng/L in AOI04-03 and AOI04-04, with concentrations of 6.79 ng/L and 15.0 ng/L, respectively.
- PFOS was detected above the SL of 4 ng/L in AOI04-03, AOI04-04, and AOI04-05, with concentrations of 25.2 ng/L, 74.2 ng/L, and 17.6 ng/L, respectively.
- PFHxS was detected above the SL of 39 ng/L at AOI04-04, with a concentration of 132 ng/L.
- PFNA was detected above the SL of 6 ng/L at AOI04-03, with a concentration of 14.7 ng/L.

PFBS was detected below the SL of 601 ng/L at three of the five wells, with a maximum concentration of 6.56 ng/L.

6.6.3 AOI 4 Conclusions

Based on the results of the SI, PFOA, PFOS, PFHxS, and PFNA were detected in groundwater at concentrations exceeding their respective SLs. All detections in soil were below their SLs. Based on the exceedances observed in groundwater, further evaluation at AOI 4 is warranted.

6.7 AOI 5-WWTP

This section presents the analytical results for soil and groundwater in comparison to SLs for the AOI 5-WWTP. The results in soil and groundwater are presented in **Table 6-2** through **Table 6-5**. Soil and groundwater results are presented on **Figures 6-2**, **6-4**, **6-6**, **6-8**, **6-10**, **6-12**, and **Figure 6-13**.

6.7.1 AOI 5-WWTP Soil Analytical Results

Figures 6-2, 6-4, 6-6, 6-8, and **Figure 6-10** present the ranges of detections in soil at AOI 5-WWTP. **Table 6-2** through **Table 6-4** summarize the soil results.

Soil was sampled from surface soil (0 to 2 feet bgs) from boring locations AOI05-05 through AOI05-09. Soil was also sampled from shallow subsurface soil (between 2 and 13 feet bgs) from boring locations AOI05-05 and AOI5-06. PFOA, PFOS, PFHxS, and PFNA were detected below their SLs in surface soil, with a maximum concentration of 1.29 µg/kg observed AOI05-05 for PFOS. PFBS was not detected in surface soil at AOI 5-WWTP. PFOS, PFHxS, and PFBS were detected in shallow subsurface soil at concentrations below the SLs, with the highest concentration of 0.222 J µg/kg observed at AOI05-06 (5 to 7 feet bgs) for PFOS. PFOA and PFNA were not detected in shallow subsurface soil samples. Deep subsurface soil (>15 feet bgs) was not sampled at the AOI 5-WWTP.

6.7.2 AOI 5-WWTP and Existing Facility Wells Groundwater Analytical Results

Figure 6-12 and **Figure 6-13** present the ranges of detections in groundwater at AOI 5-WWTP. **Table 6-5** summarizes the groundwater results.

Groundwater was sampled from temporary monitoring wells AOI05-05 and AOI05-06 at the WWTP. Exceedances of relevant compounds were observed at both wells. The following detections and exceedances of the SLs were measured:

- PFOS was detected above the SL of 4 ng/L at both AOI05-05 and AOI05-06, with concentrations of 21.2 ng/L and 62.4 ng/L, respectively.
- PFHxS was detected above the SL of 39 ng/L at AOI05-06, with a concentration of 43.0 ng/L. At AOI05-05, PFHxS was detected below the SL with a concentration of 11.7 ng/L.

PFOA was detected below the SL of 6 ng/L at AOI05-06 with a concentration of 5.24 ng/L. PFNA was detected below the SL of 6 ng/L at AOI05-06 with a concentration of 1.67 J ng/L. PFBS was detected below the SL of 601 ng/L at AOI05-05 and AOI05-06, with concentrations of 1.15 J ng/L and 3.11 J ng/L, respectively. PFOA and PFNA were not detected at AOI05-05.

Four existing facility monitoring wells, AOI05-482900, AOI05-530012, AOI05-536846, and AOI05-773250, were also sampled during the SI. These wells were originally included as part of AOI 5 to identify potential connection between AOI 5-WWTP and AOI 5-Sludge Spread Site, as well as any potential upgradient sources. However, upon further review as discussed in **Section 5.4**,

these wells will be described separately as they are not collocated with the AOI 5 potential release areas. The following detections and exceedances of SLs were measured at the facility wells:

- AOI05-482900: PFOS was detected below the SL of 4 ng/L at AOI05-482900 with a concentration of 1.99 J ng/L; all other relevant compounds were non-detect.
- AOI05-530012: PFOS was detected above the SL with a concentration of 6.87 ng/L. PFOA, PFHxS, and PFBS were detected below their respective SLs with concentrations of 4.28 ng/L, 13.0 ng/L, and 0.980 J ng/L, respectively. PFNA was not detected.
- AOI05-773250: PFBS was detected below the SL of 601 ng/L with a concentration of 18.4 ng/L; all other relevant compounds were non-detect.

Groundwater from well AOI05-536846, which is upgradient of the cantonment area and AOI 5-Sludge Spread Site, was non-detect for all relevant compounds.

6.7.3 AOI 5-WWTP Conclusions

Based on the results of the SI, PFOS and PFHxS were detected in groundwater at concentrations above their respective SLs at the AOI 5-WWTP. All detections in soil at AOI 5-WWTP were below their SLs. Based on the exceedances of the SLs in groundwater at the WWTP, further evaluation at AOI 5-WWTP is warranted.

6.8 AOI 5-Sludge Spread Site

This section presents the analytical results for soil and groundwater in comparison to SLs for the AOI 5-Sludge Spread Site. The results in soil and groundwater are presented in **Table 6-2** through **Table 6-5**. Soil and groundwater results are presented on **Figures 6-1**, **6-3**, **6-5**, **6-7**, **6-9**, **6-11**, and **Figure 6-13**.

6.8.1 AOI 5-Sludge Spread Site Soil Analytical Results

Figures 6-1, **6-3**, **6-5**, **6-7**, and **Figure 6-9** present the ranges of detections at soil at AOI 5-Sludge Spread Site. **Table 6-2** through **Table 6-4** summarize the soil results.

Soil was sampled from surface soil (0 to 2 feet bgs) from boring locations AOI05-01 through AOI05-04. Soil was also sampled from shallow subsurface soil (between 3 and 10 feet bgs) from boring locations AOI05-01 through AOI5-04. PFOA, PFOS, PFHxS, PFNA, and PFBS were detected below their SLs in surface soil, with a maximum concentration of 1.33 µg/kg observed at AOI05-02 for PFOS. PFOA, PFOS, PFHxS, PFNA, and PFBS were detected in shallow subsurface soil at concentrations below their respective SLs, with a maximum concentration of 0.260 J µg/kg observed at AOI05-02 for PFOS. Deep subsurface soil (>15 feet bgs) was not sampled at AOI 5-Sludge Spread Site.

6.8.2 AOI 5-Sludge Spread Site Groundwater Analytical Results

Figure 6-11 and **Figure 6-13** present the ranges of detections in groundwater at AOI 5-Sludge Spread Site. **Table 6-5** summarizes the groundwater results.

Groundwater was sampled from temporary monitoring wells AOI05-02 through AOI05-04 at the Sludge Spread Site. Results were non-detect for all relevant compounds at wells AOI05-02 and AOI05-03. In well AOI05-04, PFOS was detected below the SL of 4 ng/L with a concentration of 0.956 J ng/L; all other relevant compounds were not detected at AOI05-04.

6.8.3 AOI 5-Sludge Spread Site Conclusions

Based on the results of the SI, relevant compounds were detected in soil at concentrations below their respective SLs at the AOI 5-Sludge Spread Site. PFOS was detected in one of three wells sampled, below the respective SL; the remaining results were non-detect. Based on the results of soil and groundwater at the Sludge Spread Site, no further evaluation at AOI 5-Sludge Spread Site is warranted.

6.9 AOI 6

This section presents the analytical results for soil and groundwater in comparison to SLs for AOI 6: Stormwater Infiltration Basin. The results in soil and groundwater are presented in **Table 6-2** through **Table 6-5**. Soil and groundwater results are presented on **Figure 6-1** through **Figure 6-13**.

6.9.1 AOI 6 Soil Analytical Results

Figure 6-1, **Figure 6-3**, **Figure 6-5**, **Figure 6-7**, and **Figure 6-9** present the ranges of detections in soil at AOI 6. **Table 6-2** through **Table 6-4** summarize the soil results.

Soil was sampled from surface soil (0 to 2 feet bgs) from boring locations AOI06-01 through AOI06-03. Soil was also sampled from shallow subsurface soil (between 3 and 7 feet bgs) from all boring locations. No deep subsurface soil samples (>15 feet bgs) were collected at AOI 6. Among the sampled locations, PFOA, PFOS, PFHxS, PFNA, and PFBS were detected below their respective SLs, with a maximum concentration of 0.256 J µg/kg observed at AOI06-02 for PFOS.

PFOS was detected in shallow subsurface soil at boring location AOI06-03, with a concentration of 0.052 J µg/kg. PFOA, PFHxS, PFNA, and PFBS were not detected in shallow subsurface soil. Deep subsurface soil was not sampled at AOI 6.

6.9.2 AOI 6 Groundwater Analytical Results

Figure 6-11 and **Figure 6-13** present the ranges of detections in groundwater at AOI 6. **Table 6-5** summarizes the groundwater results.

Groundwater was sampled from temporary monitoring wells AOI06-01, AOI06-02, and AOI06-03. PFOS was detected above the SL of 4 ng/L at all three wells, with concentrations of 13.8 ng/L, 8.77 ng/L, and 4.71 ng/L.

PFOA, PFHxS, PFNA, and PFBS were detected below their SLs, with a maximum concentration of 2.69 J ng/L.

6.9.3 AOI 6 Conclusions

Based on the results of the SI, PFOS was detected in groundwater above the SL. All detections in soil were below the SLs. Based on the exceedances of the SL in groundwater, further evaluation at AOI 6 is warranted.

6.10 AOI 7

This section presents the analytical results for soil and groundwater in comparison to SLs for AOI 7: Buildings 2-166, 2-203, 2-233, and 2-272. The results in soil and groundwater are

presented in **Table 6-2** through **Table 6-5**. Soil and groundwater results are presented on **Figure 6-1** through **Figure 6-13**.

6.10.1 AOI 7 Soil Analytical Results

Figure 6-2, **Figure 6-4**, **Figure 6-6**, **Figure 6-8**, and **Figure 6-10** present the ranges of detections in soil at AOI 7. **Table 6-2** through **Table 6-4** summarize the soil results.

Soil was sampled from surface soil (0 to 2 feet bgs) from boring locations AOI07-01 through AOI07-04. Soil was also sampled from shallow subsurface soil (between 3 and 13 feet bgs) from all boring locations, and deep subsurface soil (15 to 17 feet bgs) from boring location AOI07-04. PFOS, PFHxS, PFBS, PFOA, and PFNA were detected at concentrations below their SLs, with the highest concentration of 7.06 µg/kg observed at AOI07-02 for PFOS.

PFOS, PFHxS, and PFBS were detected in shallow subsurface soil, at concentrations below their SLs, with the maximum concentration of 18.1 µg/kg observed at AOI07-02 for PFOS. PFOA and PFNA were not detected in shallow subsurface soil. There were no detections in deep subsurface soil.

6.10.2 AOI 7 Groundwater Analytical Results

Figure 6-12 and **Figure 6-13** present the ranges of detections in groundwater at AOI 7. **Table 6-5** summarizes the groundwater results.

Groundwater was sampled from temporary monitoring wells AOI07-01 through AOI07-04. The following exceedances of the SLs were measured:

- PFOA was detected above the SL of 6 ng/L in AOI07-02, with a concentration of 6.20 ng/L.
- PFOS was detected above the SL of 4 ng/L at AOI07-01 through AOI07-03, with concentrations ranging from 35.4 ng/L to 237 ng/L at location A0I07-01.
- PFHxS was detected above the SL of 39 ng/L at AOI07-01, with a concentration of 172 ng/L.

PFBS was detected below the SL of 601 ng/L in AOI07-01 through AOI07-03, with a maximum concentration of 14.2 ng/L at AOI07-01. PFNA was not detected in any of the wells.

6.10.3 AOI 7 Conclusions

Based on the results of the SI, PFOA, PFOS and PFHxS were detected in groundwater at concentrations above their respective SLs. All detections in soil were below their respective SLs. Based on the exceedances of the SLs in groundwater, further evaluation at AOI 7 is warranted.

6.11 AOI 8

This section presents the analytical results for soil and groundwater in comparison to SLs for AOI 8: Building 8-195. The results in soil and groundwater are presented in **Table 6-2** through **Table 6-5**. Soil and groundwater results are presented on **Figure 6-1** through **Figure 6-7**.

6.11.1 AOI 8 Soil Analytical Results

Figure 6-1, **Figure 6-3**, **Figure 6-5**, **Figure 6-7**, and **Figure 6-9** present the ranges of detections in soil at AOI 8. **Table 6-2** through **Table 6-4** summarize the soil results.

Soil was sampled from surface soil (0 to 2 feet bgs) from boring locations AOI08-01 through AOI08-03. Soil was also sampled from shallow subsurface soil (between 5 and 12.5 feet bgs) from all boring locations, and deep subsurface soil (15 to 16.5 feet bgs) from AOI08-01. In surface soil, PFOS, PFHxS, and PFNA were detected at concentrations below their SLs, with a maximum concentration of 10.2 µg/kg observed at AOI08-01 for PFOS. PFBS and PFOA were not detected in surface soil.

PFOA, PFOS, PFHxS, and PFNA were detected in shallow subsurface soil, at concentrations below the SLs. PFOA, PFHxS, and PFNA were detected below their SLs at AOI08-01, with a maximum concentration of 1.66 µg/kg for PFNA. PFOS was detected at AOI08-01 and AOI08-02 with concentrations of 30.6 µg/kg and 0.287 J µg/kg, respectively. PFBS was not detected in shallow subsurface soil, and results for AOI08-03 were non-detect for all six analytes.

PFHxS was detected in deep subsurface soil at a concentration of 0.363 J µg/kg at AOI08-01.

6.11.2 AOI 8 Groundwater Analytical Results

Figure 6-11 and **Figure 6-13** present the ranges of detections in groundwater at AOI 8. **Table 6-5** summarizes the groundwater results.

Groundwater was sampled from temporary monitoring wells AOI08-01, AOI08-02, and AOI08-03. The following exceedances of the SLs were measured:

- PFOA was detected above the SL of 6 ng/L in AOI08-01, with a concentration of 20.3 ng/L.
- PFOS was detected above the SL of 4 ng/L at all three wells, with concentrations ranging from of 19.9 ng/L to 71.0 ng/L at location AOI08-02.
- PFHxS was detected above the SL of 39 ng/L in AOI08-01 with a concentration of 247 ng/L.

PFBS was detected below the SL of 601 ng/L at two of the three wells, with a maximum concentration of 5.71 ng/L. PFNA was not detected in any of the wells.

6.11.3 AOI 8 Conclusions

Based on the results of the SI, PFOA, PFOS, and PFHxS were detected in groundwater at concentrations above their SLs. All detections in soil were below their SLs. Based on the exceedances of the SLs in groundwater, further evaluation at AOI 8 is warranted.

Table 6-2
PFOA, PFOS, PFBS, PFNA, and PFHxS Results in Surface Soil
Site Inspection Report, Camp Ripley

Area of Interest		AOI01						AOI02						AOI03						AOI04	
Sample ID		AOI01-01-SB-00-02		AOI01-02-SB-00-02		AOI01-03-SB-00-02		AOI02-01-SB-00-02		AOI02-02-SB-00-02		AOI02-03-SB-00-02		AOI03-01-SB-00-02		AOI03-02-SB-00-02		AOI03-03-SB-00-02		AOI04-01-SB-00-02	
Sample Date		06/08/2022		06/07/2022		06/08/2022		06/08/2022		06/08/2022		06/08/2022		06/09/2022		06/09/2022		06/09/2022		06/13/2022	
Depth		0-2 ft		0-2 ft		0-2 ft		0-2 ft		0-2 ft		0-2 ft		0-2 ft		0-2 ft		0-2 ft		0-2 ft	
Analyte	OSD Screening Level [a]	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual
Soil, LCMSMS compliant with QSM 5.3 Table B-15 (µg/kg)																					
PFBS	1900	ND	U	ND	U	ND	U	ND	U	ND	UJ	ND	U	ND	U	ND	U	ND	U	ND	U
PFHxS	130	0.045	J	0.123	J	ND	U	ND	U	ND	UJ	0.041	J	ND	U	ND	U	ND	U	0.052	J
PFNA	19	ND	U	0.232	J	0.020	J	0.020	J	0.021	J	0.024	J	0.034	J	0.034	J	ND	U	0.056	J
PFOA	19	ND	U	0.086	J	ND	U	ND	U	ND	UJ	ND	U	0.086	J	ND	U	ND	U	0.123	J
PFOS	13	0.272	J	33.6		0.318	J	0.070	J	0.060	J	0.195	J	0.237	J	0.326	J	0.056	J	1.79	

Grey Fill — Detected concentration exceeded OSD Screening Levels

References

a. Assistant Secretary of Defense, July 2022. Risk Based Screening Levels Calculated for PFOA, PFOS, PFBS, PFHxS, and PFNA in Groundwater or Soil using USEPA's Regional Screening Level Calculator. HQ=0.1, May 2022. Soil screening levels based on residential scenario for incidental ingestion of contaminated soil.

Interpreted Qualifiers

J = Estimated concentration

U = The analyte was not detected at a level greater than or equal to the adjusted DL

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
PFHxS	perfluorohexanesulfonic acid
PFNA	perfluorononanoic 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 with tandem mass spectrometry
LOD	limit of detection
ND	analyte not detected above the LOD
OSD	Office of the Secretary of Defense
QSM	Quality Systems Manual
Qual	interpreted qualifier
SB	soil boring
USEPA	United States Environmental Protection Agency
µg/kg	micrograms per kilogram

Table 6-2
PFOA, PFOS, PFBS, PFNA, and PFHxS Results in Surface Soil
Site Inspection Report, Camp Ripley

Area of Interest		AOI04										AOI05									
Sample ID		AOI04-02-SB-00-02		AOI04-03-SB-00-02		AOI04-04-SB-01-03		AOI04-05-SB-00-02		AOI04-05-SB-00-02-D		AOI05-01-SB-00-02		AOI05-02-SB-00-02		AOI05-03-SB-00-02		AOI05-03-SB-00-02-D		AOI05-04-SB-00-02	
Sample Date		06/13/2022		06/11/2022		06/13/2022		06/11/2022		06/11/2022		06/14/2022		06/14/2022		06/14/2022		06/14/2022		06/14/2022	
Depth		0-2 ft		0-2 ft		1-3 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	Result	Qual	Result	Qual
Soil, LCMSMS compliant with QSM 5.3 Table B-15 (µg/kg)																					
PFBS	1900	ND	U	ND	U	ND	U	ND	U	ND	U	0.025	J	0.066	J	ND	U	ND	U	ND	U
PFHxS	130	0.091	J	0.034	J	ND	U	ND	U	ND	U	0.066	J	0.084	J	ND	U	ND	U	ND	U
PFNA	19	0.039	J	0.136	J	ND	U	0.114	J	ND	UJ	0.089	J	0.294	J	0.022	J	0.023	J	0.046	J
PFOA	19	ND	U	0.154	J	ND	U	ND	U	ND	U	0.338	J	0.985	J	ND	U	ND	U	ND	U
PFOS	13	0.604	J	1.30		ND	U	0.587	J	0.082	J	0.843	J	1.33		0.074	J	0.076	J	0.145	J

Grey Fill — Detected concentration exceeded OSD Screening Levels

References

a. Assistant Secretary of Defense, July 2022. Risk Based Screening Levels Calculated for PFOA, PFOS, PFBS, PFHxS, and PFNA in Groundwater or Soil using USEPA's Regional Screening Level Calculator. HQ=0.1, May 2022. Soil screening levels based on residential scenario for incidental ingestion of contaminated soil.

Interpreted Qualifiers

J = Estimated concentration

U = The analyte was not detected at a level greater than or equal to the adjusted DL

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
PFHxS	perfluorohexanesulfonic acid
PFNA	perfluorononanoic 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 with tandem mass spectrometry
LOD	limit of detection
ND	analyte not detected above the LOD
OSD	Office of the Secretary of Defense
QSM	Quality Systems Manual
Qual	interpreted qualifier
SB	soil boring
USEPA	United States Environmental Protection Agency
µg/kg	micrograms per kilogram

Table 6-2
PFOA, PFOS, PFBS, PFNA, and PFHxS Results in Surface Soil
Site Inspection Report, Camp Ripley

Area of Interest		AOI05												AOI06						AOI07	
Sample ID		AOI05-05-SB-00-02		AOI05-06-SB-00-02		AOI05-07-SB-00-02		AOI05-08-SB-00-02		AOI05-08-SB-00-02-D		AOI05-09-SB-00-02		AOI06-01-SB-00-02		AOI06-02-SB-00-02		AOI06-03-SB-00-02		AOI07-01-SB-00-02	
Sample Date		06/10/2022		06/10/2022		06/10/2022		06/10/2022		06/10/2022		06/10/2022		06/14/2022		06/13/2022		06/13/2022		06/10/2022	
Depth		0-2 ft		0-2 ft		0-2 ft		0-2 ft		0-2 ft		0-2 ft		0-2 ft		0-2 ft		0-2 ft		0-2 ft	
Analyte	**OSD Screening Level [a]**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**
Soil, LCMSMS compliant with QSM 5.3 Table B-15 (µg/kg)																					
PFBS	1900	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U	0.180	J	ND	U	ND	U
PFHxS	130	0.104	J	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U	0.174	J	ND	U	0.211	J
PFNA	19	0.066	J	ND	U	0.131	J	0.049	J	0.042	J	0.021	J	ND	U	0.194	J	0.039	J	0.036	J
PFOA	19	0.161	J	ND	U	ND	U	0.135	J	0.125	J	ND	U	ND	U	0.220	J	ND	U	0.170	J
PFOS	13	1.29		0.242	J	1.00	J	0.395	J	0.355	J	0.302	J	0.069	J	0.256	J	0.118	J	1.59	

Grey Fill — Detected concentration exceeded OSD Screening Levels

References

a. Assistant Secretary of Defense, July 2022. Risk Based Screening Levels Calculated for PFOA, PFOS, PFBS, PFHxS, and PFNA in Groundwater or Soil using USEPA's Regional Screening Level Calculator. HQ=0.1, May 2022. Soil screening levels based on residential scenario for incidental ingestion of contaminated soil.

Interpreted Qualifiers

J = Estimated concentration

U = The analyte was not detected at a level greater than or equal to the adjusted DL

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
PFHxS	perfluorohexanesulfonic acid
PFNA	perfluorononanoic 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 with tandem mass spectrometry
LOD	limit of detection
ND	analyte not detected above the LOD
OSD	Office of the Secretary of Defense
QSM	Quality Systems Manual
Qual	interpreted qualifier
SB	soil boring
USEPA	United States Environmental Protection Agency
µg/kg	micrograms per kilogram

Table 6-2
PFOA, PFOS, PFBS, PFNA, and PFHxS Results in Surface Soil
Site Inspection Report, Camp Ripley

Area of Interest		AOI07								AOI08							
Sample ID		AOI07-02-SB-00-02		AOI07-02-SB-00-02-D		AOI07-03-SB-00-02		AOI07-04-SB-00-02		AOI08-01-SB-00-02		AOI08-02-SB-00-02		AOI08-02-SB-00-02-D		AOI08-03-SB-00-02	
Sample Date		06/10/2022		06/10/2022		06/13/2022		06/10/2022		06/07/2022		06/07/2022		06/07/2022		06/07/2022	
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, LCMSMS compliant with QSM 5.3 Table B-15 (µg/kg)																	
PFBS	1900	0.045	J	0.053	J	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U
PFHxS	130	0.679	J	0.672	J	0.037	J	ND	U	0.219	J	0.135	J	0.038	J	ND	U
PFNA	19	0.020	J	0.021	J	0.020	J	ND	U	0.032	J	ND	UJ	0.023	J	ND	U
PFOA	19	0.093	J	0.099	J	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U
PFOS	13	6.79		7.06		0.068	J	0.054	J	10.2		0.197	J	0.582	J	0.112	J

Grey Fill — Detected concentration exceeded OSD Screening Levels

References

a. Assistant Secretary of Defense, July 2022. Risk Based Screening Levels Calculated for PFOA, PFOS, PFBS, PFHxS, and PFNA in Groundwater or Soil using USEPA's Regional Screening Level Calculator. HQ=0.1, May 2022. Soil screening levels based on residential scenario for incidental ingestion of contaminated soil.

Interpreted Qualifiers

J = Estimated concentration

U = The analyte was not detected at a level greater than or equal to the adjusted DL

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
PFHxS	perfluorohexanesulfonic acid
PFNA	perfluorononanoic 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 with tandem mass spectrometry
LOD	limit of detection
ND	analyte not detected above the LOD
OSD	Office of the Secretary of Defense
QSM	Quality Systems Manual
Qual	interpreted qualifier
SB	soil boring
USEPA	United States Environmental Protection Agency
µg/kg	micrograms per kilogram

Table 6-3
PFOA, PFOS, PFBS, PFNA, and PFHxS Results in Shallow Subsurface Soil
Site Inspection Report, Camp Ripley

Area of Interest		AOI01												AOI02							
Sample ID		AOI01-01-SB-06-08		AOI01-01-SB-10.5-12.5		AOI01-02-SB-6.5-8.5		AOI01-02-SB-6.5-8.5-D		AOI01-02-SB-11.3-13.3		AOI01-03-SB-07-09		AOI02-01-SB-04-06		AOI02-01-SB-08-10		AOI02-02-SB-05-07		AOI02-02-SB-10-12	
Sample Date		06/08/2022		06/08/2022		06/07/2022		06/07/2022		06/07/2022		06/08/2022		06/08/2022		06/08/2022		06/08/2022		06/08/2022	
Depth		6-8 ft		10.5-12.5 ft		6.5-8.5 ft		6.5-8.5 ft		11.3-13.3 ft		7-9 ft		4-6 ft		8-10 ft		5-7 ft		10-12 ft	
Analyte	**OSD Screening Level [a]**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**
Soil, LCMSMS compliant with QSM 5.3 Table B-15 (µg/kg)																					
PFBS	25000	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U
PFHxS	1600	0.039	J	ND	U	0.116	J	0.091	J	0.126	J	ND	U	ND	U	ND	U	ND	U	ND	U
PFNA	250	ND	U	ND	U	0.028	J	0.026	J	0.021	J	ND	U	ND	U	ND	U	ND	U	ND	U
PFOA	250	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U
PFOS	160	ND	U	ND	U	1.13		1.18		4.45		ND	U	ND	U	ND	U	ND	U	ND	U

Grey Fill — Detected concentration exceeded OSD Screening Levels

References

a. Assistant Secretary of Defense, July 2022. Risk Based Screening Levels Calculated for PFOA, PFOS, PFBS, PFHxS, and PFNA in Groundwater or Soil using USEPA's Regional Screening Level Calculator. HQ=0.1, May 2022. Soil screening levels based on industrial/commercial composite worker scenario for incidental ingestion of contaminated soil.

Interpreted Qualifiers

J = Estimated concentration

J+ = Estimated concentration, biased high

U = The analyte was not detected at a level greater than or equal to the adjusted DL

Notes

ND = Analyte not detected above the LOD. LOD values are presented in Appendix F.

Chemical Abbreviations

PFBS	perfluorobutanesulfonic acid
PFHxS	perfluorohexanesulfonic acid
PFNA	perfluorononanoic acid
PFOA	perfluorooctanoic acid
PFOS	perfluorooctanesulfonic acid

Acronyms and Abbreviations

AASF	Army Aviation Support Facility
AOI	Area of Interest
D	duplicate
DL	detection limit
ft	feet
HQ	hazard quotient
ID	identification
LCMSMS	liquid chromatography with tandem mass spectrometry
LOD	limit of detection
ND	analyte not detected above the LOD
OSD	Office of the Secretary of Defense
QSM	Quality Systems Manual
Qual	interpreted qualifier
SB	soil boring
USEPA	United States Environmental Protection Agency
µg/kg	micrograms per kilogram

Table 6-3
PFOA, PFOS, PFBS, PFNA, and PFHxS Results in Shallow Subsurface Soil
Site Inspection Report, Camp Ripley

Area of Interest		AOI02				AOI03										AOI04					
Sample ID		AOI02-03-SB-03-05		AOI02-03-SB-06-08		AOI03-01-6.3-8.3		AOI03-02-SB-05-07		AOI03-02-SB-05-07-D		AOI03-02-SB-10-11.5		AOI03-03-SB-10-12		AOI04-01-SB-03-05		AOI04-01-SB-5.5-7.5		AOI04-01-SB-5.5-7.5-D	
Sample Date		06/08/2022		06/08/2022		06/09/2022		06/09/2022		06/09/2022		06/09/2022		06/09/2022		06/13/2022		06/13/2022		06/13/2022	
Depth		3-5 ft		6-8 ft		6.3-8.3 ft		5-7 ft		5-7 ft		10-11.5 ft		10-12 ft		3-5 ft		5.5-7.5 ft		5.5-7.5 ft	
Analyte	OSD Screening Level [a]	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual
Soil, LCMSMS compliant with QSM 5.3 Table B-15 (µg/kg)																					
PFBS	25000	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U
PFHxS	1600	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U
PFNA	250	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U
PFOA	250	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U
PFOS	160	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U	0.208	J+	ND	U	ND	U

Grey Fill — Detected concentration exceeded OSD Screening Levels

References

a. Assistant Secretary of Defense, July 2022. Risk Based Screening Levels Calculated for PFOA, PFOS, PFBS, PFHxS, and PFNA in Groundwater or Soil using USEPA's Regional Screening Level Calculator. HQ=0.1, May 2022. Soil screening levels based on industrial/commercial composite worker scenario for incidental ingestion of contaminated soil.

Interpreted Qualifiers

J = Estimated concentration

J+ = Estimated concentration, biased high

U = The analyte was not detected at a level greater than or equal to the adjusted DL

Notes

ND = Analyte not detected above the LOD. LOD values are presented in Appendix F.

Chemical Abbreviations

PFBS	perfluorobutanesulfonic acid
PFHxS	perfluorohexanesulfonic acid
PFNA	perfluorononanoic acid
PFOA	perfluorooctanoic acid
PFOS	perfluorooctanesulfonic acid

Acronyms and Abbreviations

AASF	Army Aviation Support Facility
AOI	Area of Interest
D	duplicate
DL	detection limit
ft	feet
HQ	hazard quotient
ID	identification
LCMSMS	liquid chromatography with tandem mass spectrometry
LOD	limit of detection
ND	analyte not detected above the LOD
OSD	Office of the Secretary of Defense
QSM	Quality Systems Manual
Qual	interpreted qualifier
SB	soil boring
USEPA	United States Environmental Protection Agency
µg/kg	micrograms per kilogram

Table 6-3
PFOA, PFOS, PFBS, PFNA, and PFHxS Results in Shallow Subsurface Soil
Site Inspection Report, Camp Ripley

Area of Interest		AOI04																		AOI05	
Sample ID		AOI04-02-SB-07-09		AOI04-02-SB-11.5-13.5		AOI04-03-SB-03-05		AOI04-03-SB-5.5-6.5		AOI04-03-SB-5.5-6.5-D		AOI04-04-SB-03-05		AOI04-04-SB-5.5-7.5		AOI04-05-SB-05-07		AOI04-05-SB-10.5-12.5		AOI05-01-SB-04-06	
Sample Date		06/13/2022		06/13/2022		06/11/2022		06/11/2022		06/11/2022		06/13/2022		06/13/2022		06/11/2022		06/11/2022		06/14/2022	
Depth		7-9 ft		11.5-13.5 ft		3-5 ft		5.5-6.5 ft		5.5-6.5 ft		3-5 ft		5.5-7.5 ft		5-7 ft		10.5-12.5 ft		4-6 ft	
Analyte	**OSD Screening Level [a]**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**
Soil, LCMSMS compliant with QSM 5.3 Table B-15 (µg/kg)																					
PFBS	25000	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U	0.022	J
PFHxS	1600	0.066	J	0.054	J	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U	0.048	J
PFNA	250	ND	U	ND	U	0.088	J	0.082	J	0.108	J	ND	U	ND	U	ND	U	ND	U	ND	U
PFOA	250	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U
PFOS	160	ND	U	ND	U	0.684	J	0.421	J	0.517	J	ND	U	ND	U	ND	U	ND	U	0.145	J

Grey Fill — Detected concentration exceeded OSD Screening Levels

References

a. Assistant Secretary of Defense, July 2022. Risk Based Screening Levels Calculated for PFOA, PFOS, PFBS, PFHxS, and PFNA in Groundwater or Soil using USEPA's Regional Screening Level Calculator. HQ=0.1, May 2022. Soil screening levels based on industrial/commercial composite worker scenario for incidental ingestion of contaminated soil.

Interpreted Qualifiers

J = Estimated concentration

J+ = Estimated concentration, biased high

U = The analyte was not detected at a level greater than or equal to the adjusted DL

Notes

ND = Analyte not detected above the LOD. LOD values are presented in Appendix F.

Chemical Abbreviations

PFBS	perfluorobutanesulfonic acid
PFHxS	perfluorohexanesulfonic acid
PFNA	perfluorononanoic acid
PFOA	perfluorooctanoic acid
PFOS	perfluorooctanesulfonic acid

Acronyms and Abbreviations

AASF	Army Aviation Support Facility
AOI	Area of Interest
D	duplicate
DL	detection limit
ft	feet
HQ	hazard quotient
ID	identification
LCMSMS	liquid chromatography with tandem mass spectrometry
LOD	limit of detection
ND	analyte not detected above the LOD
OSD	Office of the Secretary of Defense
QSM	Quality Systems Manual
Qual	interpreted qualifier
SB	soil boring
USEPA	United States Environmental Protection Agency
µg/kg	micrograms per kilogram

Table 6-3
PFOA, PFOS, PFBS, PFNA, and PFHxS Results in Shallow Subsurface Soil
Site Inspection Report, Camp Ripley

Area of Interest		AOI05																AOI06			
Sample ID		AOI05-01-SB-08-10		AOI05-02-SB-03-05		AOI05-02-SB-05-07		AOI05-03-SB-03-05		AOI05-04-SB-03-05		AOI05-05-SB-02-04		AOI05-06-SB-05-07		AOI05-06-SB-11-13		AOI06-01-SB-03-05		AOI06-02-SB-03-05	
Sample Date		06/14/2022		06/14/2022		06/14/2022		06/14/2022		06/14/2022		06/10/2022		06/10/2022		06/10/2022		06/14/2022		06/13/2022	
Depth		8-10 ft		3-5 ft		5-7 ft		3-5 ft		3-5 ft		2-4 ft		5-7 ft		11-13 ft		3-5 ft		3-5 ft	
Analyte	**OSD Screening Level [a]**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**
Soil, LCMSMS compliant with QSM 5.3 Table B-15 (µg/kg)																					
PFBS	25000	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U	0.073	J	ND	U	ND	U
PFHxS	1600	ND	U	ND	U	ND	U	ND	U	ND	U	0.036	J	ND	U	0.043	J	ND	U	ND	U
PFNA	250	ND	U	0.051	J	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U
PFOA	250	ND	U	0.167	J	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U
PFOS	160	0.088	J	0.260	J	ND	U	0.055	J	ND	U	0.131	J	0.222	J	ND	U	ND	U	ND	U

Grey Fill — Detected concentration exceeded OSD Screening Levels

References

a. Assistant Secretary of Defense, July 2022. Risk Based Screening Levels Calculated for PFOA, PFOS, PFBS, PFHxS, and PFNA in Groundwater or Soil using USEPA's Regional Screening Level Calculator. HQ=0.1, May 2022. Soil screening levels based on industrial/commercial composite worker scenario for incidental ingestion of contaminated soil.

Interpreted Qualifiers

J = Estimated concentration

J+ = Estimated concentration, biased high

U = The analyte was not detected at a level greater than or equal to the adjusted DL

Notes

ND = Analyte not detected above the LOD. LOD values are presented in Appendix F.

Chemical Abbreviations

PFBS	perfluorobutanesulfonic acid
PFHxS	perfluorohexanesulfonic acid
PFNA	perfluorononanoic acid
PFOA	perfluorooctanoic acid
PFOS	perfluorooctanesulfonic acid

Acronyms and Abbreviations

AASF	Army Aviation Support Facility
AOI	Area of Interest
D	duplicate
DL	detection limit
ft	feet
HQ	hazard quotient
ID	identification
LCMSMS	liquid chromatography with tandem mass spectrometry
LOD	limit of detection
ND	analyte not detected above the LOD
OSD	Office of the Secretary of Defense
QSM	Quality Systems Manual
Qual	interpreted qualifier
SB	soil boring
USEPA	United States Environmental Protection Agency
µg/kg	micrograms per kilogram

Table 6-3
PFOA, PFOS, PFBS, PFNA, and PFHxS Results in Shallow Subsurface Soil
Site Inspection Report, Camp Ripley

Area of Interest		AOI06				AOI07														AOI08	
Sample ID		AOI06-03-SB-03-05		AOI06-03-SB-05-07		AOI07-01-SB-03-05		AOI07-01-SB-06-08		AOI07-02-SB-05-07		AOI07-02-SB-10-12		AOI07-03-SB-06-08		AOI07-03-SB-11-13		AOI07-04-SB-06-08		AOI08-01-SB-7.5-8.5	
Sample Date		06/13/2022		06/13/2022		06/10/2022		06/10/2022		06/10/2022		06/10/2022		06/13/2022		06/13/2022		06/10/2022		06/07/2022	
Depth		3-5 ft		5-7 ft		3-5 ft		6-8 ft		5-7 ft		10-12 ft		6-8 ft		11-13 ft		6-8 ft		7.5-8.5 ft	
Analyte	OSD Screening Level [a]	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual
Soil, LCMSMS compliant with QSM 5.3 Table B-15 (µg/kg)																					
PFBS	25000	ND	U	ND	U	ND	U	ND	U	0.023	J	ND	U	ND	U	ND	U	ND	U	ND	U
PFHxS	1600	ND	U	ND	U	0.051	J	0.126	J	0.926	J	0.149	J	ND	U	ND	U	ND	U	0.700	J
PFNA	250	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U	1.66	
PFOA	250	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U	0.891	J
PFOS	160	0.052	J	ND	U	ND	U	ND	U	18.1		0.785	J	ND	U	ND	U	ND	U	30.6	

Grey Fill — Detected concentration exceeded OSD Screening Levels

References

a. Assistant Secretary of Defense, July 2022. Risk Based Screening Levels Calculated for PFOA, PFOS, PFBS, PFHxS, and PFNA in Groundwater or Soil using USEPA's Regional Screening Level Calculator. HQ=0.1, May 2022. Soil screening levels based on industrial/commercial composite worker scenario for incidental ingestion of contaminated soil.

Interpreted Qualifiers

J = Estimated concentration

J+ = Estimated concentration, biased high

U = The analyte was not detected at a level greater than or equal to the adjusted DL

Notes

ND = Analyte not detected above the LOD. LOD values are presented in Appendix F.

Chemical Abbreviations

PFBS	perfluorobutanesulfonic acid
PFHxS	perfluorohexanesulfonic acid
PFNA	perfluorononanoic acid
PFOA	perfluorooctanoic acid
PFOS	perfluorooctanesulfonic acid

Acronyms and Abbreviations

AASF	Army Aviation Support Facility
AOI	Area of Interest
D	duplicate
DL	detection limit
ft	feet
HQ	hazard quotient
ID	identification
LCMSMS	liquid chromatography with tandem mass spectrometry
LOD	limit of detection
ND	analyte not detected above the LOD
OSD	Office of the Secretary of Defense
QSM	Quality Systems Manual
Qual	interpreted qualifier
SB	soil boring
USEPA	United States Environmental Protection Agency
µg/kg	micrograms per kilogram

Table 6-3
PFOA, PFOS, PFBS, PFNA, and PFHxS Results in Shallow Subsurface Soil
Site Inspection Report, Camp Ripley

Area of Interest		AOI08							
Sample ID		AOI08-02-SB-05-07		AOI08-02-SB-10-12		AOI08-03-SB-05-07		AOI08-03-SB-11.5-12.5	
Sample Date		06/07/2022		06/07/2022		06/07/2022		06/07/2022	
Depth		5-7 ft		10-12 ft		5-7 ft		11.5-12.5 ft	
Analyte	**OSD Screening Level [a]**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**
Soil, LCMSMS compliant with QSM 5.3 Table B-15 (µg/kg)									
PFBS	25000	ND	U	ND	U	ND	U	ND	U
PFHxS	1600	ND	U	ND	U	ND	U	ND	U
PFNA	250	ND	U	ND	U	ND	U	ND	U
PFOA	250	ND	U	ND	U	ND	U	ND	U
PFOS	160	0.287	J	ND	U	ND	U	ND	U

Grey Fill — Detected concentration exceeded OSD Screening Levels

References

a. Assistant Secretary of Defense, July 2022. Risk Based Screening Levels Calculated for PFOA, PFOS, PFBS, PFHxS, and PFNA in Groundwater or Soil using USEPA's Regional Screening Level Calculator. HQ=0.1, May 2022. Soil screening levels based on industrial/commercial composite worker scenario for incidental ingestion of contaminated soil.

Interpreted Qualifiers

J = Estimated concentration

J+ = Estimated concentration, biased high

U = The analyte was not detected at a level greater than or equal to the adjusted DL

Notes

ND = Analyte not detected above the LOD. LOD values are presented in Appendix F.

Chemical Abbreviations

PFBS	perfluorobutanesulfonic acid
PFHxS	perfluorohexanesulfonic acid
PFNA	perfluorononanoic acid
PFOA	perfluorooctanoic acid
PFOS	perfluorooctanesulfonic acid

Acronyms and Abbreviations

AASF	Army Aviation Support Facility
AOI	Area of Interest
D	duplicate
DL	detection limit
ft	feet
HQ	hazard quotient
ID	identification
LCMSMS	liquid chromatography with tandem mass spectrometry
LOD	limit of detection
ND	analyte not detected above the LOD
OSD	Office of the Secretary of Defense
QSM	Quality Systems Manual
Qual	interpreted qualifier
SB	soil boring
USEPA	United States Environmental Protection Agency
µg/kg	micrograms per kilogram

Table 6-4
PFOA, PFOS, PFBS, PFNA, and PFHxS Results in Deep Subsurface Soil
Site Inspection Report, Camp Ripley

Area of Interest	AOI01				AOI03				AOI07		AOI08	
Sample ID	AOI01-03-SB-15-17		AOI01-03-SB-15-17-D		AOI03-01-SB-15-17		AOI03-03-SB-15-16		AOI07-04-SB-15-17		AOI08-01-SB-15-16.5	
Sample Date	06/08/2022		06/08/2022		06/09/2022		06/09/2022		06/10/2022		06/07/2022	
Depth	15-17 ft		15-17 ft		15-17 ft		15-16 ft		15-17 ft		15-16.5 ft	
Analyte	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**
Soil, LCMSMS compliant with QSM 5.3 Table B-15 (µg/kg)												
PFBS	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U
PFHxS	ND	U	ND	U	ND	U	ND	U	ND	U	0.363	J
PFNA	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U
PFOA	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U
PFOS	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U

Interpreted Qualifiers

J = Estimated concentration

U = The analyte was not detected at a level greater than or equal to the adjusted DL

Chemical Abbreviations

PFBS	perfluorobutanesulfonic acid
PFHxS	perfluorohexanesulfonic acid
PFNA	perfluorononanoic acid
PFOA	perfluorooctanoic acid
PFOS	perfluorooctanesulfonic acid

Acronyms and Abbreviations

AOI	Area of Interest
D	duplicate
DL	detection limit
ft	feet
ID	identification
LCMSMS	liquid chromatography with tandem mass spectrometry
LOD	limit of detection
ND	analyte not detected above the LOD
QSM	Quality Systems Manual
Qual	interpreted qualifier
SB	soil boring
µg/kg	micrograms per kilogram

Table 6-5
PFOA, PFOS, PFBS, PFNA, and PFHxS Results in Groundwater
Site Inspection Report, Camp Ripley

Area of Interest		AOI01								AOI02								AOI03	
Sample ID		AOI01-01-GW		AOI01-02-GW		AOI01-03-GW		AOI01-03-GW-D		AOI02-01-GW		AOI02-01-GW-D		AOI02-02-GW		AOI02-03-GW		AOI03-01-GW	
Sample Date		06/08/2022		06/07/2022		06/08/2022		06/08/2022		06/09/2022		06/09/2022		06/09/2022		06/09/2022		06/10/2022	
Analyte	**OSD Screening Level [a]**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**
Water, LCMSMS compliant with QSM 5.3 Table B-15 (ng/l)																			
PFBS	601	2.11	J	10.8		ND	UJ	0.691	J	0.872	J	ND	UJ	0.972	J	ND	U	1.36	J
PFHxS	39	12.1		216		ND	U	ND	U	10.9		9.72		ND	U	23.0		ND	U
PFNA	6	ND	U	34.9		ND	U	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U
PFOA	6	6.16		56.0		ND	U	ND	U	8.92		7.95		ND	U	ND	U	2.13	J
PFOS	4	3.57	J	1500		15.4		15.0		20.5		17.9		3.81	J	0.921	J	1.64	J

Grey Fill — Detected concentration exceeded OSD Screening Levels

References

a. Assistant Secretary of Defense, July 2022. Risk Based Screening Levels Calculated for PFOA, PFOS, PFBS, PFHxS, and PFNA in Groundwater or Soil using USEPA's Regional Screening Level Calculator. HQ=0.1, May 2022 Groundwater screening levels based on residential scenario for direct ingestion of groundwater.

Interpreted Qualifiers

J = Estimated concentration

U = The analyte was not detected at a level greater than or equal to the adjusted DL

Notes

ND = Analyte not detected above the LOD. LOD values are presented in Appendix F.

Chemical Abbreviations

PFBS	perfluorobutanesulfonic acid
PFHxS	perfluorohexanesulfonic acid
PFNA	perfluorononanoic acid
PFOA	perfluorooctanoic acid
PFOS	perfluorooctanesulfonic acid

Acronyms and Abbreviations

AASF	Army Aviation Support Facility
AOI	Area of Interest
D	duplicate
DL	detection limit
GW	groundwater
HQ	hazard quotient
ID	identification
LCMSMS	liquid chromatography with tandem mass spectrometry
LOD	limit of detection
ND	analyte not detected above the LOD
OSD	Office of the Secretary of Defense
QSM	Quality Systems Manual
Qual	interpreted qualifier
USEPA	United States Environmental Protection Agency
ng/l	nanogram per liter

Table 6-5
PFOA, PFOS, PFBS, PFNA, and PFHxS Results in Groundwater
Site Inspection Report, Camp Ripley

Area of Interest		AOI03				AOI04										AOI05			
Sample ID		AOI03-02-GW		AOI03-03-GW		AOI04-01-GW		AOI04-02-GW		AOI04-03-GW		AOI04-04-GW		AOI04-05-GW		AOI05-482900-GW		AOI05-530012-GW	
Sample Date		06/10/2022		06/10/2022		06/13/2022		06/14/2022		06/11/2022		06/14/2022		06/11/2022		06/13/2022		06/11/2022	
Analyte	**OSD Screening Level [a]**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**
Water, LCMSMS compliant with QSM 5.3 Table B-15 (ng/l)																			
PFBS	601	1.26	J	1.48	J	0.667	J	4.81		ND	U	6.56		ND	U	ND	U	0.980	J
PFHxS	39	ND	U	ND	U	4.50		9.15		2.34	J	132		1.86	J	ND	U	13.0	
PFNA	6	ND	U	ND	U	ND	U	ND	U	14.7		ND	U	ND	U	ND	U	ND	U
PFOA	6	3.76	J	1.32	J	ND	U	ND	U	6.79		15.0		ND	U	ND	U	4.28	
PFOS	4	2.80	J	1.32	J	3.08	J	1.95	J	25.2		74.2		17.6		1.99	J	6.87	

Grey Fill — Detected concentration exceeded OSD Screening Levels

References

a. Assistant Secretary of Defense, July 2022. Risk Based Screening Levels Calculated for PFOA, PFOS, PFBS, PFHxS, and PFNA in Groundwater or Soil using USEPA's Regional Screening Level Calculator. HQ=0.1, May 2022 Groundwater screening levels based on residential scenario for direct ingestion of groundwater.

Interpreted Qualifiers

J = Estimated concentration

U = The analyte was not detected at a level greater than or equal to the adjusted DL

Notes

ND = Analyte not detected above the LOD. LOD values are presented in Appendix F.

Chemical Abbreviations

PFBS	perfluorobutanesulfonic acid
PFHxS	perfluorohexanesulfonic acid
PFNA	perfluorononanoic acid
PFOA	perfluorooctanoic acid
PFOS	perfluorooctanesulfonic acid

Acronyms and Abbreviations

AASF	Army Aviation Support Facility
AOI	Area of Interest
D	duplicate
DL	detection limit
GW	groundwater
HQ	hazard quotient
ID	identification
LCMSMS	liquid chromatography with tandem mass spectrometry
LOD	limit of detection
ND	analyte not detected above the LOD
OSD	Office of the Secretary of Defense
QSM	Quality Systems Manual
Qual	interpreted qualifier
USEPA	United States Environmental Protection Agency
ng/l	nanogram per liter

Table 6-5
PFOA, PFOS, PFBS, PFNA, and PFHxS Results in Groundwater
Site Inspection Report, Camp Ripley

Area of Interest		AOI05																AOI06	
Sample ID		AOI05-530012-GW-D		AOI05-536846-GW		AOI05-773250-GW		AOI05-02-GW		AOI05-03-GW		AOI05-04-GW		AOI05-05-GW		AOI05-06-GW		AOI06-01-GW	
Sample Date		06/11/2022		06/08/2022		06/08/2022		06/16/2022		06/15/2022		06/14/2022		06/10/2022		06/10/2022		06/14/2022	
Analyte	OSD Screening Level [a]	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual
Water, LCMSMS compliant with QSM 5.3 Table B-15 (ng/l)																			
PFBS	601	0.652	J	ND	U	18.4		ND	U	ND	U	ND	U	1.15	J	3.11	J	0.735	J
PFHxS	39	9.68		ND	U	ND	U	ND	U	ND	U	ND	U	11.7		43.0		2.37	J
PFNA	6	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U	1.67	J	1.06	J
PFOA	6	3.43	J	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U	5.24		1.59	J
PFOS	4	5.49		ND	U	ND	U	ND	U	ND	U	0.956	J	21.2		62.4		13.8	

Grey Fill — Detected concentration exceeded OSD Screening Levels

References

a. Assistant Secretary of Defense, July 2022. Risk Based Screening Levels Calculated for PFOA, PFOS, PFBS, PFHxS, and PFNA in Groundwater or Soil using USEPA's Regional Screening Level Calculator. HQ=0.1, May 2022 Groundwater screening levels based on residential scenario for direct ingestion of groundwater.

Interpreted Qualifiers

J = Estimated concentration

U = The analyte was not detected at a level greater than or equal to the adjusted DL

Notes

ND = Analyte not detected above the LOD. LOD values are presented in Appendix F.

Chemical Abbreviations

PFBS	perfluorobutanesulfonic acid
PFHxS	perfluorohexanesulfonic acid
PFNA	perfluorononanoic acid
PFOA	perfluorooctanoic acid
PFOS	perfluorooctanesulfonic acid

Acronyms and Abbreviations

AASF	Army Aviation Support Facility
AOI	Area of Interest
D	duplicate
DL	detection limit
GW	groundwater
HQ	hazard quotient
ID	identification
LCMSMS	liquid chromatography with tandem mass spectrometry
LOD	limit of detection
ND	analyte not detected above the LOD
OSD	Office of the Secretary of Defense
QSM	Quality Systems Manual
Qual	interpreted qualifier
USEPA	United States Environmental Protection Agency
ng/l	nanogram per liter

Table 6-5
PFOA, PFOS, PFBS, PFNA, and PFHxS Results in Groundwater
Site Inspection Report, Camp Ripley

Area of Interest		AOI06				AOI07										AOI08			
Sample ID		AOI06-02-GW		AOI06-03-GW		AOI07-01-GW		AOI07-02-GW		AOI07-02-GW-D		AOI07-03-GW		AOI07-04-GW		AOI08-01-GW		AOI08-02-GW	
Sample Date		06/14/2022		06/14/2022		06/13/2022		06/10/2022		06/10/2022		06/14/2022		06/11/2022		06/07/2022		06/07/2022	
Analyte	**OSD Screening Level [a]**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**
Water, LCMSMS compliant with QSM 5.3 Table B-15 (ng/l)																			
PFBS	601	0.655	J	0.817	J	14.2		0.707	J	0.930	J	1.74	J	ND	U	5.71		0.785	J
PFHxS	39	2.69	J	1.81	J	172		17.9		19.6		2.69	J	1.87	J	247		4.26	
PFNA	6	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U
PFOA	6	ND	U	0.935	J	5.04		5.39		6.20		4.96		ND	U	20.3		2.28	J
PFOS	4	8.77		4.71		237		93.7		107		35.4		1.26	J	34.6		71.0	

Grey Fill — Detected concentration exceeded OSD Screening Levels

References

a. Assistant Secretary of Defense, July 2022. Risk Based Screening Levels Calculated for PFOA, PFOS, PFBS, PFHxS, and PFNA in Groundwater or Soil using USEPA's Regional Screening Level Calculator. HQ=0.1, May 2022 Groundwater screening levels based on residential scenario for direct ingestion of groundwater.

Interpreted Qualifiers

J = Estimated concentration

U = The analyte was not detected at a level greater than or equal to the adjusted DL

Notes

ND = Analyte not detected above the LOD. LOD values are presented in Appendix F.

Chemical Abbreviations

PFBS	perfluorobutanesulfonic acid
PFHxS	perfluorohexanesulfonic acid
PFNA	perfluorononanoic acid
PFOA	perfluorooctanoic acid
PFOS	perfluorooctanesulfonic acid

Acronyms and Abbreviations

AASF	Army Aviation Support Facility
AOI	Area of Interest
D	duplicate
DL	detection limit
GW	groundwater
HQ	hazard quotient
ID	identification
LCMSMS	liquid chromatography with tandem mass spectrometry
LOD	limit of detection
ND	analyte not detected above the LOD
OSD	Office of the Secretary of Defense
QSM	Quality Systems Manual
Qual	interpreted qualifier
USEPA	United States Environmental Protection Agency
ng/l	nanogram per liter

Table 6-5
PFOA, PFOS, PFBS, PFNA, and PFHxS Results in Groundwater
Site Inspection Report, Camp Ripley

	Area of Interest	AOI08	
	Sample ID	AOI08-03-GW	
	Sample Date	06/07/2022	
Analyte	OSD Screening Level [a]	Result	Qual
Water, LCMSMS compliant with QSM 5.3 Table B-15 (ng/l)			
PFBS	601	ND	U
PFHxS	39	2.28	J
PFNA	6	ND	U
PFOA	6	1.84	J
PFOS	4	19.9	

Grey Fill — Detected concentration exceeded OSD Screening Levels

References

a. Assistant Secretary of Defense, July 2022. Risk Based Screening Levels Calculated for PFOA, PFOS, PFBS, PFHxS, and PFNA in Groundwater or Soil using USEPA's Regional Screening Level Calculator. HQ=0.1, May 2022 Groundwater screening levels based on residential scenario for direct ingestion of groundwater.

Interpreted Qualifiers

J = Estimated concentration

U = The analyte was not detected at a level greater than or equal to the adjusted DL

Notes

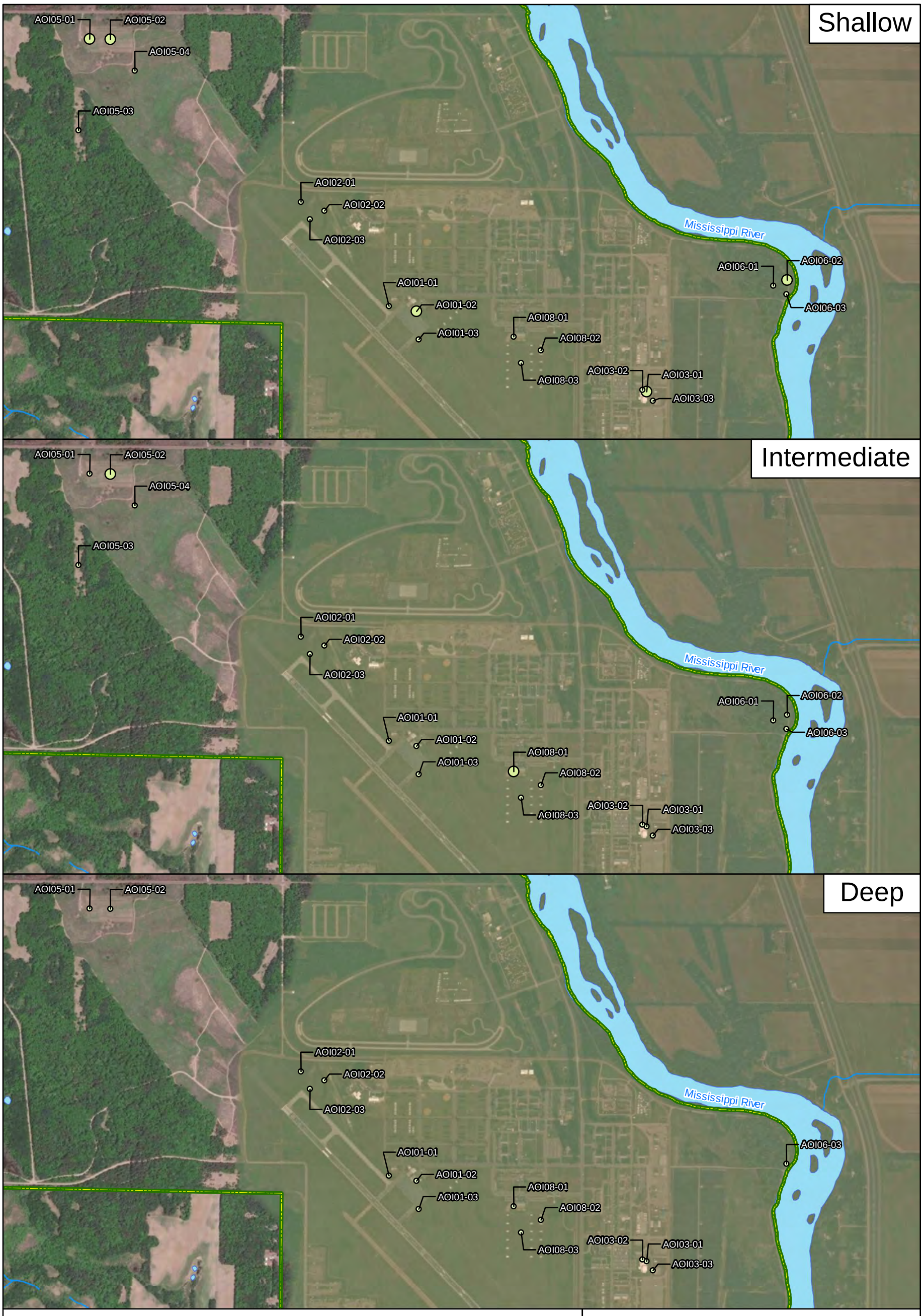
ND = Analyte not detected above the LOD. LOD values are presented in Appendix F.

Chemical Abbreviations

PFBS	perfluorobutanesulfonic acid
PFHxS	perfluorohexanesulfonic acid
PFNA	perfluorononanoic acid
PFOA	perfluorooctanoic acid
PFOS	perfluorooctanesulfonic acid

Acronyms and Abbreviations

AASF	Army Aviation Support Facility
AOI	Area of Interest
D	duplicate
DL	detection limit
GW	groundwater
HQ	hazard quotient
ID	identification
LCMSMS	liquid chromatography with tandem mass spectrometry
LOD	limit of detection
ND	analyte not detected above the LOD
OSD	Office of the Secretary of Defense
QSM	Quality Systems Manual
Qual	interpreted qualifier
USEPA	United States Environmental Protection Agency
ng/l	nanogram per liter



PFOA Results (µg/Kg)

- ND
- >ND - 19
- >19 - 250
- >250 - 2,500
- >2,500

Legend

- Facility Boundary
- Water Body
- River/Stream

N

0 850 1,700 3,400 Feet

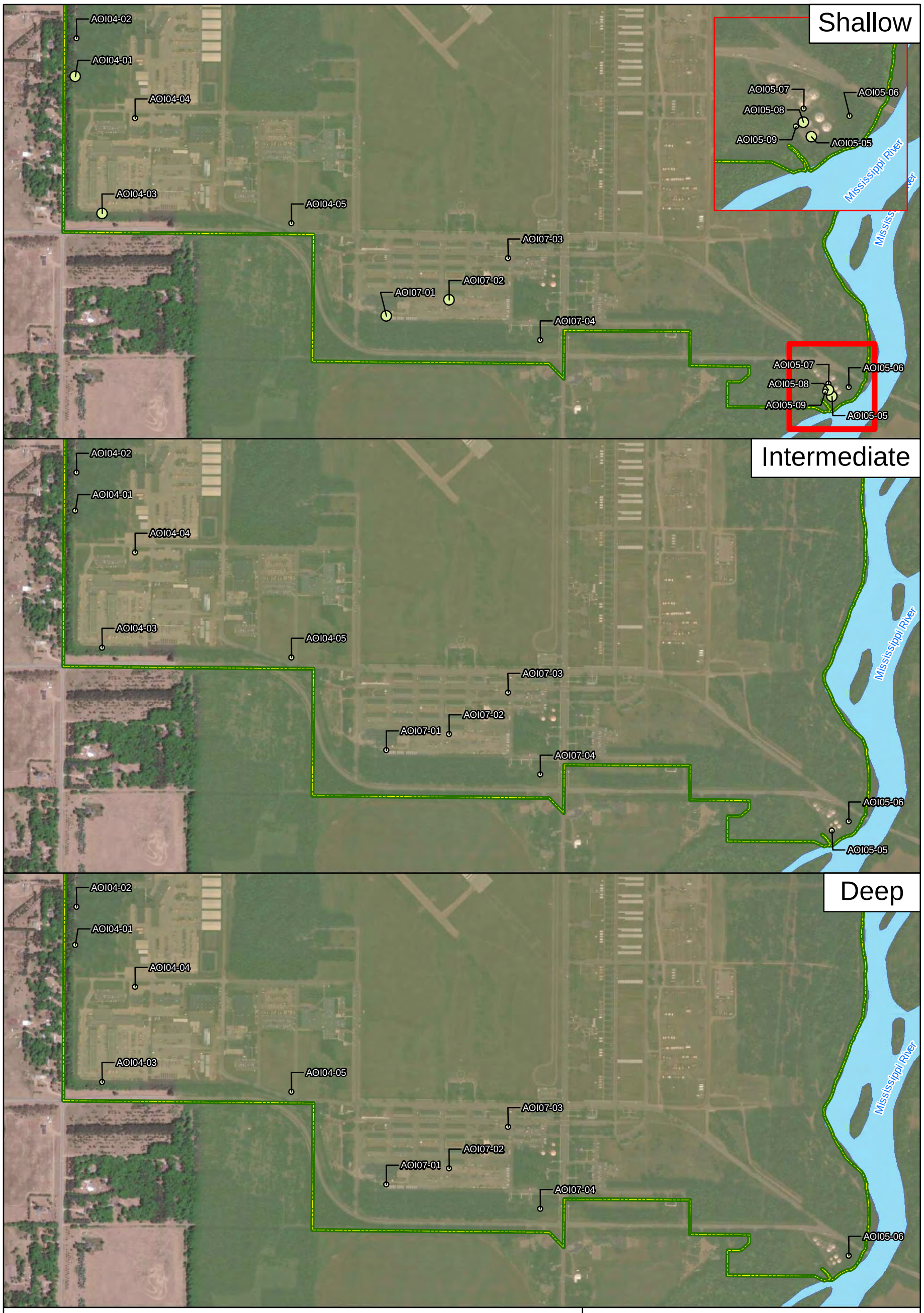
Exceedances of the OSD SL are depicted with a yellow halo.
Depth intervals shown represent respective sampling position within a given soil boring location.

PFOA Detections in Soil, AOI 1, AOI 2, AOI 3, AOI 5, AOI 6 and AOI 8

CLIENT	ARNG			
PROJECT	Site Inspection at Camp Ripley, MN			
REVISED	2/15/2023	GIS BY	MS	2/15/2023
SCALE	1:20,400	CHK BY	AB	2/15/2023
Base Map: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community		PM	CM	2/15/2023

AECOM 12420 Milestone Center Drive Germantown, MD 20876

Figure 6-1



PFOA Results (µg/Kg)

- ND
- >ND - 19
- >19 - 250
- >250 - 2,500
- >2,500

Legend

- Facility Boundary
- Water Body

N

0 510 1,020 2,040 Feet

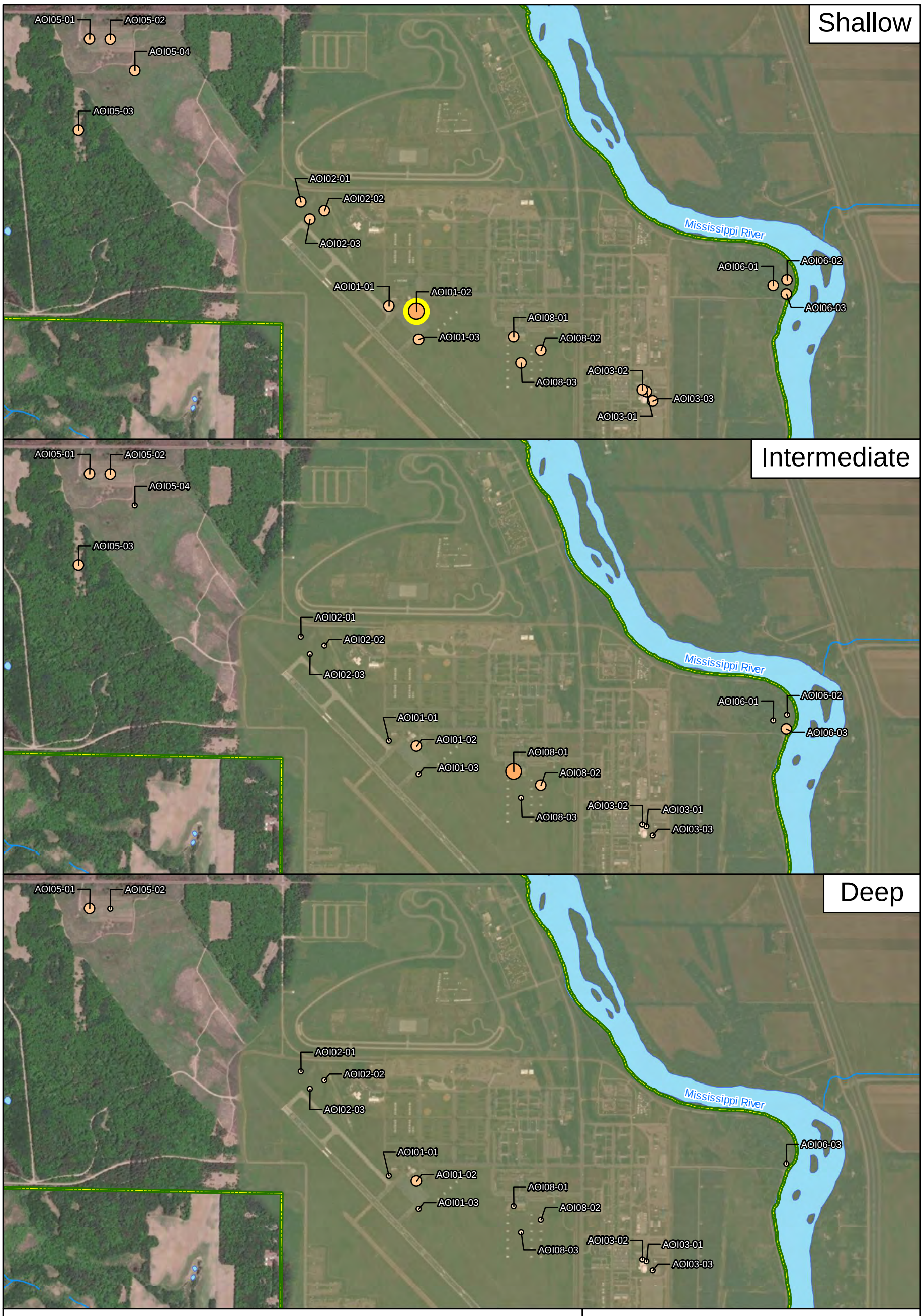
Exceedances of the OSD SL are depicted with a yellow halo.
Depth intervals shown represent respective sampling position within a given soil boring location.

PFOA Detections in Soil, AOI 4, AOI 5, AOI 7

CLIENT	ARNG			
PROJECT	Site Inspection at Camp Ripley, MN			
REVISED	11/21/2022	GIS BY	MS	11/21/2022
SCALE	1:12,240	CHK BY	AB	11/21/2022
Base Map: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community		PM	CM	11/21/2022

AECOM 12420 Milestone Center Drive Germantown, MD 20876

Figure 6-2



Legend

- Facility Boundary
- Water Body
- River/Stream

PFOS Results (µg/Kg)

- ND
- >ND - 13
- >13 - 160
- >160 - 1,600
- >1,600

N

0 850 1,700 3,400 Feet

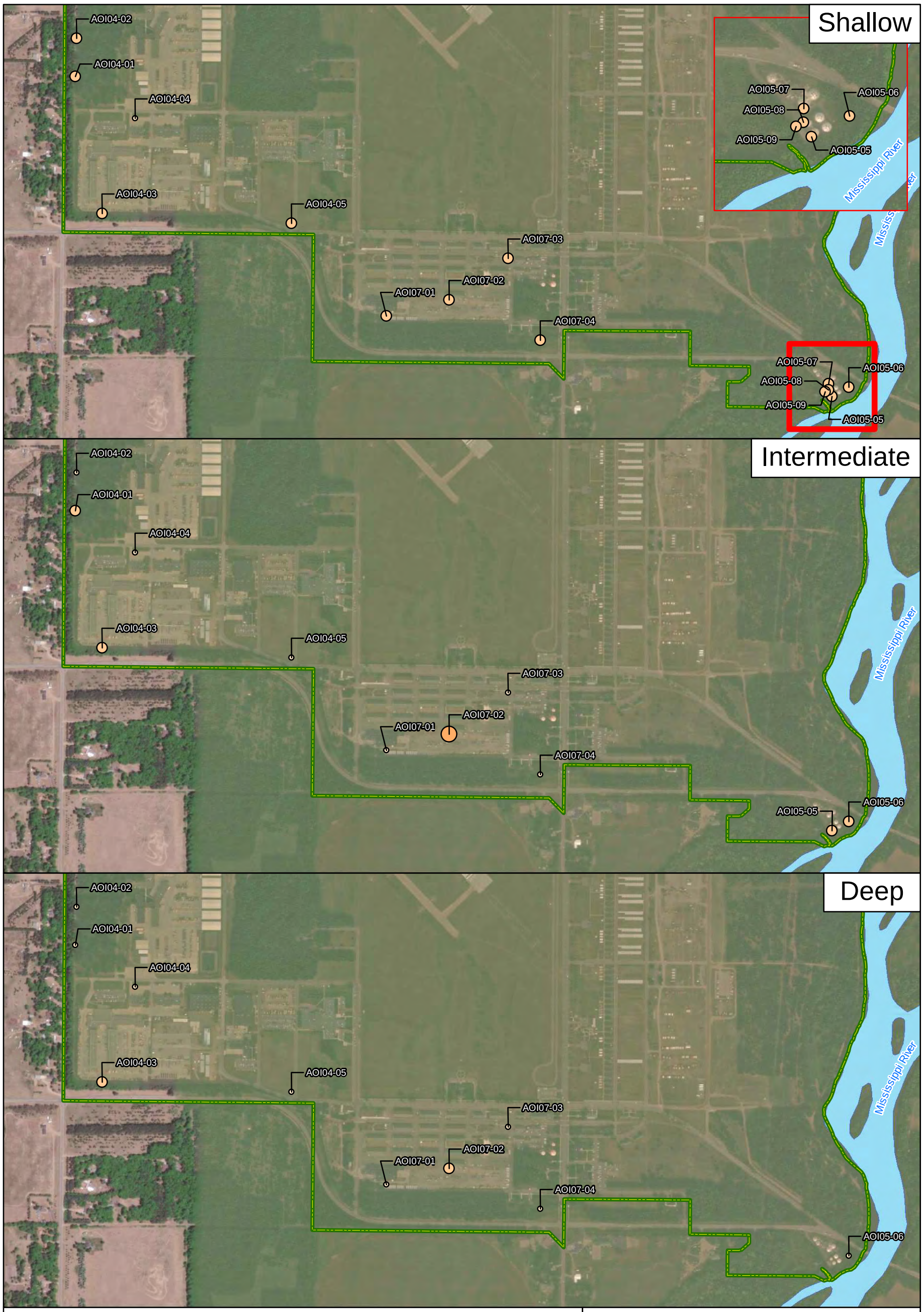
Exceedances of the OSD SL are depicted with a yellow halo.
Depth intervals shown represent respective sampling position within a given soil boring location.

PFOS Detections in Soil, AOI 1, AOI 2, AOI 3, AOI 5, AOI 6 and AOI 8

CLIENT	ARNG			
PROJECT	Site Inspection at Camp Ripley, MN			
REVISED	2/15/2023	GIS BY	MS	2/15/2023
SCALE	1:20,400	CHK BY	AB	2/15/2023
Base Map: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community		PM	CM	2/15/2023

AECOM 12420 Milestone Center Drive Germantown, MD 20876

Figure 6-3



PFOS Results (µg/Kg)

- ND
- >ND - 13
- >13 - 160
- >160 - 1,600
- >1,600

Legend

- Facility Boundary
- Water Body

N

0 510 1,020 2,040 Feet

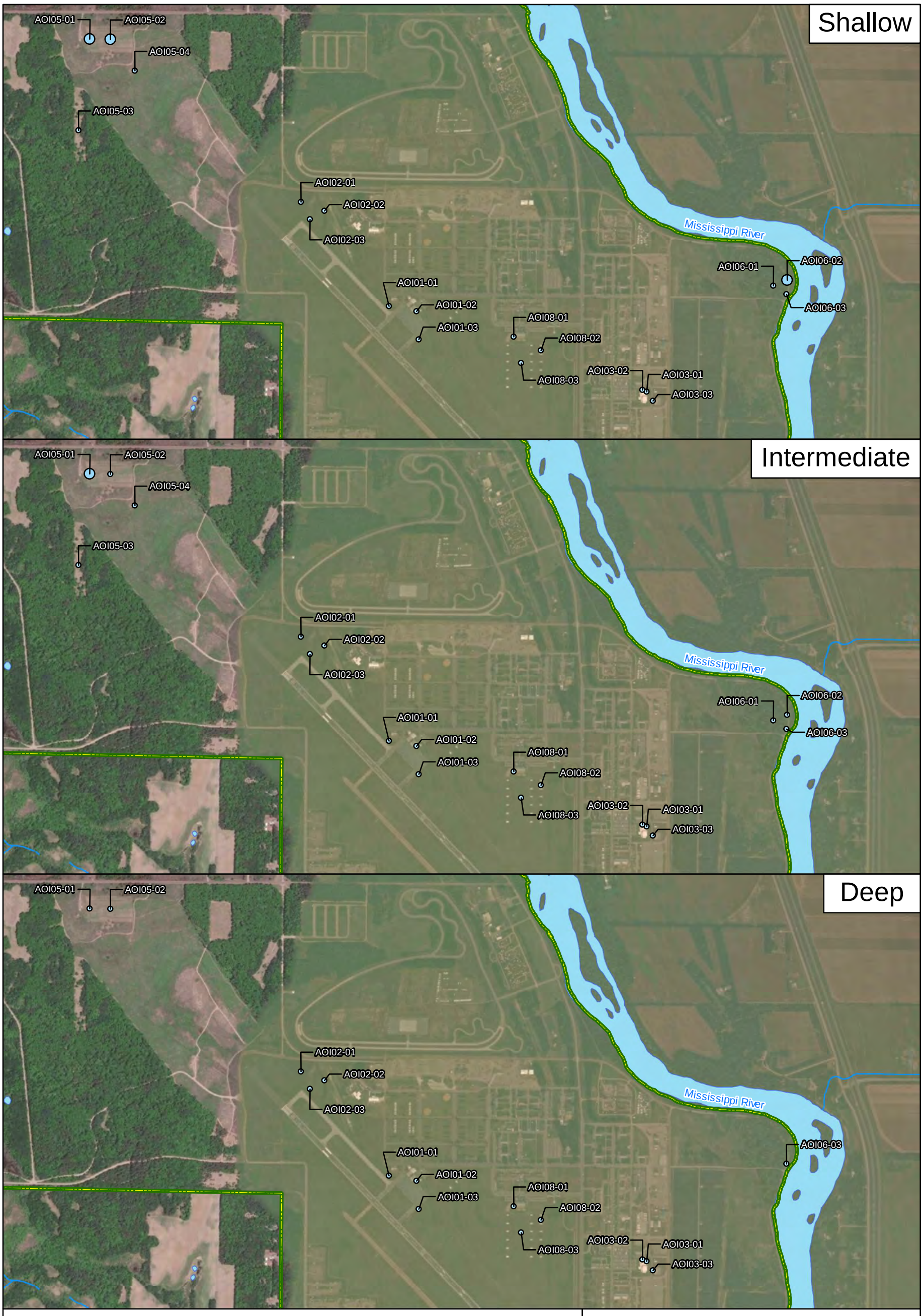
Exceedances of the OSD SL are depicted with a yellow halo.
Depth intervals shown represent respective sampling position within a given soil boring location.

PFOS Detections in Soil, AOI 4, AOI 5, AOI 7

CLIENT	ARNG			
PROJECT	Site Inspection at Camp Ripley, MN			
REVISED	11/21/2022	GIS BY	MS	11/21/2022
SCALE	1:12,240	CHK BY	AB	11/21/2022
Base Map: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community		PM	CM	11/21/2022

AECOM 12420 Milestone Center Drive Germantown, MD 20876

Figure 6-4



PFBS Results (µg/Kg)

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

Legend

- Facility Boundary
- Water Body
- River/Stream

N

0 850 1,700 3,400 Feet

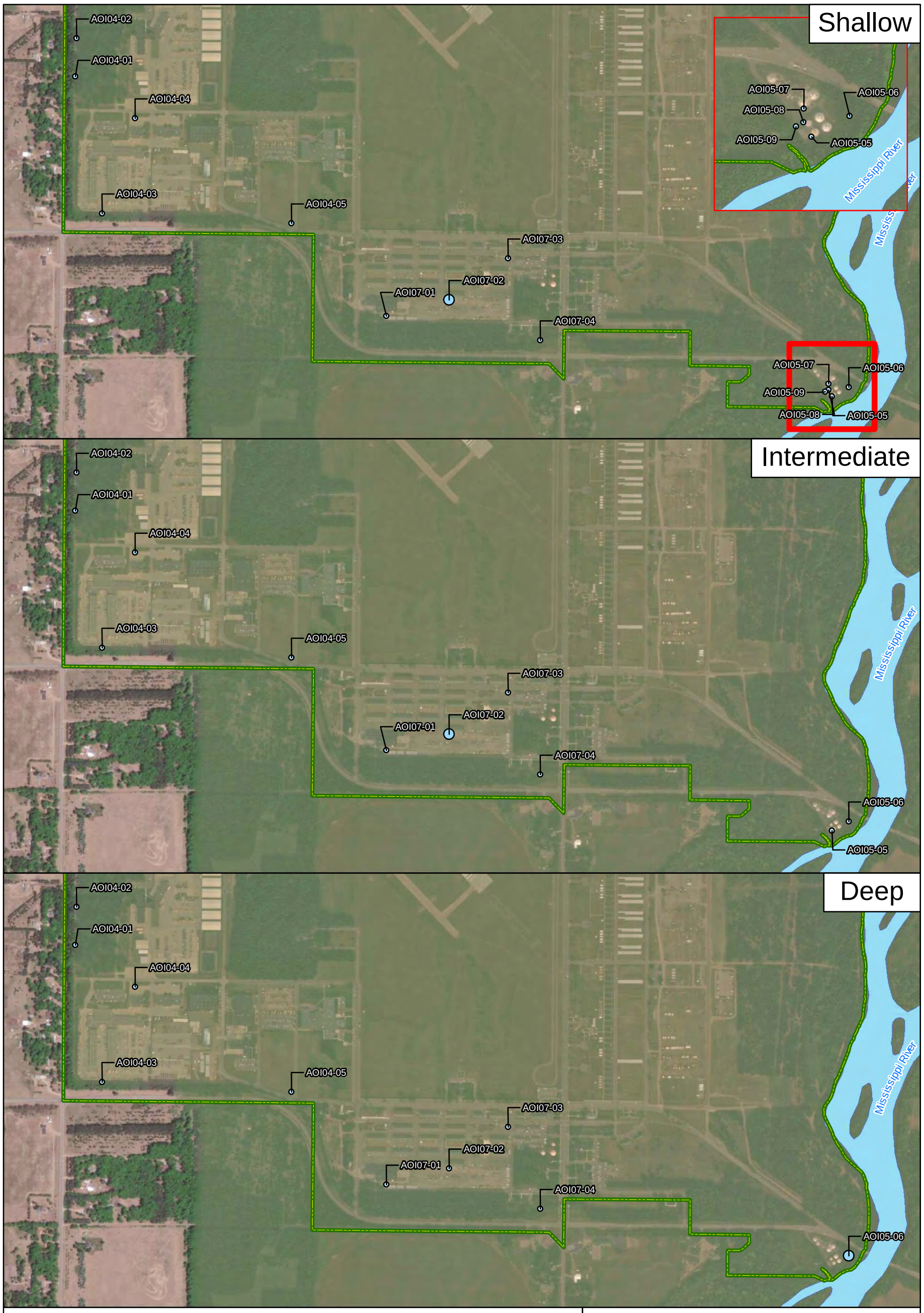
Exceedances of the OSD SL are depicted with a yellow halo.
Depth intervals shown represent respective sampling position within a given soil boring location.

PFBS Detections in Soil, AOI 1, AOI 2, AOI 3, AOI 5, AOI 6, and AOI 8

CLIENT	ARNG			
PROJECT	Site Inspection at Camp Ripley, MN			
REVISED	2/15/2023	GIS BY	MS	2/15/2023
SCALE	1:20,400	CHK BY	AB	2/15/2023
Base Map: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community		PM	CM	2/15/2023

AECOM 12420 Milestone Center Drive Germantown, MD 20876

Figure 6-5



PFBS Results (µg/Kg)

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

Legend

- Facility Boundary
- Water Body

N

0 510 1,020 2,040 Feet

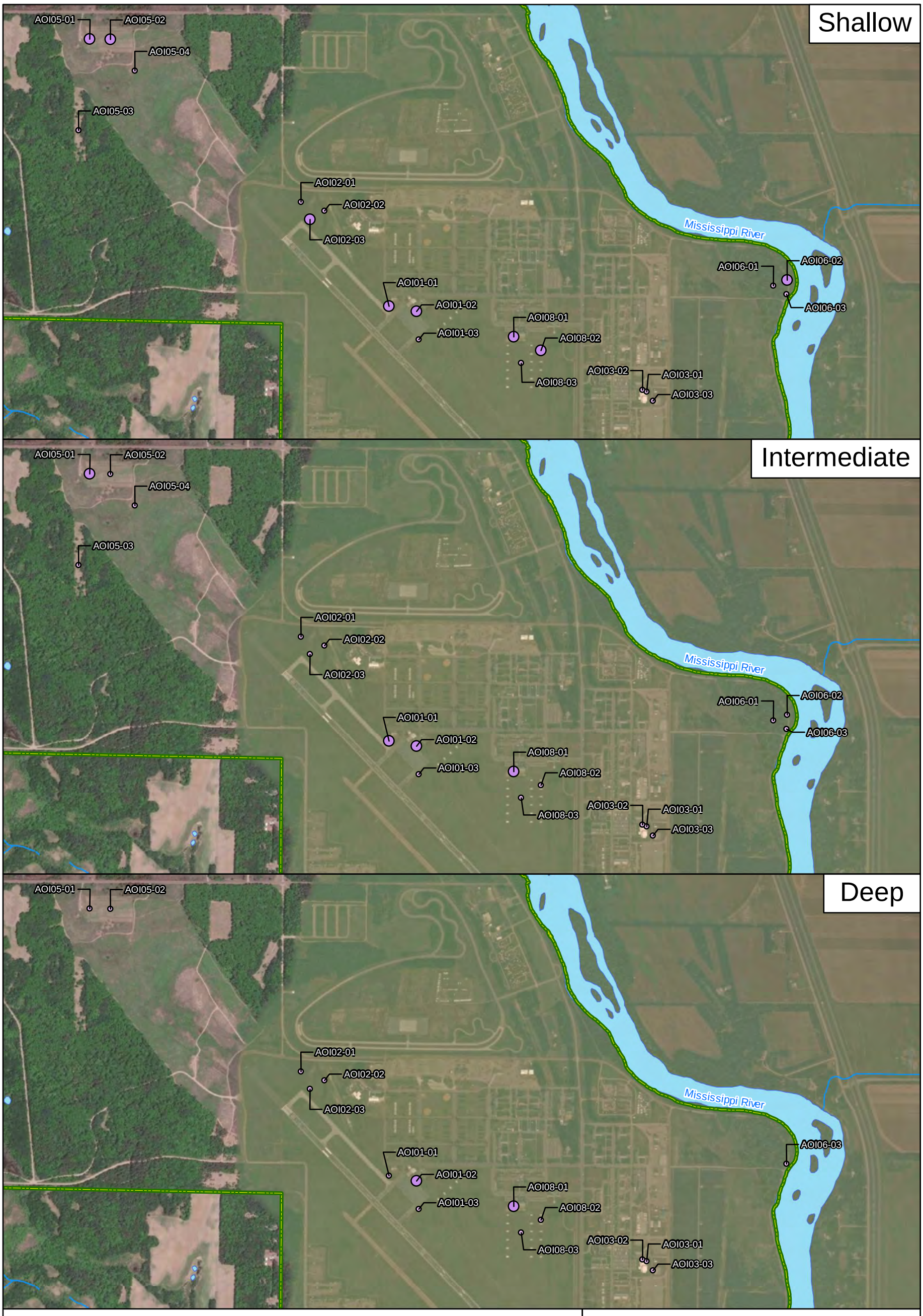
Exceedances of the OSD SL are depicted with a yellow halo.
Depth intervals shown represent respective sampling position within a given soil boring location.

PFBS Detections in Soil, AOI 4, AOI 5, AOI 7

CLIENT	ARNG			
PROJECT	Site Inspection at Camp Ripley, MN			
REVISED	11/21/2022	GIS BY	MS	11/21/2022
SCALE	1:12,240	CHK BY	AB	11/21/2022
Base Map: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community		PM	CM	11/21/2022

AECOM 12420 Milestone Center Drive Germantown, MD 20876

Figure 6-6



Legend

- Facility Boundary
- Water Body
- River/Stream

PFHxS Results (µg/Kg)

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

N

0 850 1,700 3,400 Feet

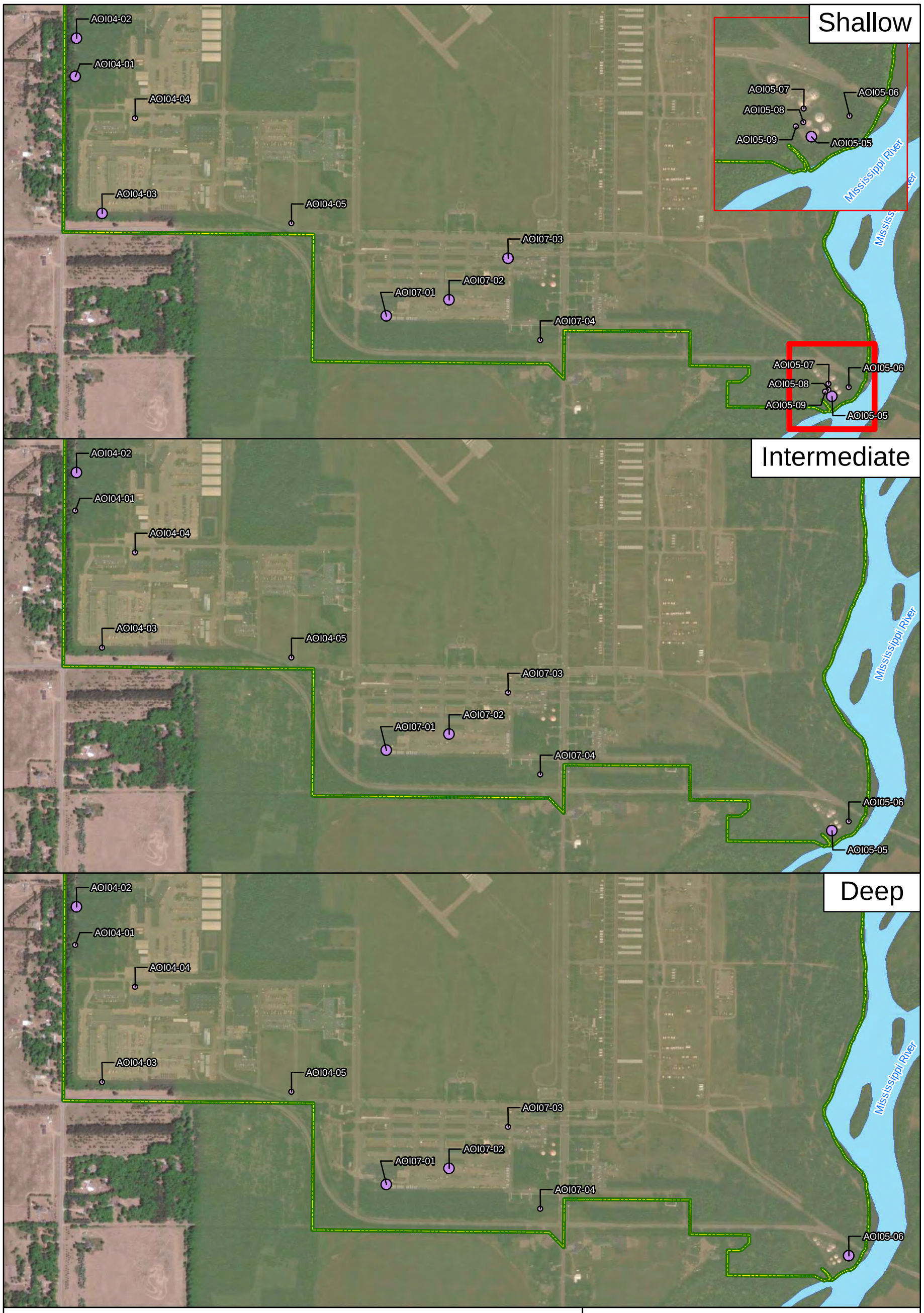
Exceedances of the OSD SL are depicted with a yellow halo.
Depth intervals shown represent respective sampling position within a given soil boring location.

PFHxS Detections in Soil, AOI 1, AOI 2, AOI 3, AOI 5, AOI 6 and AOI 8

CLIENT	ARNG			
PROJECT	Site Inspection at Camp Ripley, MN			
REVISED	2/15/2023	GIS BY	MS	2/15/2023
SCALE	1:20,400	CHK BY	AB	2/15/2023
Base Map: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community		PM	CM	2/15/2023

AECOM 12420 Milestone Center Drive Germantown, MD 20876

Figure 6-7



PFHxS Results (µg/Kg)

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

Legend

- Facility Boundary
- Water Body

N

0 510 1,020 2,040 Feet

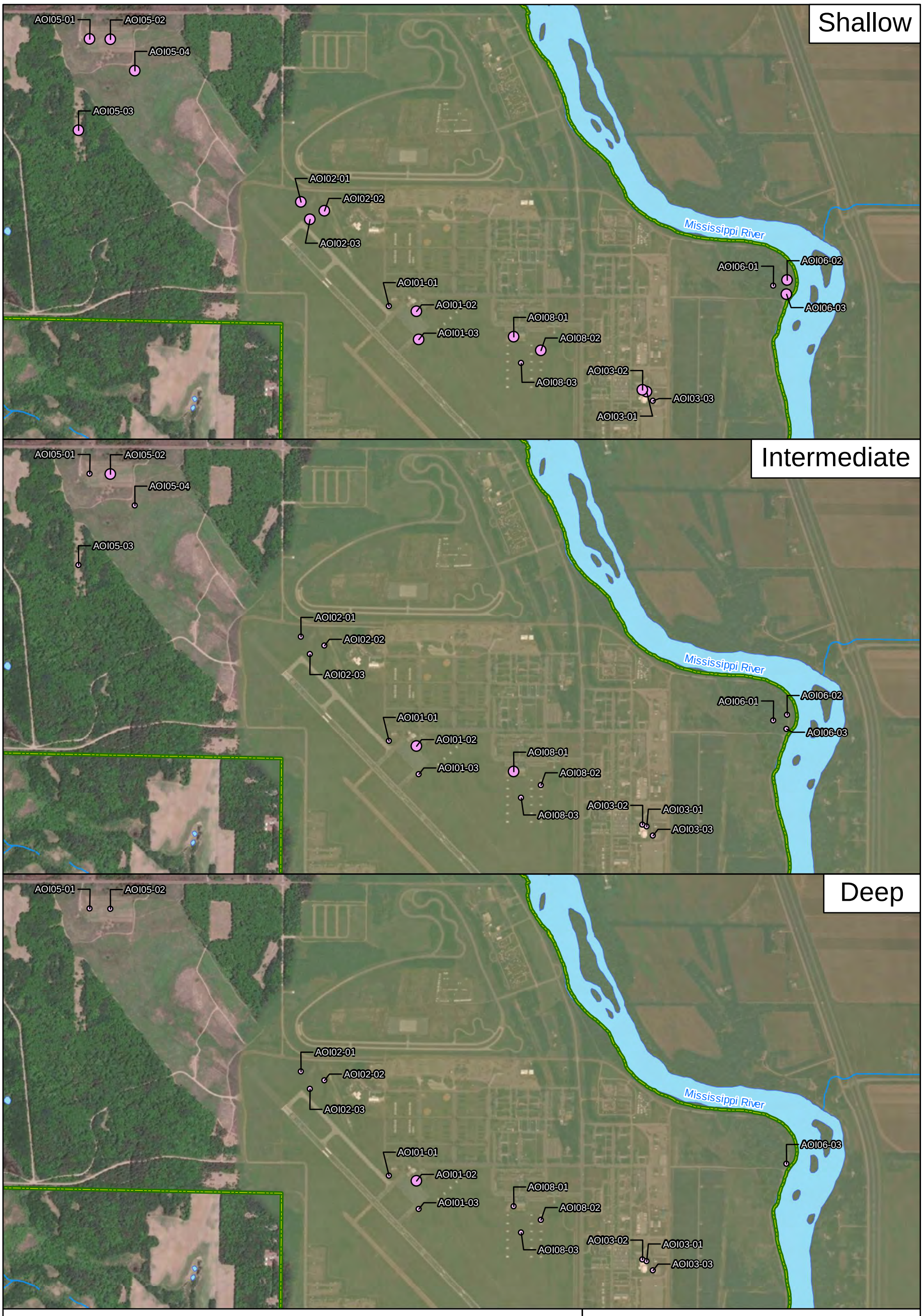
Exceedances of the OSD SL are depicted with a yellow halo.
Depth intervals shown represent respective sampling position within a given soil boring location.

PFHxS Detections in Soil, AOI 4, AOI 5, AOI 7

CLIENT	ARNG			
PROJECT	Site Inspection at Camp Ripley, MN			
REVISED	11/21/2022	GIS BY	MS	11/21/2022
SCALE	1:12,240	CHK BY	AB	11/21/2022
Base Map: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community		PM	CM	11/21/2022

AECOM
12420 Milestone Center Drive
Germantown, MD 20876

Figure 6-8



PFNA Results (µg/Kg)

- ND
- >ND - 19
- >19 - 250
- >250 - 2,500
- >2,500

Legend

- Facility Boundary
- Water Body
- River/Stream

N

0 850 1,700 3,400 Feet

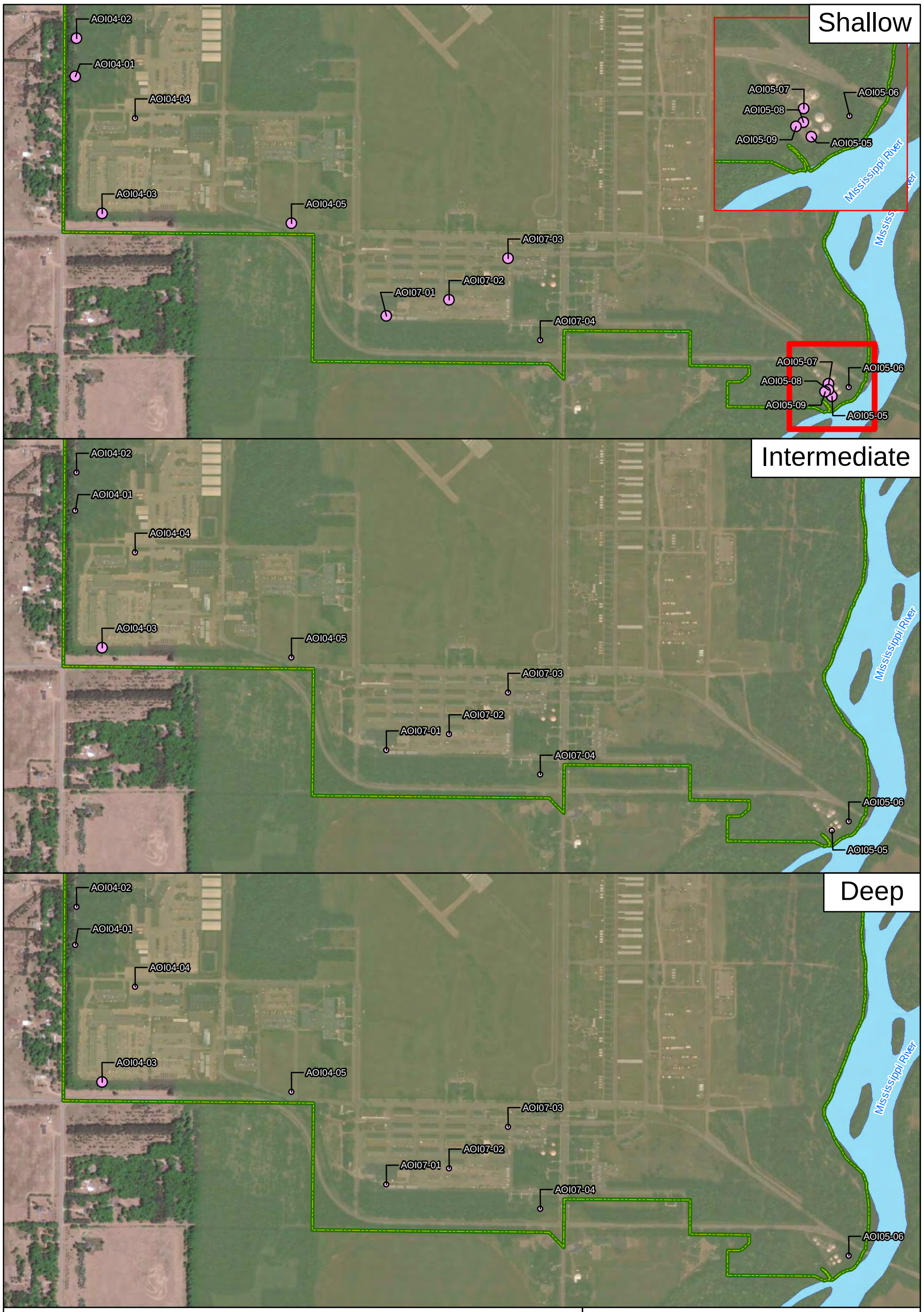
Exceedances of the OSD SL are depicted with a yellow halo.
Depth intervals shown represent respective sampling position within a given soil boring location.

PFNA Detections in Soil, AOI 1, AOI 2, AOI 3, AOI 5, AOI 6 and AOI 8

CLIENT	ARNG			
PROJECT	Site Inspection at Camp Ripley, MN			
REVISED	2/15/2023	GIS BY	MS	2/15/2023
SCALE	1:20,400	CHK BY	AB	2/15/2023
Base Map: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community		PM	CM	2/15/2023

AECOM 12420 Milestone Center Drive Germantown, MD 20876

Figure 6-9



PFNA Results (µg/Kg)

- ND
- >ND - 19
- >19 - 250
- >250 - 2,500
- >2,500

Legend

- Facility Boundary
- Water Body

N

0 510 1,020 2,040 Feet

Exceedances of the OSD SL are depicted with a yellow halo.
Depth intervals shown represent respective sampling position within a given soil boring location.

PFNA Detections in Soil, AOI 4, AOI 5, AOI 7

CLIENT	ARNG			
PROJECT	Site Inspection at Camp Ripley, MN			
REVISED	11/21/2022	GIS BY	MS	11/21/2022
SCALE	1:12,240	CHK BY	AB	11/21/2022
Base Map: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community		PM	CM	11/21/2022

AECOM 12420 Milestone Center Drive Germantown, MD 20876

Figure 6-10

536846 is 3 mi to NW, **PFOA Result: ND**

PFOA

AOI05-02
AOI05-04
AOI05-03
773250
AOI02-01
AOI02-02
AOI02-03
Mississippi River
AOI06-01
AOI06-02
AOI06-03
AOI01-01
AOI01-02
AOI01-03
AOI08-01
AOI08-02
AOI08-03
AOI03-02
AOI03-01
AOI03-03

PFOA Results (ng/L)
- ND
- >ND - 6
- >6 - 40
- >40 - 70
- >70

536846 is 3 mi to NW, **PFOS Result: ND**

PFOS

AOI05-02
AOI05-04
AOI05-03
773250
AOI02-01
AOI02-02
AOI02-03
Mississippi River
AOI06-01
AOI06-02
AOI06-03
AOI01-01
AOI01-02
AOI01-03
AOI08-01
AOI08-02
AOI08-03
AOI03-02
AOI03-01
AOI03-03

PFOS Results (ng/L)
- ND
- >ND - 4
- >4 - 40
- >40 - 70
- >70

536846 is 3 mi to NW, **PFBS Result: ND**

PFBS

AOI05-02
AOI05-04
AOI05-03
773250
AOI02-01
AOI02-02
AOI02-03
Mississippi River
AOI06-01
AOI06-02
AOI06-03
AOI01-01
AOI01-02
AOI01-03
AOI08-01
AOI08-02
AOI08-03
AOI03-02
AOI03-01
AOI03-03

PFBS Results (ng/L)
- ND
- >ND - 100
- >100 - 601
- >601 - 2,000
- >2,000

Legend
- Facility Boundary
- Water Body
- River/Stream
- Groundwater Elevation Contour
- Inferred Groundwater Elevation Contour
- Groundwater Flow Direction

N

0 850 1,700 3,400 Feet

Groundwater was not collected from AOI05-01.
Exceedances of the OSD SL are depicted with a yellow halo.

PFOA, PFOS, and PFBS Detections in Groundwater, AOI 1, AOI 2, AOI 3, AOI 5, AOI 6, and AOI 8

CLIENT	ARNG			
PROJECT	Site Inspection at Camp Ripley, MN			
REVISED	1/12/2023	GIS BY	MS	1/12/2023
SCALE	1:20,400	CHK BY	AB	1/12/2023
Base Map: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community		PM	CM	1/12/2023

AECOM
12420 Milestone Center Drive
Germantown, MD 20876

Figure 6-11

536846 is 4 mi to NW, **PFOA Result: ND**

PFOA

AOI04-02
AOI04-01
AOI04-04
AOI04-03
AOI04-05
530012
AOI07-03
AOI07-02
AOI07-01
AOI07-04
482900
AOI05-05
AOI05-06
Mississippi River

PFOA Results (ng/L)
ND
>ND - 6
>6 - 40
>40 - 70
>70

536846 is 4 mi to NW, **PFOS Result: ND**

PFOS

AOI04-02
AOI04-01
AOI04-04
AOI04-03
AOI04-05
530012
AOI07-03
AOI07-02
AOI07-01
AOI07-04
482900
AOI05-05
AOI05-06
Mississippi River

PFOS Results (ng/L)
ND
>ND - 4
>4 - 40
>40 - 70
>70

536846 is 4 mi to NW, **PFBS Result: ND**

PFBS

AOI04-02
AOI04-01
AOI04-04
AOI04-03
AOI04-05
530012
AOI07-03
AOI07-02
AOI07-01
AOI07-04
482900
AOI05-05
AOI05-06
Mississippi River

PFBS Results (ng/L)
ND
>ND - 100
>100 - 601
>601 - 2,000
>2,000

Legend
Facility Boundary
Water Body
River/Stream
Groundwater Flow Direction

N

0 550 1,100 2,200
Feet

Exceedances of the OSD SL are depicted with a yellow halo.

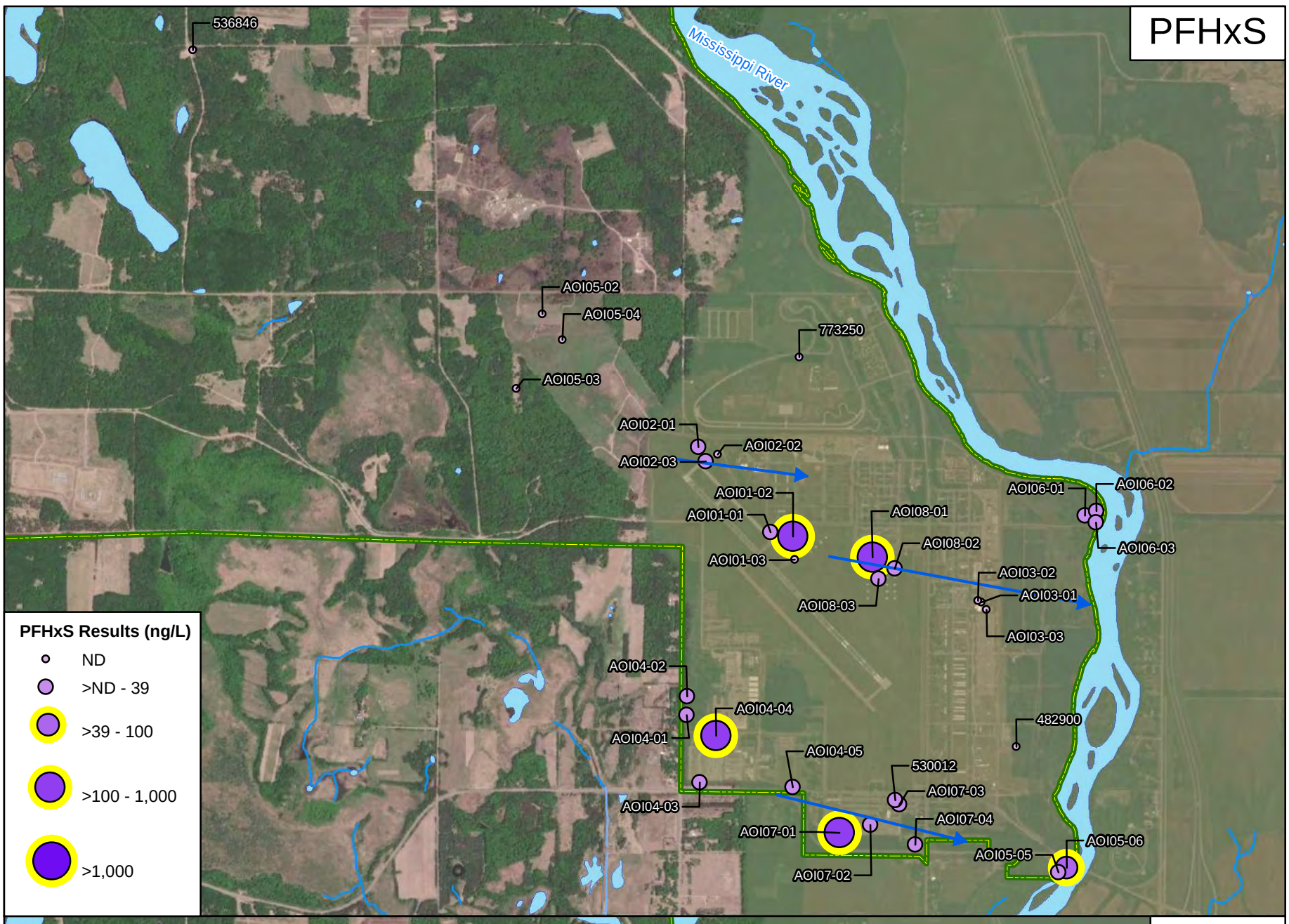
PFOA, PFOS, and PFBS Detections in Groundwater, AOI 4, AOI 5, AOI 7

CLIENT	ARNG			
PROJECT	Site Inspection at Camp Ripley, MN			
REVISED	1/12/2023	GIS BY	MS	1/12/2023
SCALE	1:13,200	CHK BY	AB	1/12/2023
Base Map: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community		PM	CM	1/12/2023

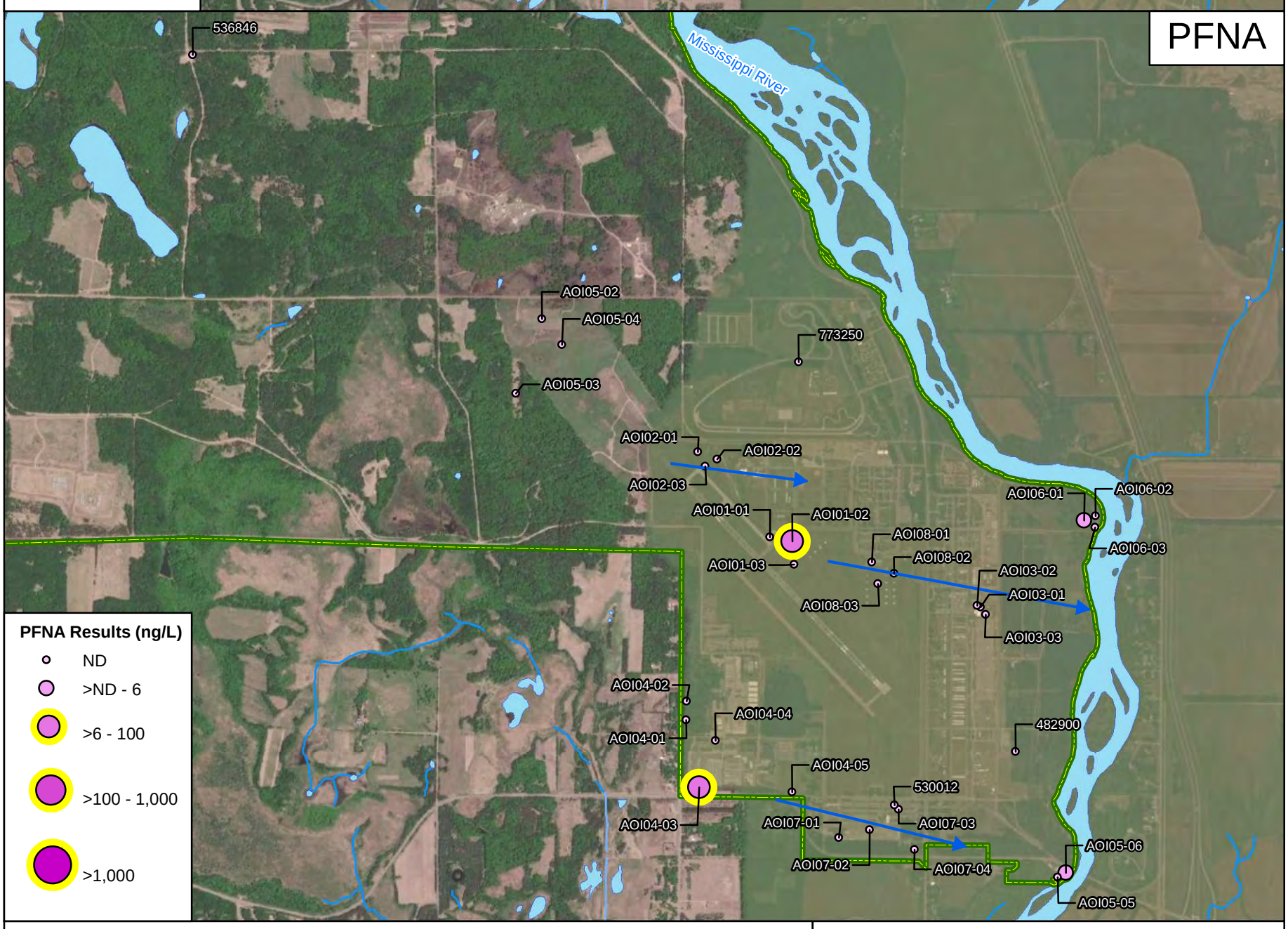
AECOM
12420 Milestone Center Drive
Germantown, MD 20876

Figure 6-12

PFHxS



PFNA



Legend

- Facility Boundary
- Water Body
- River/Stream
- Canal/Ditch
- Groundwater Flow Direction

N

0 1,450 2,900 5,800 Feet

Exceedances of the OSD SL are depicted with a yellow halo.

PFHxS and PFNA Detections in Groundwater

CLIENT	ARNG			
PROJECT	Site Inspection at Camp Ripley, MN			
REVISED	12/8/2022	GIS BY	MS	12/8/2022
SCALE	1:34,800	CHK BY	AB	12/8/2022
Base Map: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community		PM	CM	12/8/2022

AECOM
12420 Milestone Center Drive
Germantown, MD 20876

Figure 6-13

THIS PAGE INTENTIONALLY BLANK

7. Exposure Pathways

The CSMs for each AOI, revised based on the SI findings, are presented on **Figure 7-1** through **Figure 7-8**. Please note that while the CSM discussion assists in determining if a receptor may be impacted, the decision to move from SI to RI is determined based upon exceedances of the SLs for the relevant compounds and whether the release is more than likely attributable to the DoD. A CSM presents the current understanding of the facility conditions with respect to known and suspected sources, potential transport mechanisms and migration pathways, and potentially exposed human receptors. A human exposure pathway is considered potentially complete when the following conditions are present:

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

If any of these elements are missing, the pathway is incomplete. The CSM figures use an empty circle symbol to represent an incomplete exposure pathway. Areas with an incomplete pathway generally warrant no further action. However, the pathway is considered potentially complete if the relevant compounds 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 relevant compounds above the SLs. Areas with an identified potentially complete pathway that have detections of the relevant compounds above the SLs may warrant further investigation. Although the CSMs indicate whether potentially complete exposure pathways may exist, the recommendation for future study in an RI or no action at this time is based on the comparison of the SI analytical results for the relevant compounds to the SLs.

In general, the potential routes of exposure to the relevant compounds 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 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 (although unlikely due to restricted access), on-facility residents inside the cantonment area, off-facility residents outside the facility boundary, and recreational users outside of the facility boundary.

7.1 Soil Exposure Pathway

The SI results in soil were used to determine whether a potentially complete pathway exists between the source and potential receptors at AOI 1 through AOI 8 based on the aforementioned criteria.

7.1.1 AOI 1

AOI 1 is the TriMax™ Discharge Area and Building 8-197, where potential PFAS releases to soil by the MNARNG occurred once in the early 2000s and where three firetrucks and three all-terrain vehicles, all with AFFF capabilities, were stored. PFAS were potentially released to soil and groundwater from AOI 1 through previous fire training exercises and/or firetruck storage.

PFOA, PFOS, PFHxS, and PFNA were detected in surface soil at AOI 1. Of these, PFOS exceeded the SL. Site workers, construction workers, on- and off-facility residents, and trespassers could contact constituents in surface soil via incidental ingestion and inhalation of dust. No active construction was observed to be occurring near AOI 1 at the time of the SI. Therefore, the surface soil exposure pathway for site workers, on- and off-facility residents, future construction workers, and trespassers are potentially complete with exceedances. PFHxS, PFNA, and PFOS were detected in subsurface soil at AOI 1. Construction workers could contact constituents in subsurface soil via incidental ingestion; therefore, the subsurface soil exposure pathway for future construction workers is potentially complete. The CSM for AOI 1 is presented on **Figure 7-1**.

7.1.2 AOI 2

AOI 2 is the Burn Pit Fire Training Area, where a single coordinated fire training event occurred in the late 1980s. The burn pit may have also been used for coordinated fire training exercises; however, additional uses were not confirmed during the PA process.

PFOS, PFHxS, and PFNA were detected in surface soil at AOI 2. Site workers, construction workers, on- and off-facility residents, and trespassers could contact constituents in surface soil via incidental ingestion and inhalation of dust. No active construction was observed to be occurring near AOI 2 at the time of the SI. Therefore, the surface soil exposure pathway for site workers, future construction workers, on- and off-facility residents, and trespassers are considered potentially complete. PFOA, PFOS, PFHxS, PFNA, and PFBS were not detected in subsurface soil at AOI 2; therefore, all subsurface soil exposure pathways are considered incomplete. The CSM for AOI 2 is presented on **Figure 7-2**.

7.1.3 AOI 3

AOI 3 is the DHS Demonstration at the EMTC. A coordinated fire training event occurred in November 2014 at the EMTC between DHS, MNARNG, and local municipalities. Potential PFAS was released to soil and groundwater from AOI 3 through previous fire training exercises and/or firetruck storage.

PFOA, PFOS, and PFNA were detected below their respective SLs in surface soil at AOI 3. Site workers, construction workers, on- and off-facility residents, and trespassers could contact constituents in surface soil via incidental ingestion and inhalation of dust. At the time of the SI, construction activities were occurring approximately 700 feet away from AOI 3. Therefore, the surface soil exposure pathway for site workers, current and future construction workers, on- and off-facility residents, and trespassers are potentially complete. PFOA, PFOS, PFHxS, PFNA, and PFBS were not detected in subsurface soil at AOI 3; therefore, all subsurface soil exposure pathways are considered incomplete. The CSM for AOI 3 is presented on **Figure 7-3**.

7.1.4 AOI 4

AOI 4 consists of the USPFO Warehouse, CMA Shop, and CMA Discharge Area. Unused or expired fire equipment from MNARNG facilities is shipped to the USPFO warehouse to be stored and/or processed prior to reutilization or disposition. TriMax™ fire extinguishers were required to be demilitarized, which involved physically destroying them by the CMA shop, prior to final disposition. AFFF was dispensed and allowed to dissipate to the ground surface in approximately 2010. The discharge area is in proximity to up-and side-gradient onsite drinking water supply wells L Well and N Well, as well as downgradient onsite drinking water supply well H Well. As of June 2021, the facility processes TriMax™ units by draining and triple rinsing. The solution and rinsate are stored in the CMA shop in hazardous waste storage rooms.

PFOA, PFOS, PFHxS, and PFNA were detected in surface soil at AOI 4. Site workers, construction workers, on- and off-facility residents, and trespassers could contact constituents in surface soil via incidental ingestion and inhalation of dust. No active construction was observed to be occurring near AOI 4 at the time of the SI. Therefore, the surface soil exposure pathway for site workers, future construction workers, on- and off-facility residents, and trespassers are considered potentially complete. PFOS, PFNA, and PFHxS were detected in subsurface soil at AOI 4. Construction workers could contact constituents in subsurface soil via incidental ingestion; therefore, the subsurface soil exposure pathway for future construction workers is potentially complete. The CSM for AOI 4 is presented on **Figure 7-4**.

7.1.5 AOI 5-WWTP

AOI 5-WWTP is located in the southeast part of the facility abutting the Mississippi River. The WWTP does not contain a treatment for PFAS, leading to the potential release to soil and groundwater from AOI 5 through wastewater treatment and sludge disposal at the AOI 5-Sludge Spread Site.

PFOA, PFOS, PFHxS, and PFNA, were detected in surface soil at AOI 5-WWTP. Site workers, construction workers, on- and off-facility residents, and trespassers could contact constituents in surface soil via incidental ingestion and inhalation of dust. At the time of the SI, no construction activities were observed to be occurring near AOI 5. Therefore, the surface soil exposure pathway for site workers, future construction workers, on- and off-facility residents, and trespassers are potentially complete. PFOS, PFHxS, and PFBS were detected in subsurface soil at AOI 5-WWTP. Construction workers could contact constituents in subsurface soil via incidental ingestion, and therefore, the subsurface soil exposure pathway for future construction workers is potentially complete. The CSM for the AOI 5-WWTP is presented on **Figure 7-5**.

7.1.6 AOI 5-Sludge Spread Site

The AOI 5-Sludge Spread Site is located to the northwest of the main cantonment area. Since 1987, Camp Ripley has been permitted to perform land application of sludge from the WWTP at the Sludge Spread Site, which may have introduced PFAS to the area.

PFOA, PFOS, PFHxS, PFNA, and PFBS were detected in surface soil at AOI 5. Site workers, construction workers, on- and off-facility residents, and trespassers could contact constituents in surface soil via incidental ingestion and inhalation of dust. At the time of the SI, no construction activities were observed to be occurring near AOI 5-Sludge Spread Site. Therefore, the surface soil exposure pathway for site workers, future construction workers, on- and off-facility residents, and trespassers are potentially complete. PFHxS, PFBS, PFNA, PFOA, and PFOS were detected in subsurface soil at AOI 5-Sludge Spread Site. Construction workers could contact constituents in subsurface soil via incidental ingestion, and therefore, the subsurface soil exposure pathway for future construction workers is potentially complete. The CSM for AOI 5 Sludge Spread Site is presented on **Figure 7-6**.

7.1.7 AOI 6

AOI 6 is the Stormwater Infiltration Basin located in the northeast portion of the facility. Fire training exercises occurred at the EMTC. The disposition of the foam mixture was likely disposed of in the stormwater sewer system, which drains to the stormwater infiltration basin.

PFOA, PFOS, PFHxS, PFNA, and PFBS was detected in surface soil at AOI 6. Site workers, construction workers, on- and off-facility residents, and trespassers could contact constituents in surface soil via incidental ingestion and inhalation of dust. There were no construction activities observed to be occurring near AOI 6 at the time of the SI. Therefore, the surface soil exposure

pathway for site workers, future construction workers, on- and off-facility residents, and trespassers are potentially complete. PFOS was detected in subsurface soil at AOI 6. Construction workers could contact constituents in subsurface soil via incidental ingestion, and therefore, the subsurface soil exposure pathway for future construction workers is considered potentially complete. The CSM for AOI 6 is presented on **Figure 7-7**.

7.1.8 AOI 7

AOI 7 consists of Buildings 2-166, 2-203. 2-223, and 2-272. Three AFFF capable firetrucks were at the old CSMS, referred to as Building 2-166, two were stored in Building 2-203, and a rescue truck was stored in Building 2-272. Significant maintenance for current and previous fire support vehicles have been performed, with potential releases of PFAS to the soil and groundwater. Bulk AFFF is stored in Buildings 2-223 and 2-272, both containing floor drains that connect to an oil-water separator or to the sanitary sewer. PFAS were potentially released to soil and groundwater from AOI 7 through previous fire training exercises and/or firetruck and AFFF storage.

PFOA, PFOS, PFHxS, PFNA, and PFBS were detected in surface soil at AOI 7. Site workers, construction workers, on- and off-facility residents, and trespassers could contact constituents in surface soil via incidental ingestion and inhalation of dust. No active construction activities were observed to be occurring near AOI 7 at the time of the SI. Therefore, the surface soil exposure pathway for site workers, future construction workers, on- and off-facility residents, and trespassers are potentially complete. PFOS, PFHxS, and PFBS were detected in subsurface soil at AOI 7. Construction workers could contact constituents in subsurface soil via incidental ingestion, and therefore, the subsurface soil exposure pathway for future construction workers is potentially complete. The CSM for AOI 7 is presented on **Figure 7-8**.

7.1.9 AOI 8

AOI 8 is Building 8-195, which has stored a large crash rescue truck (011A) since around 1987. It is unclear if the truck had AFFF capability. Building 8-195 was renovated in 2010 and is currently a Morale Welfare Recreation facility.

PFOS, PFHxS, and PFNA were detected in surface soil at AOI 8. Site workers, construction workers, on- and off-facility residents, and trespassers could contact constituents in surface soil via incidental ingestion and inhalation of dust. At the time of the SI, no construction activities were observed to be occurring near AOI 8 at the time of the SI. Therefore, the surface soil exposure pathway for site workers, future construction workers, on- and off-facility residents, and trespassers are potentially complete. PFHxS, PFNA, PFOA, and PFOS were detected in subsurface soil at AOI 8. Construction workers could contact constituents in subsurface soil via incidental ingestion; therefore, the subsurface soil exposure pathway for future construction workers is potentially complete. The CSM for AOI 8 is presented on **Figure 7-9**.

7.2 Groundwater Exposure Pathway

The SI results in groundwater were used to determine whether a potentially complete pathway exists between the source and potential receptors based on the aforementioned criteria.

7.2.1 AOI 1

PFOA, PFOS, PFNA, and PFHxS were detected above their SLs in groundwater samples collected at AOI 1. Due to the presence of domestic wells within a 4-mile radius of the facility, approximately screened within the same water bearing unit, the pathway for exposure to off-facility residents via ingestion of groundwater is considered potentially complete with exceedances. Drinking water at Camp Ripley is provided by on-facility potable wells. Based on

this and the results of the SI, the pathway for exposure to site workers, on-facility residents, and trespassers is considered potentially complete with exceedances. Depths to water measured at AOI 1 in June 2022 during the SI ranged from 18.01 to 18.74 feet bgs. Therefore, the ingestion exposure pathway for future construction workers is considered incomplete. The CSM for AOI 1 is presented on **Figure 7-1**.

7.2.2 AOI 2

PFOA and PFOS were detected above their SLs in groundwater samples collected at AOI 2. Due to the presence of domestic wells within a 4-mile radius of the facility, approximately screened within the same water bearing unit, the pathway for exposure to off-facility residents via ingestion of groundwater is considered potentially complete with exceedances. Drinking water at Camp Ripley is provided by on-facility potable wells. Based on this and the results of the SI, the pathway for exposure to site workers, trespassers, and on-facility residents is considered potentially complete with exceedances. Depths to water measured in June 2022 during the SI ranged from 10.55 to 12.52 feet bgs. Therefore, the ingestion exposure pathway for future construction workers is considered potentially complete with exceedances. The CSM for AOI 2 is presented on **Figure 7-2**.

7.2.3 AOI 3

PFOA, PFOS, and PFBS were detected below their SLs in groundwater samples collected at AOI 3. Due to the presence of domestic wells within a 4-mile radius of the facility, approximately screened within the same water bearing unit, the pathway for exposure to off-facility residents via ingestion of groundwater is considered potentially complete. Drinking water at Camp Ripley is provided by on-facility potable wells. Based on this and the results of the SI, the pathway for exposure to site workers, on-facility residents, and trespassers is considered potentially complete. Depths to water measured in June 2022 during the SI ranged from 15.72 to 17.47 feet bgs. At the time of the SI, construction activities were occurring approximately 700 feet from AOI 3. Therefore, the ingestion exposure pathway for current and future construction workers is considered incomplete. The CSM for AOI 3 is presented on **Figure 7-3**.

7.2.4 AOI 4

PFOA, PFOS, PFHxS, and PFNA were detected above their SLs in groundwater samples collected at AOI 4. Due to the presence of domestic wells within a 4-mile radius of the facility, approximately screened within the same water bearing unit, the pathway for exposure to off-facility residents via ingestion of groundwater is considered potentially complete with exceedances. Drinking water at Camp Ripley is provided by on-facility potable wells. Based on drinking water at the facility and the results of the SI, the pathway for exposure to site workers, on-facility residents, and trespassers is considered potentially complete with exceedances. Depths to water measured in June 2022 during the SI ranged from 8.12 to 16.75 feet bgs. Therefore, the ingestion exposure pathway for future construction workers is considered potentially complete with exceedances. The CSM for AOI 4 is presented on **Figure 7-4**.

7.2.5 AOI 5-WWTP

PFOS and PFHxS were detected above their SLs in groundwater samples collected at the AOI 5-WWTP. Drinking water at Camp Ripley is provided by on-facility potable wells, which are located upgradient of the WWTP and thus are not interpreted to be at risk of receiving contamination from the WWTP. Based on this and the results of the SI, the pathway for exposure to site workers, on-facility residents, and trespassers is considered incomplete. Depths to water measured in June 2022 during the SI ranged from 8.26 to 12.90 feet bgs at AOI 5-WWTP. Therefore, the ingestion

exposure pathway for future construction workers is considered potentially complete with exceedances. The CSM for AOI 5 is presented on **Figure 7-5**.

Four existing facility wells were sampled along with AOI 5; however, they are considered independent from the AOI 5 release areas and have no bearing on either the AOI 5-WWTP or the AOI 5-Sludge Spread Site CSM.

7.2.6 AOI 5-Sludge Spread Site

The AOI 5-Sludge Spread Site is located to the northwest of the main cantonment area, upgradient of drinking water wells supplying the cantonment area. PFOS was detected below the SL at one well (AOI05-04) and results were non-detect for all relevant compounds at the other wells at the Sludge Spread Site. Therefore, the pathway for exposure to site workers, on-facility residents, and trespassers is considered incomplete. Depths to water measured in June 2022 during the SI ranged from 3.67 to 22.38 feet bgs. Therefore, the ingestion exposure pathway for future construction workers is considered potentially complete. The CSM for the AOI 5-Sludge Spread Site is shown on **Figure 7-6**.

7.2.7 AOI 6

PFOS was detected above the SL in groundwater samples collected at AOI 6. Due to the presence of domestic wells within a 4-mile radius of the facility, approximately screened within the same water bearing unit, the pathway for exposure to off-facility residents via ingestion of groundwater is considered potentially complete with exceedances. Drinking water at Camp Ripley is provided by on-facility potable wells. Based on this and the results of the SI, the pathway for exposure to site workers, on-facility residents, and trespassers is considered potentially complete with exceedances. Depths to water measured in June 2022 during the SI ranged from 3.04 to 5.87 feet bgs. Therefore, the ingestion exposure pathway for future construction workers is considered potentially complete with exceedances. The CSM for AOI 6 is presented on **Figure 7-7**.

7.2.8 AOI 7

PFOA, PFOS, and PFHxS were detected above their SLs in groundwater samples collected at AOI 7. Due to the presence of domestic wells within a 4-mile radius of the facility, approximately screened within the same water bearing unit, the pathway for exposure to off-facility residents via ingestion of groundwater is considered potentially complete with exceedances. Drinking water at Camp Ripley is provided by on-facility potable wells. Based on this and the results of the SI, the pathway for exposure to site workers, on-facility residents, and trespassers is considered potentially complete with exceedances. Depths to water measured in July 2022 during the SI ranged from 11.69 to 17.89 feet bgs. Therefore, the ingestion exposure pathway for future construction workers is considered potentially complete with exceedances. The CSM for AOI 7 is presented on **Figure 7-8**.

7.2.9 AOI 8

PFOA, PFOS, and PFHxS were detected above their respective SLs in groundwater samples collected at AOI 8. Due to the presence of domestic wells within a 4-mile radius of the facility, approximately screened within the same water bearing unit, the pathway for exposure to off-facility residents via ingestion of groundwater is considered potentially complete with exceedances. Drinking water at Camp Ripley is provided by on-facility potable wells. Based on this and the results of the SI, the pathway for exposure to site workers, on-facility residents, and trespassers is considered potentially complete with exceedances. Depths to water measured in June 2022 during the SI ranged from 17.17 to 18.88 feet bgs. Therefore, the ingestion exposure

pathway for future construction workers is considered incomplete. The CSM for AOI 8 is presented on **Figure 7-9**.

7.3 Surface Water and Sediment Exposure Pathway

The SI results in soil and groundwater, in combination with knowledge of the fate and transport properties of PFAS, were used to determine whether a potentially complete pathway exists between the source and potential receptors.

7.3.1 AOI 1

PFAS are water soluble and can migrate readily from soil to surface water via leaching and run-off. PFOA, PFOS, PFHxS, PFNA, and PFBS were detected in soil and groundwater at AOI 1. It is possible that those compounds may have migrated from soil and groundwater to the Mississippi River via shallow groundwater discharge or discharge to the stormwater infiltration basins along the southeastern facility boundary. These infiltration basins are designed to allow stormwater to infiltrate into the subsurface and subsequently the unconfined surficial aquifer, which is in connection with surface water. Therefore, the surface water and sediment ingestion exposure pathway for site workers, future construction workers, on- and off-facility residents, or trespassers/recreational user is considered potentially complete.

There is documentation of a PFAS release from a TriMax™ fire extinguisher discharge at AOI 1 in the early 2000s. The area within and outside the facility boundaries are relatively flat, making the possible route of runoff uncertain. Stormwater conveyance at the airfield is primarily via overland flow, so stormwater may either locally infiltrate in grassy areas, or eventually drain east-southeast. As surface water and shallow groundwater are connected, stormwater from these basins may eventually enter the Mississippi River. Due to potential recreational use of the Mississippi River and City of Little Falls-Mississippi River watershed south of the facility, the surface water and sediment ingestion exposure pathway for off-facility recreational users is also considered potentially complete. The CSM for AOI 1 is presented on **Figure 7-1**.

7.3.2 AOI 2

PFOA, PFOS, PFHxS, PFNA, and PFBS were detected in soil and groundwater at AOI 2. It is possible that those compounds may have migrated from soil and groundwater to the Mississippi River via shallow groundwater discharge. As AOI 2 is located in a grassy area north of the airfield runway, any surface water is likely to infiltrate locally into the soil and subsequently may migrate into the unconfined surficial aquifer. Therefore, the surface water and sediment ingestion exposure pathway for site workers, future construction workers, on- and off-facility residents, or trespassers is considered potentially complete.

Shallow groundwater at the facility is understood to be in connection with surface water; due to potential recreational use of the Mississippi River downgradient of AOI 2, the surface water and sediment exposure pathway for off-facility recreational users is also considered potentially complete. The CSM for AOI 2 is presented on **Figure 7-2**.

7.3.3 AOI 3

PFOA, PFOS, PFNA, and PFBS were detected in soil and groundwater at AOI 3 below their respective SLs. It is possible that those compounds may have migrated from soil and groundwater to the Mississippi River via shallow groundwater discharge or discharge to the stormwater infiltration basins along the southeastern facility boundary. As AOI 3 is primarily located in grassy or non-paved areas, any surface water likely infiltrates locally into the soil which may subsequently migrate into the unconfined surficial aquifer. Therefore, the surface water and sediment ingestion

exposure pathway for site workers, future construction workers, on- and off-facility residents, or trespassers is considered potentially complete.

Shallow groundwater at the facility is understood to be in connection with surface water; due to potential recreational use of the Mississippi River downgradient of AOI 3, the surface water and sediment exposure pathway for off-facility residents and recreational users is also considered potentially complete. The CSM for AOI 3 is presented on **Figure 7-3**.

7.3.4 AOI 4

PFOA, PFOS, PFHxS, PFNA, and PFBS were detected in soil and groundwater at AOI 4. It is possible that those compounds may have migrated from soil and groundwater to the Mississippi River via shallow groundwater discharge or discharge to the stormwater infiltration basins along the southeastern facility boundary. Additionally, AOI 4 is serviced by a stormwater drainage network which discharges to Infiltration Basin D; any stormwater runoff from this area may locally infiltrate directly to the soil in non-paved areas or gets captured in the infiltration basin. PFOA, PFOS, PFHxS, and PFNA were detected with exceedances in groundwater at AOI 4. TriMax™ fire extinguishers containing AFFF were historically shipped to and demilitarized by the CMA shop located within AOI 4. It is unknown if the units were received full or emptied at the airfield. Therefore, the surface water and sediment ingestion exposure pathway for site workers, future construction workers, on- and off-facility residents, or trespassers is considered potentially complete.

Shallow groundwater and surface water at the facility are understood to be connected. The Infiltration Basin D collecting runoff from AOI 4 allows stormwater to infiltrate into the subsurface, where it can migrate to shallow groundwater and then downgradient to the Mississippi River. Due to potential recreational use of the Mississippi River, the surface water and sediment ingestion exposure pathway for off-facility recreational users is also considered potentially complete. The CSM for AOI 4 is presented on **Figure 7-4**.

7.3.5 AOI 5 – WWTP

PFAS was potentially released to soil and groundwater from wastewater treatment at AOI 5-WWTP through leaching and/or stormwater conveyance. The WWTP does not contain a PFAS treatment system, leading to a potential release through surface water infiltration into the subsurface or via a stormwater outfall which discharges to the Mississippi River. PFOS and PFHxS were detected with exceedances of their respective SLs in groundwater at the WWTP. Therefore, the surface water and sediment ingestion exposure pathway for site workers, future construction workers, on- and off-facility residents, or trespassers is considered incomplete.

As mentioned, surface water may migrate to shallow groundwater at the WWTP and discharge to the Mississippi River through infiltration or the WWTP stormwater outfall. Therefore, due to potential recreational use of the Mississippi River, the surface water and sediment ingestion exposure pathway for off-facility recreational users is considered potentially complete. The CSM for AOI 5-WWTP is presented on **Figure 7-5**.

As discussed in **Section 7.2.5**, the four existing facility wells sampled along with AOI 5-WWTP and the AOI 5-Sludge Spread Site are not evaluated as part of the CSM.

7.3.6 AOI 5 – Sludge Spread Site

PFAS was potentially released to soil and groundwater from the AOI 5-WWTP during sludge land application at the AOI 5-Sludge Spread Site. There were no exceedances of soil and groundwater at this release area, and two of the three wells sampled in this upgradient area (AOI05-02 and AOI05-03) were non-detect for all relevant PFAS. Surface water at the Sludge Spread Site likely

infiltrates locally but is not connected to the stormwater drainage network like the AOIs in the cantonment area. It is possible that surface water may migrate to shallow groundwater at this location followed by drinking water supply wells located downgradient of the Sludge Spread Site. Therefore, the surface water and sediment ingestion exposure pathway for site workers, future construction workers, and on- and off-facility residents, or trespassers is considered incomplete.

As surface water may migrate to the unconfined surficial aquifer on the facility, it may eventually discharge to the Mississippi River. The surface water and sediment ingestion exposure pathway for off-facility recreational users is considered potentially complete. The CSM for AOI 5-Sludge Spread Site is presented on **Figure 7-6**.

7.3.7 AOI 6

AOI 6 is a Stormwater Infiltration Basin, located in the northeast portion of the facility, bordering the Mississippi River. PFAS from other potential releases of AFFF within the cantonment area may have been drained to AOI 6 via sewers or infiltrated shallow groundwater and migrated to the Mississippi River. PFAS was potentially released to soil and groundwater from AOI 6 during previous fire training exercises held at the EMTC. The final disposition of any remaining foam mixture was likely disposed of in the stormwater sewer system, which drains to the AOI 6 stormwater infiltration basin. PFOS was detected with exceedances in groundwater at AOI 6. The stormwater collected in the infiltration basin eventually migrates to the subsurface. As AOI 6 is located generally up- or side-gradient of some drinking water supply wells in the cantonment area, there is potential for impacts from soil and groundwater at AOI 6 to these wells via surface water infiltration and migration. Therefore, the surface water and sediment exposure pathways for site workers, future construction workers, on- and off-facility residents, trespassers, and off-facility recreational users are potentially complete. The CSM for AOI 6 is presented on **Figure 7-7**.

7.3.8 AOI 7

PFOA, PFOS, PFHxS, and PFBS were detected in soil and groundwater at AOI 7. The buildings located within AOI 7 stored fire and rescue trucks, as well as bulk AFFF. Floor drains in Building 2-272, which stored the bulk AFFF and rescue truck, are connected to the sanitary sewer. It is possible that those compounds may have migrated from soil and groundwater to the Mississippi River in the east-southeast portion of the facility via shallow groundwater discharge or discharge to the stormwater Infiltration Basin E. PFOA, PFOS, and PFHxS were detected with exceedances in groundwater. Therefore, the surface water and sediment ingestion exposure pathway for site workers, future construction workers, on- and off-facility residents, or trespassers is considered potentially complete.

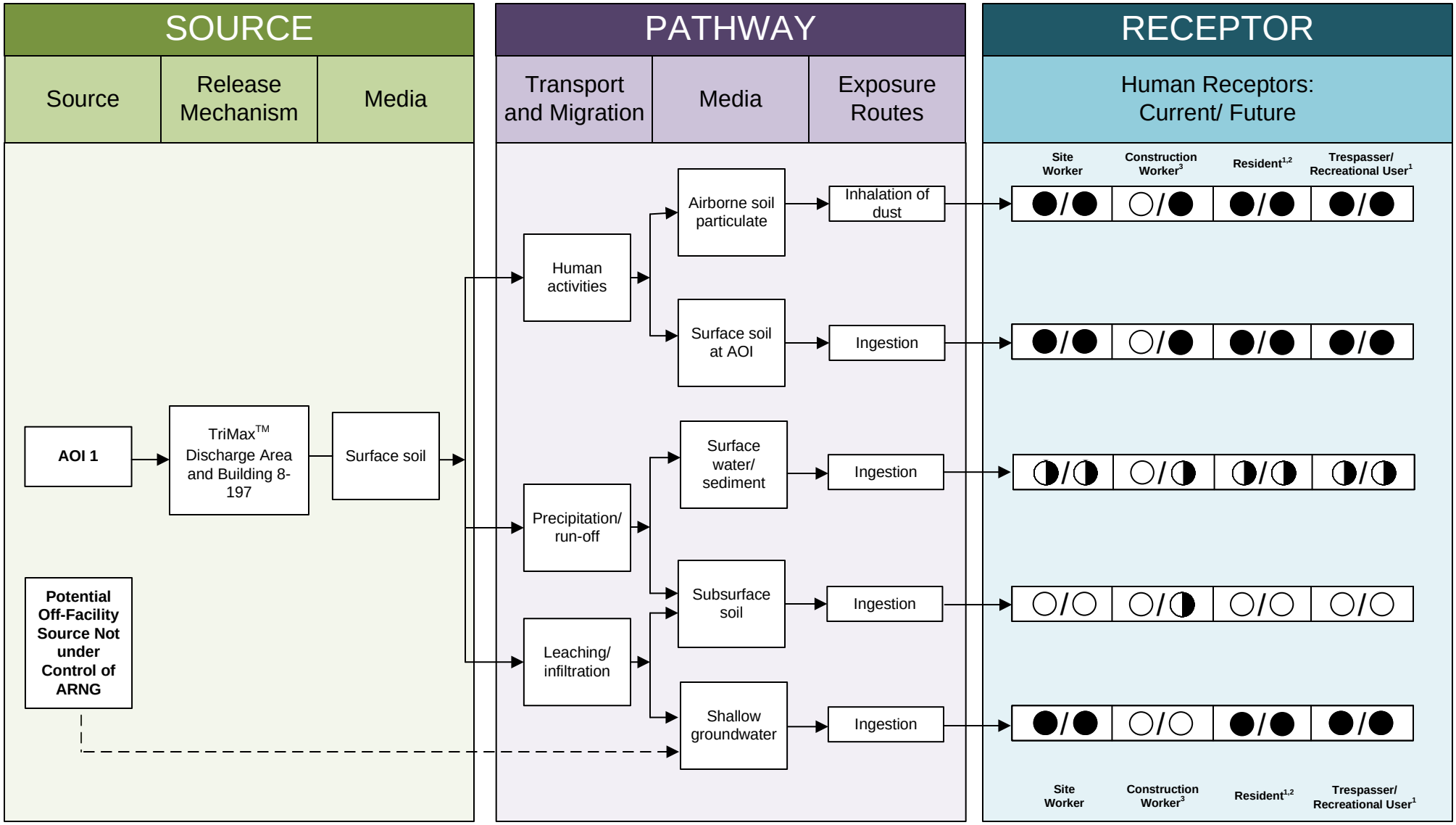
Stormwater drainages across AOI 7 convey runoff to Infiltration Basin E, which eventually infiltrates into the subsurface. As surface water may migrate to the unconfined surficial aquifer on the facility, it may eventually discharge to the Mississippi River. The surface water and sediment ingestion exposure pathway for off-facility recreational users is also considered potentially incomplete. The CSM for AOI 7 is presented on **Figure 7-8**.

7.3.9 AOI 8

AOI 8 is Building 8-195, which has stored a large crash rescue truck (011A) since around 1987. It is unclear if the truck had AFFF capability. Building 8-195 was renovated in 2010 and is currently a Morale Welfare Recreation facility, which has an outside recreation and eating area frequented by facility residents and personnel, family members (including children), and site workers.

PFOA, PFOS, and PFHxS were detected in groundwater at concentrations above their SLs. AOI 8 has stormwater drainage conveyance to Infiltration Basin A. It is possible that releases from AOI

8 migrated to surface water either by infiltration through the subsurface to groundwater or via stormwater conveyance. Stormwater in the infiltration basin may eventually migrate to the Mississippi River. Therefore, the surface water and sediment ingestion exposure pathway for site workers, future construction workers, on- and off-facility residents, or trespassers is considered potentially complete. Due to recreational use of the Mississippi River, the surface water and sediment ingestion exposure pathway for off-facility recreational users is also considered potentially complete. The CSM for AOI 8 is presented on **Figure 7-9**.



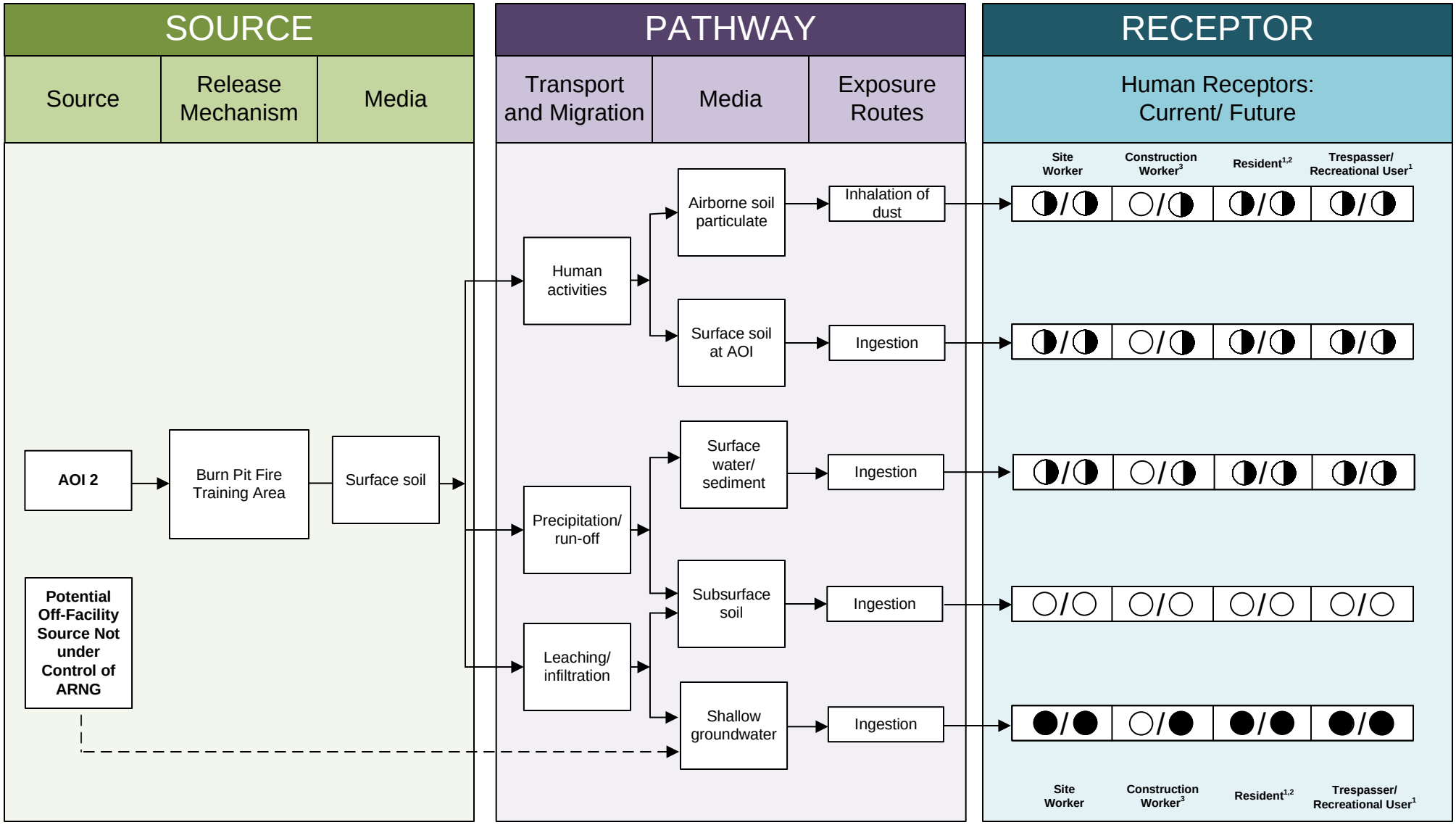
LEGEND

- 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 users refer to on- and off-facility receptors.
2. Inhalation of dust for off-facility receptors is likely insignificant.
3. No current active construction at AOI 1.

Figure 7-1
Conceptual Site Model, AOI 1
Camp Ripley



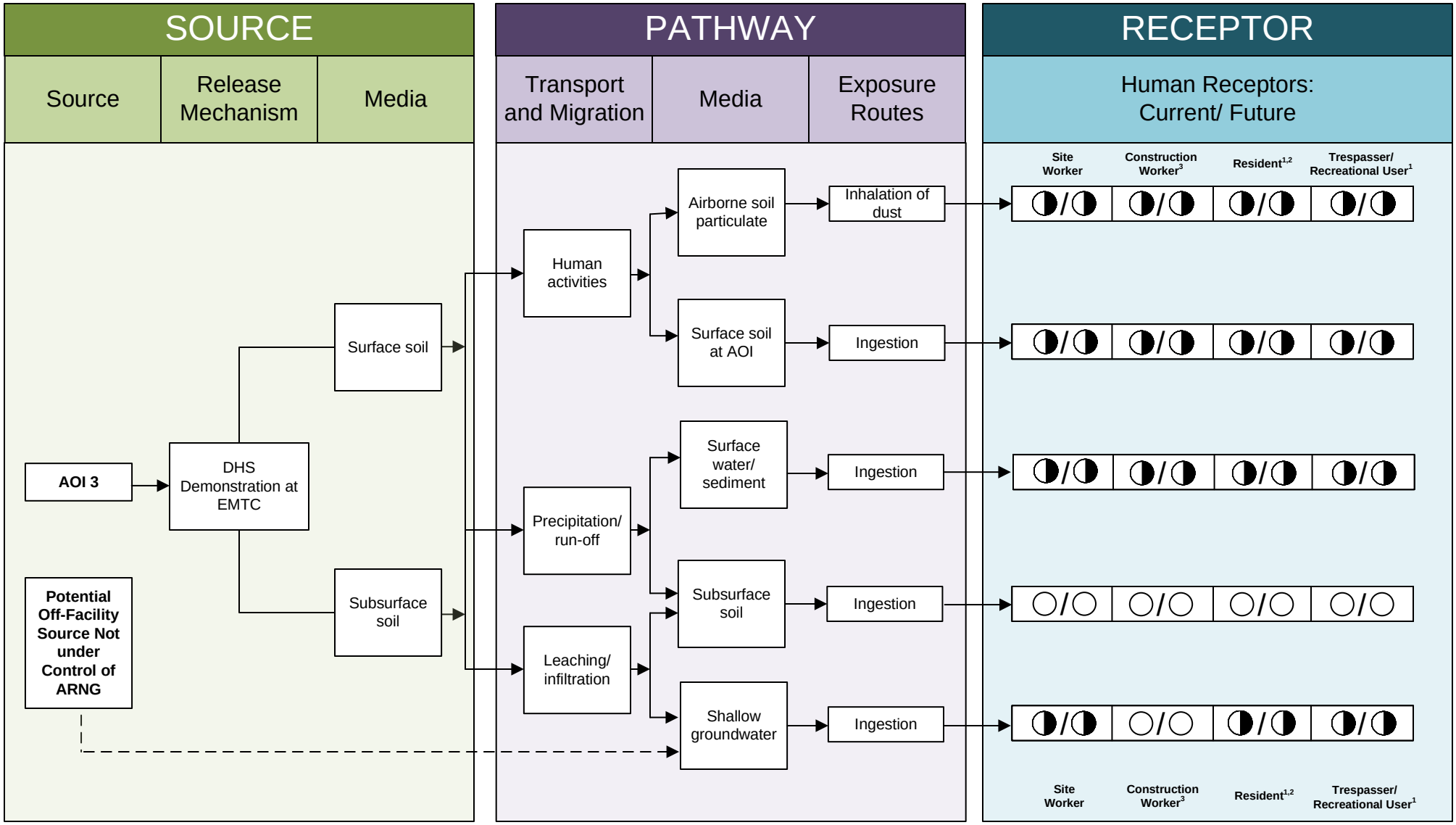
LEGEND

- 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 users refer to on- and off-facility receptors.
2. Inhalation of dust for off-facility receptors is likely insignificant.
3. No current active construction at AOI 2.

Figure 7-2
Conceptual Site Model, AOI 2
Camp Ripley



LEGEND

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

Notes:

DHS = Department of Homeland Security

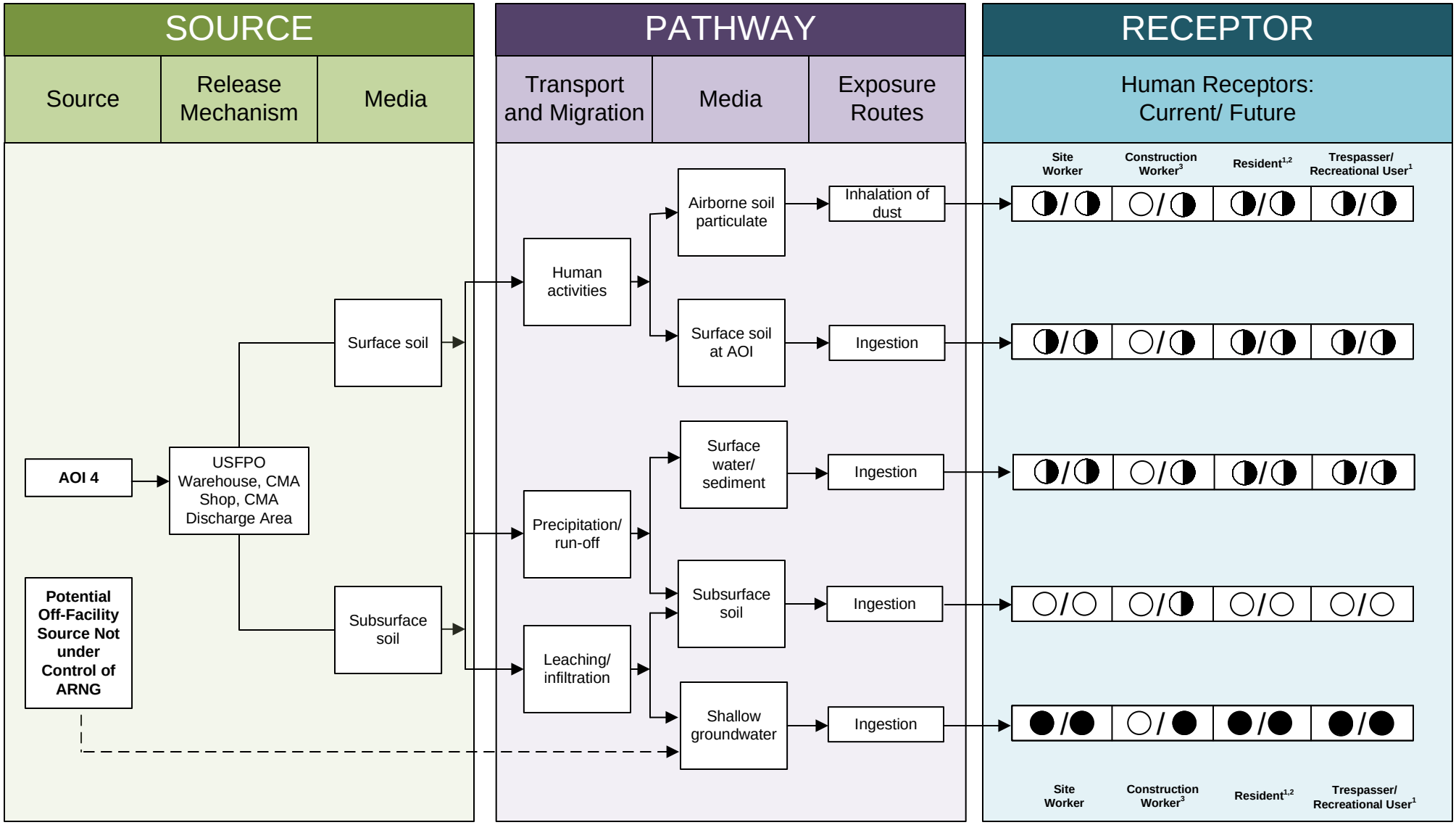
EMTC = Emergency Management Training Center

1. The resident and recreational users refer to on- and off-facility receptors.

2. Inhalation of dust for off-facility receptors is likely insignificant.

3. At the time of the SI, construction was occurring approximately 700 feet away from AOI 3.

Figure 7-3
Conceptual Site Model, AOI 3
Camp Ripley



LEGEND

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

Notes:

CMA = Combined Maintenance Activity

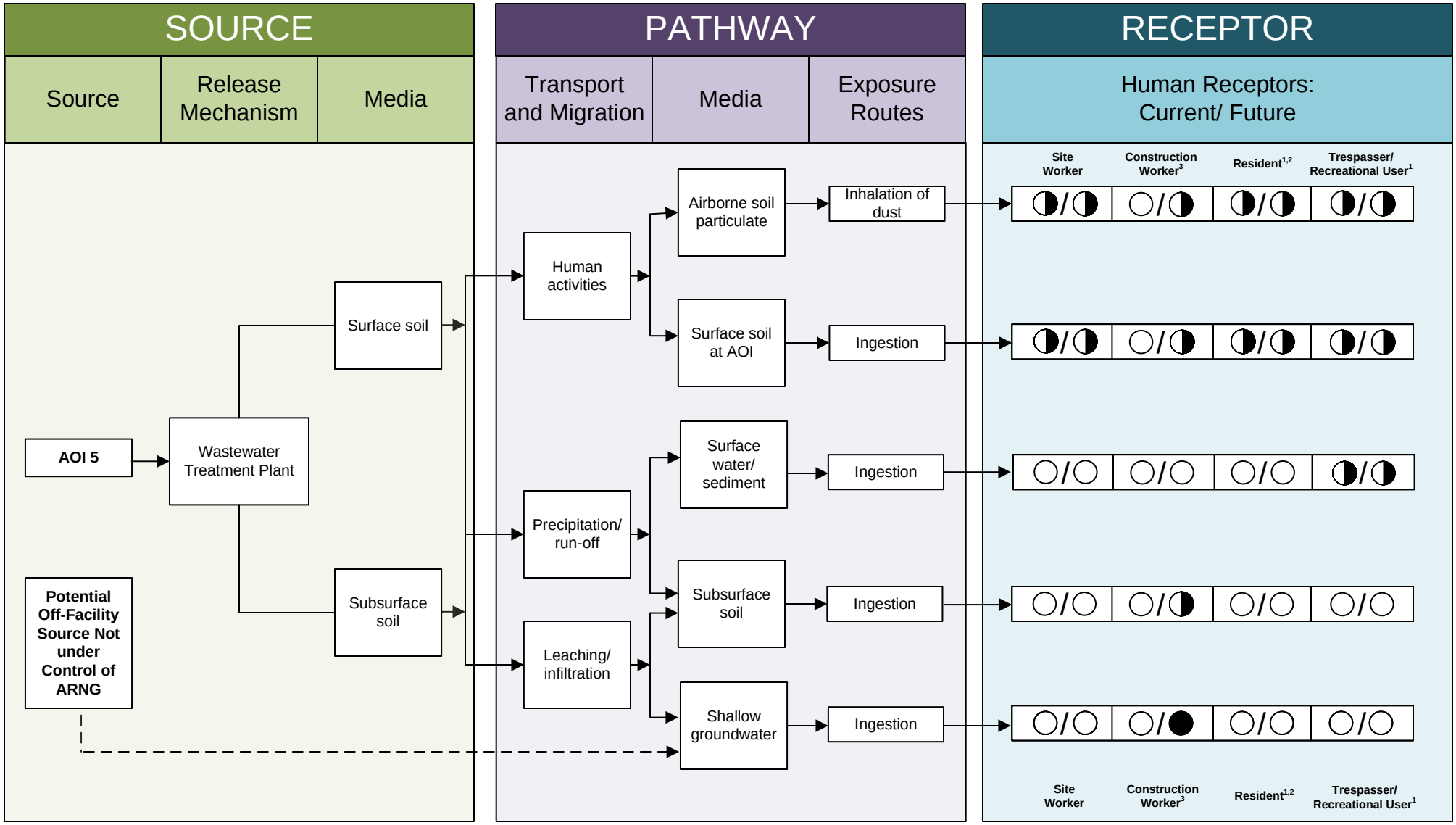
USFPO = US Property and Fiscal Office

1. The resident and recreational users refer to on- and off-facility receptors.

2. Inhalation of dust for off-facility receptors is likely insignificant.

3. No current active construction at AOI 4.

Figure 7-4
Conceptual Site Model, AOI 4
Camp Ripley



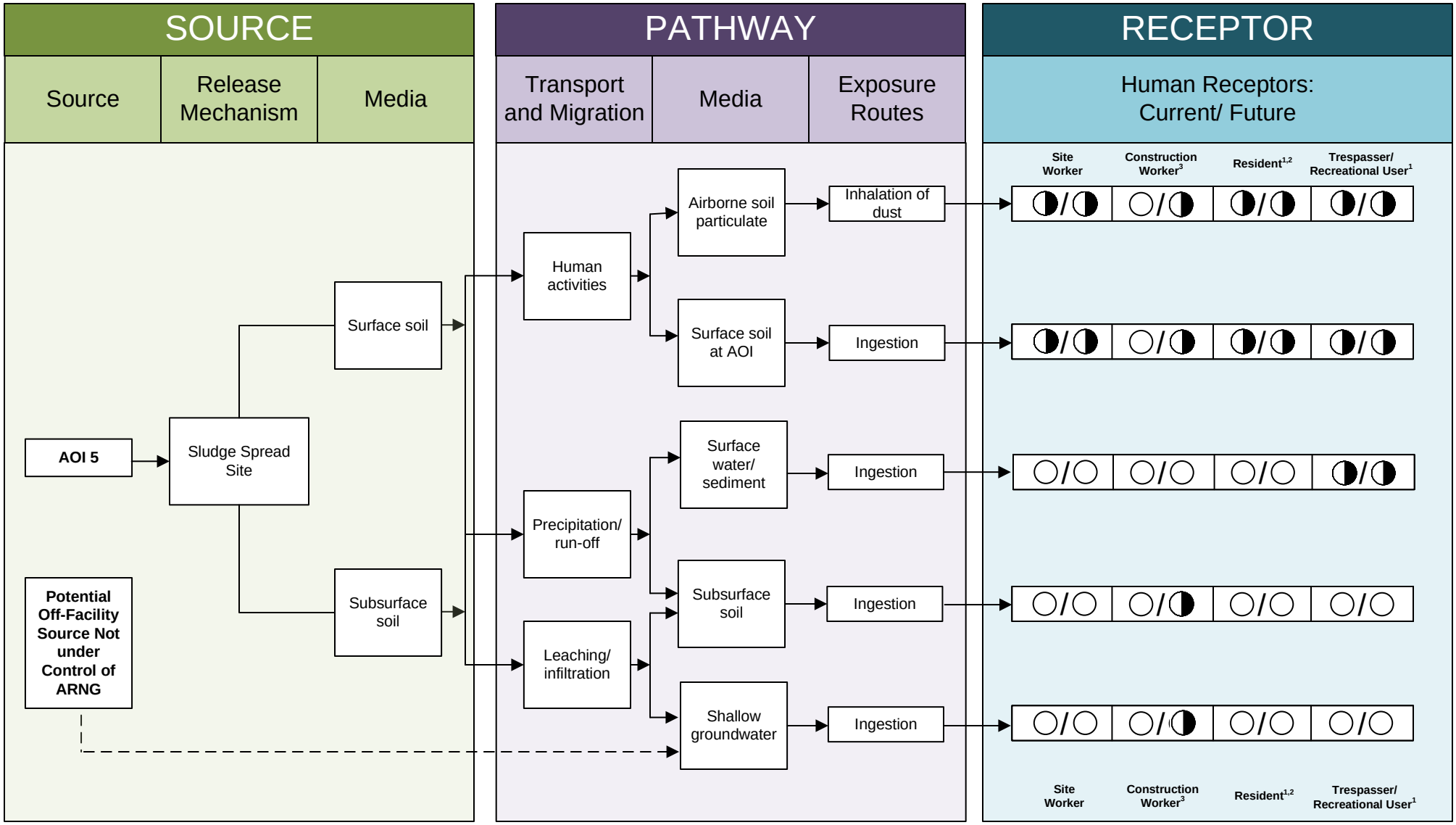
LEGEND

- 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 users refer to on- and off-facility receptors.
2. Inhalation of dust for off-facility receptors is likely insignificant.
3. No current active construction at AOI 5-WWTP.

Figure 7-5
Conceptual Site Model, AOI 5-Wastewater Treatment Plant
Camp Ripley



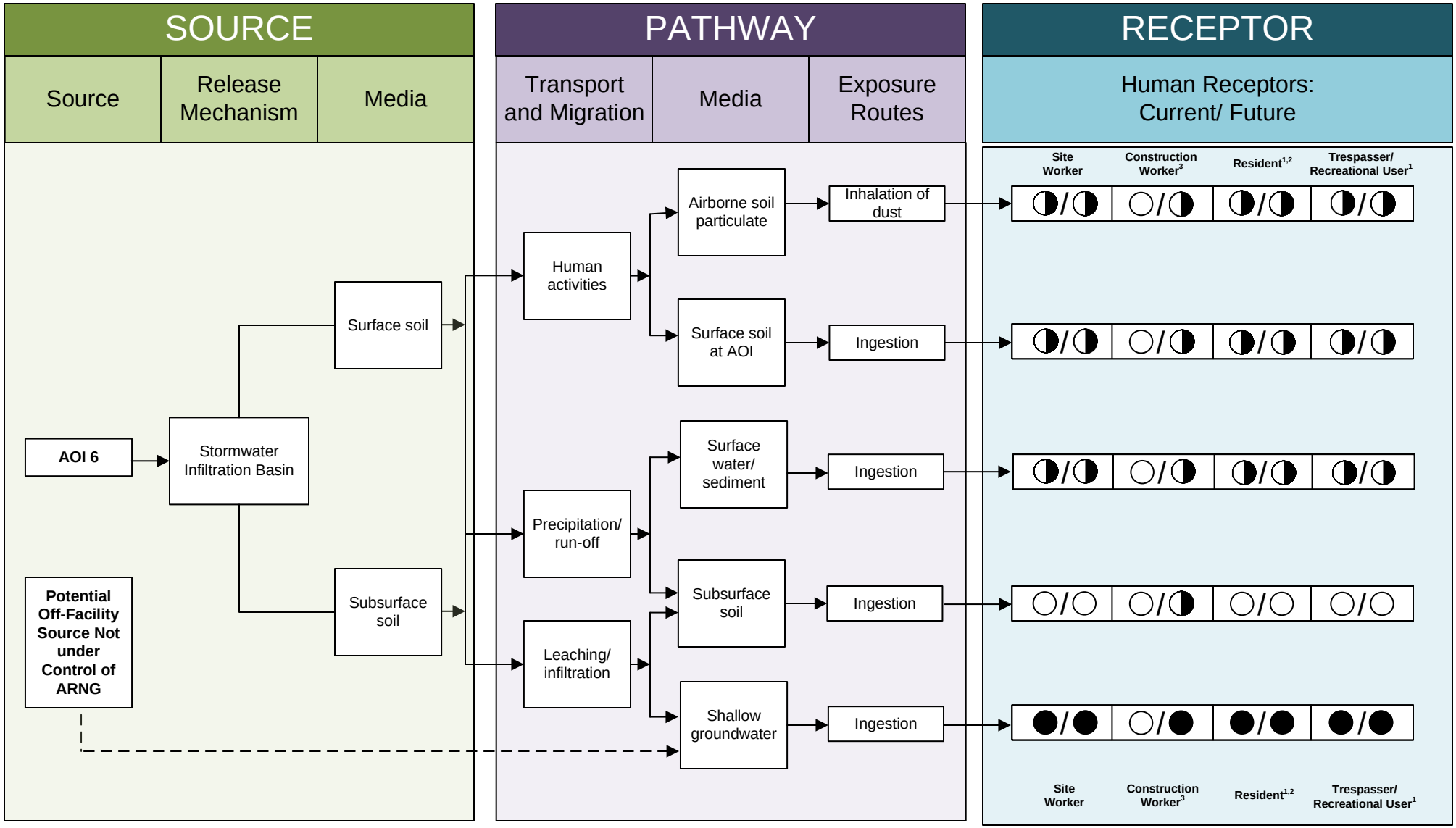
LEGEND

- 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 users refer to on- and off-facility receptors.
2. Inhalation of dust for off-facility receptors is likely insignificant.
3. No current active construction at AOI 5-Sludge Spread Site.

Figure 7-6
Conceptual Site Model, AOI 5-Sludge Spread Site
Camp Ripley



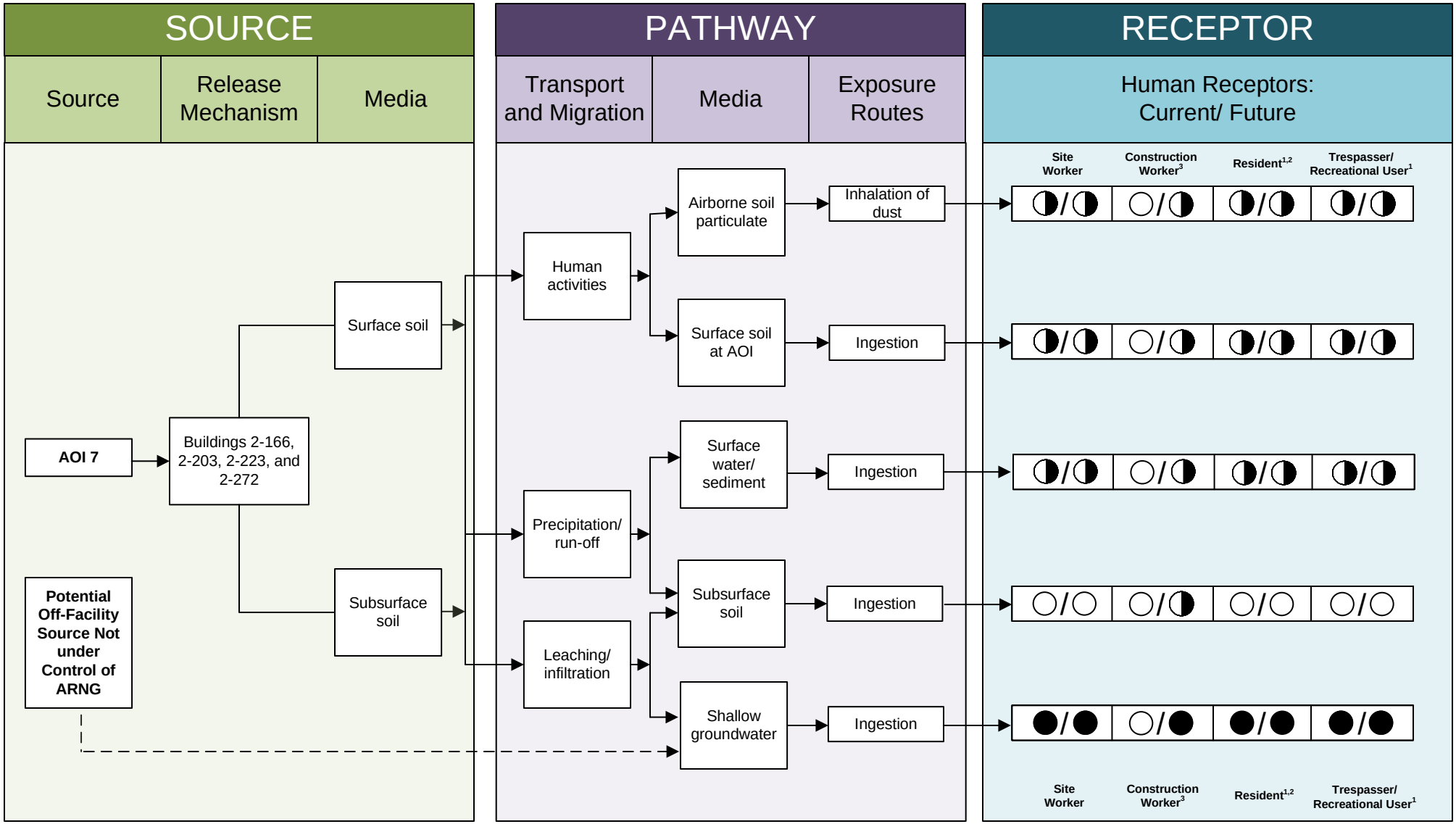
LEGEND

- 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 users refer to on- and off-facility receptors.
2. Inhalation of dust for off-facility receptors is likely insignificant.
3. No current active construction at AOI 6.

Figure 7-7
Conceptual Site Model, AOI 6
Camp Ripley



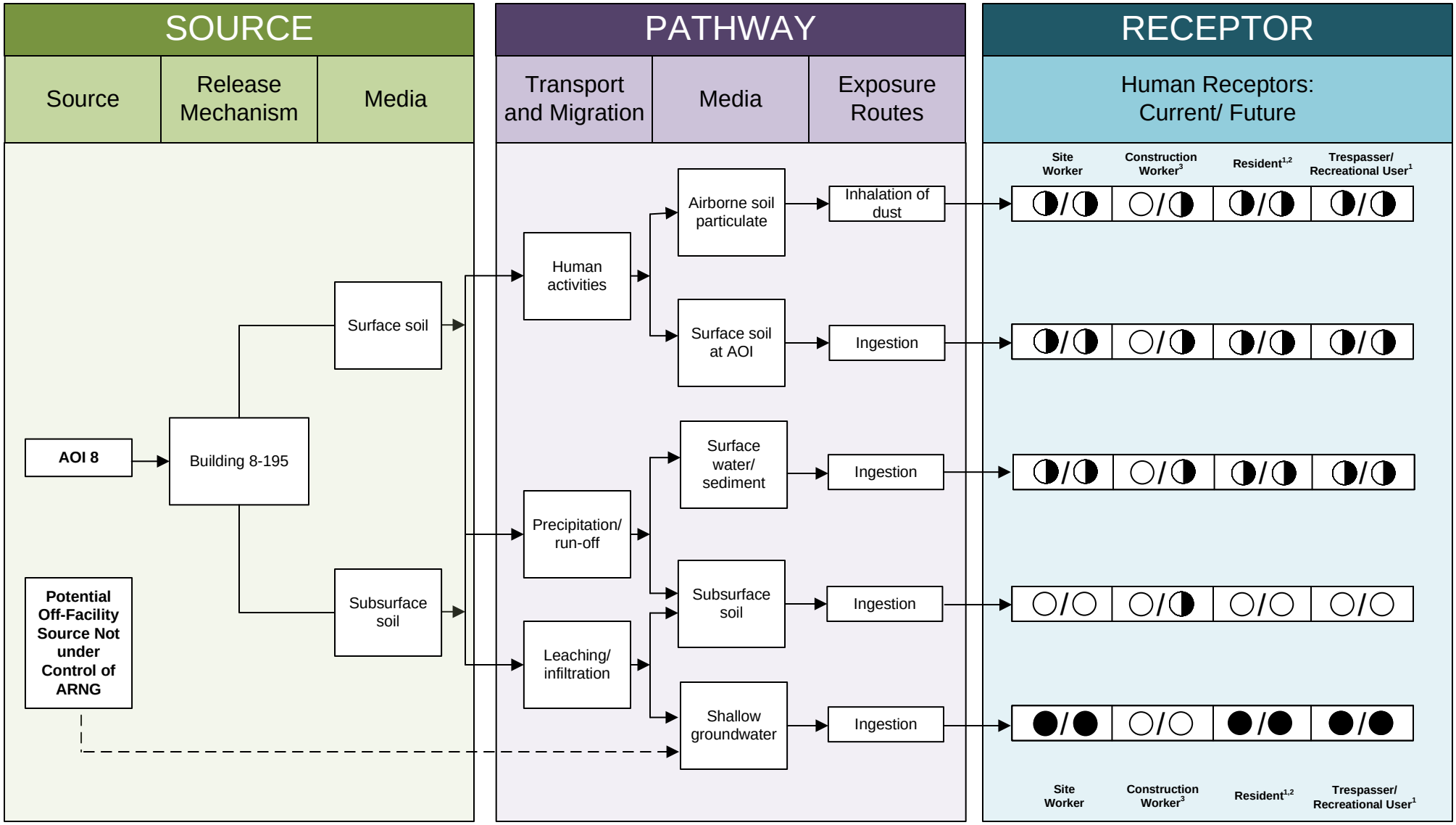
LEGEND

- 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 users refer to on- and off-facility receptors.
2. Inhalation of dust for off-facility receptors is likely insignificant.
3. No current active construction at AOI 7.

Figure 7-8
Conceptual Site Model, AOI 7
Camp Ripley



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 users refer to on- and off-facility receptors.
2. Inhalation of dust for off-facility receptors is likely insignificant.
3. No current active construction at AOI 8.

Figure 7-9
Conceptual Site Model, AOI 8
Camp Ripley

THIS PAGE INTENTIONALLY BLANK

8. Summary and Outcome

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

8.1 SI Activities

The SI field activities were conducted from 6 to 17 June 2022 and consisted of utility clearance, direct push boring, soil sample collection, temporary monitoring well installation, grab groundwater sample collection, synoptic gauging, temporary well abandonment, and land surveying. Field activities were conducted in accordance with the SI QAPP Addendum (AECOM, 2022a), except as previously noted in **Section 5.9**.

To fulfill the project DQOs set forth in the approved SI QAPP Addendum (AECOM, 2022a), samples were collected and analyzed for a subset of 18 compounds by LC/MS/MS compliant with QSM 5.3 Table B-15 as follows.

- Eighty-eight (88) soil samples from 32 boring locations;
- Twenty-nine (29) grab groundwater samples from 30 temporary well locations;
- Four (4) grab groundwater samples from four existing permanent wells;
- Thirty-five (35) QA/ QC samples.

An SI is conducted when the PA determines an AOI exists based on probable use, storage, and/or disposal of PFAS-containing materials. The SI includes multi-media sampling at AOIs to determine whether or not a release has occurred. The SI may conclude further investigation is warranted, a removal action is required to address immediate threats, or no further action is required. Additionally, the CSMs were refined to assess whether a potentially complete pathway exists between the source and potential receptors for potential exposure at the AOIs, which are described in **Section 7**.

8.2 Outcome

Based on the results of this SI, further evaluation under CERCLA is warranted in an RI for AOI 1, AOI 2, AOI 4, AOI 5-WWTP, AOI 6, AOI 7, and AOI 8; no further evaluation is warranted for AOI 3 or AOI 5-Sludge Spread Site at this time (see **Table 8-1**). Based on the CSMs developed and revised in light of the SI findings, there is potential for exposure to drinking water receptors from AOI 1, AOI 2, AOI 4, AOI 5-WWTP, AOI 6, AOI 7, and AOI 8 from sources on the facility resulting from historical DoD activities. Sample analytical concentrations collected during the SI were compared against the project SLs in soil and groundwater, as described in **Table 6-1**. A summary of the results of the SI data relative to the SLs is as follows:

- At AOI 1:
    - PFOA, PFOS, PFNA, and PFHxS in groundwater exceeded their SLs. PFOA exceeded the SL of 6 ng/L, with a maximum concentration of 56.0 ng/L at location AOI01-02. PFOS exceeded the SL of 4 ng/L, with a maximum concentration of 1500 ng/L at location AOI01-02. PFNA exceeded the SL of 6 ng/L, with a maximum concentration of 34.9 ng/L at location AOI01-02. PFHxS exceeded the SL of 39 ng/L, with a maximum concentration of 216 ng/L at location AOI01-02. Based on the results of the SI, further evaluation of AOI 1 is warranted in an RI.

  - PFOS in surface soil exceeded the SL of 13 µg/kg at AOI01-02, with a concentration of 33.6 µg/kg. The detected concentrations of PFOA, PFHxS, and PFNA in soil were below their respective SLs.

- At AOI 2:
  - PFOA and PFOS in groundwater exceeded their SLs. PFOA exceeded the SL of 6 ng/L with a concentration of 8.92 ng/L at location AOI02-01. PFOS exceeded the SL of 4 ng/L with a maximum concentration of 20.5 ng/L at location AOI02-01. Based on the results of the SI, further evaluation of AOI 2 is warranted in an RI.
  - The detected concentrations of PFOS, PFHxS, and PFNA in soil at AOI 2 were below their respective SLs.
- At AOI 3:
  - The detected concentrations of PFOA, PFOS, and PFBS in groundwater at AOI 3 were below their respective SLs. Based on the results of the SI, further evaluation of AOI 3 is not warranted in an RI.
  - Detected concentrations of PFOA, PFOS, and PFNA in surface soil at AOI 3 were below their respective SLs.
- At AOI 4:
  - PFOA, PFOS, PFHxS, and PFNA in groundwater exceeded their respective SLs. PFOA exceeded the SL of 6 ng/L, with a maximum concentration of 15.0 ng/L at location AOI04-04. PFOS exceeded the SL of 4 ng/L, with a maximum concentration of 74.2 ng/L at location AOI04-04. PFHxS exceeded the SL of 39 ng/L, with a concentration of 132 ng/L at location AOI04-04. PFNA exceeded the SL of 6 ng/L, with a concentration of 14.7 ng/L at location AOI04-03. Based on the results of the SI, further evaluation of AOI 4 is warranted in an RI.
  - Detected concentrations of PFOA, PFOS, PFHxS, and PFNA in surface soil at AOI 4 were below their respective SLs.
- At AOI 5-WWTP:
  - PFOS and PFHxS in groundwater exceeded their SLs. PFOS exceeded the SL of 4 ng/L, with a maximum concentration of 62.4 ng/L at location AOI05-06. PFHxS exceeded the SL of 39 ng/L, with a concentration of 43.0 ng/L at location AOI05-06. Based on the results of the SI, further evaluation of AOI 5-WWTP is warranted in an RI.
  - Detected concentrations of PFOA, PFOS, PFHxS, PFNA, and PFBS in soil at AOI 5-WWTP were below their respective SLs.
- At AOI 5-Sludge Spread Site
  - PFOS was detected below the SL of 4 ng/L in one well, AOI05-04, with a concentration of 0.956 J ng/L. All other relevant compounds were non-detect for AOI05-04, and all relevant compounds were non-detect for wells AOI05-02 and AOI05-03. Based on the results of the SI, further evaluation of AOI 5-Sludge Spread Site is not warranted in an RI.
  - Detected concentrations of PFOA, PFOS, PFHxS, PFNA, and PFBS in soil at AOI 5-Sludge Spread Site were below their respective SLs.

- At AOI 6:
    - PFOS detected in groundwater at AOI 6 exceeded the SL of 4 ng/L in all three wells sampled, with a maximum concentration of 13.8 ng/L at location AOI06-01. The detected concentrations of PFOA, PFNA, PFHxS, and PFBS in groundwater at AOI 6 were below their respective SLs. Based on the results of the SI, further evaluation of AOI 6 is warranted in an RI.
    - Detected concentrations of PFOA, PFOS, PFHxS, PFNA, and PFBS in surface soil at AOI 6 were below their respective SLs.
- At AOI 7:
    - PFOA, PFOS, and PFHxS in groundwater at AOI 7 exceeded their respective SLs. PFOA exceeded the SL of 6 ng/L, with a concentration of 6.20 ng/L at location AOI07-02. PFOS exceeded the SL of 4 ng/L, with a maximum concentration of 237 ng/L at location AOI07-01. PFHxS exceeded the SL of 39 ng/L, with a maximum concentration of 172 ng/L at location AOI07-01. Based on the results of the SI, further evaluation of AOI 7 is warranted in an RI.
    - Detected concentrations of PFOS, PFNA, PFHxS, PFBS, and PFOA in surface soil at AOI 7 were below their SLs.
- At AOI 8:
    - PFOA, PFOS, and PFHxS in groundwater at AOI 8 exceeded their respective SLs. PFOA exceeded the SL of 6 ng/L, with a concentration of 20.3 ng/L at location AOI08-01. PFOS exceeded the SL of 4 ng/L at all three wells sampled, with a maximum concentration of 71.0 ng/L at location AOI08-02. PFHxS exceeded the SL of 39 ng/L, with a concentration of 247 ng/L at location AOI08-01. Based on the results of the SI, further evaluation of AOI 8 is warranted in an RI.
    - Detected concentrations of PFOS, PFNA, and PFHxS in surface soil at AOI 8 were below their respective SLs.

Of the six PFAS compounds presented in the 6 July 2022 OSD memorandum, HFPO-DA (commonly referred to as GenX) was not included as an analyte at the time of this SI. Based on the CSM developed during the PA and revised based on SI findings, the presence of HFPO-DA is not anticipated at the facility because HFPO-DA is generally not a component of MIL-SPEC AFFF and based on its history including distribution limitations that restricted use of GenX, it is generally not a component of other products the military used. In addition, it is unlikely that GenX would be an individual chemical of concern in the absence of other PFAS.

Table 8-1 summarizes the SI results for soil and groundwater used to determine if an AOI should be considered for further investigation under CERCLA and undergo an RI.

Table 8-1: Summary of Site Inspection Findings and Recommendations

AOI	Potential Release Area	Soil – Source Area	Groundwater – Source Area	Future Action
1	TriMax™ Discharge Area and Building 8-197	●	●	Proceed to RI
2	Burn Pit Fire Training Area	◐	●	Proceed to RI
3	DHS Demonstration	◐	◐	No Further Action
4	USPFO Warehouse, CMA Shop, and CMA Discharge Area	◐	●	Proceed to RI
5	WWTP	◐	●	Proceed to RI
	Sludge Spread Site	◐	◐	No Further Action
6	Stormwater Infiltration Basin	◐	●	Proceed to RI
7	Buildings 2-166, 2-203, 2-223, and 2-272	◐	●	Proceed to RI
8	Building 8-195	◐	●	Proceed to RI

Legend:
CMA = Combined Maintenance Activity
DHS = Department of Homeland Security
FTA = fire training area
RI = Remedial Investigation
USPFO = United States Property and Fiscal Office
WWTP = wastewater treatment plant
● = detected; exceedance of the screening levels
◐ = detected; no exceedance of the screening levels
○ = not detected

9. References

AECOM. 2018a. *Final Site Inspection Programmatic Uniform Federal Policy-Quality Assurance Project Plan, Perfluorooctane Sulfonic Acid (PFOS) and Perfluorooctanoic Acid (PFOA) Impacted Sites ARNG Installations, Nationwide Contract No. W912DR-12-D-0014/ W912DR17F0192*. 9 March.

AECOM. 2018b. *Final Programmatic Accident Prevention Plan, Perfluorooctane Sulfonic Acid (PFOS) and Perfluorooctanoic Acid (PFOA) Impacted Sites ARNG Installations, Nationwide Contract No. W912DR-12-D-0014/W912DR17F0192.* July.

AECOM. 2019. *Final Preliminary Assessment Report, Camp Ripley, Minnesota*. November.

AECOM. 2022a. *Final Site Inspection Uniform Federal Policy-Quality Assurance Project Plan Addendum, Camp Ripley, Little Falls, Minnesota, Perfluorooctane Sulfonic Acid (PFOS) and Perfluorooctanoic Acid (PFOA) Impacted Sites ARNG Installations, Nationwide.* March.

AECOM. 2022b. *Final Site Safety and Health Plan, Camp Ripley, Little Falls, Minnesota, Perfluorooctane Sulfonic Acid (PFOS) and Perfluorooctanoic Acid (PFOA) Impacted Sites ARNG Installations, Nationwide*. June.

Assistant Secretary of Defense. 2022. *Investigation Per- and Polyfluoroalkyl Substances within the Department of Defense Cleanup Program*. United States Department of Defense. 6 July.

BAL. 1987. *Camp Ripley Hydrogeologic Investigation*, *Test Drilling and 24 Hour Pumping Test*.

Baratta, V.M. 2019. *Groundwater Atlas of Morrison County, Minnesota: Minnesota Department of Natural Resources, County Atlas Series C-31, Part B*. Accessed 14 June 2023 at: https://files.dnr.state.mn.us/waters/groundwater_section/mapping/cga/c31_morrison/morrison_report.pdf.

DA. 2018. *Army Guidance for Addressing Releases of Per- and Polyfluoroalkyl Substances.* 4 September.

Delta Consultants. 2010. *Perfluorocarbon-Containing Firefighting Foams And Their Use In Minnesota.* June.

DoD. 2019a. *Department of Defense (DoD), Department of Energy (DOE) Consolidated Quality Systems Manual (QSM) for Environmental Laboratories, Version 5.3*.

DoD. 2019b. *General Data Validation Guidelines. Environmental Data Quality Workgroup*. 4 November.

Foth and Van Dyke. 1997. *Water Quality Survey, Camp Ripley, Minnesota.*

Guelfo, J.L. and Higgins, C.P. 2013. *Subsurface Transport Potential of Perfluoroalkyl Acids at Aqueous Film-Forming Foam (AFFF)-Impacted Sites.* Environmental Science and Technology 47(9): 4164-71.

Higgins, C.P., and Luthy, R.G. 2006. *Sorption of perfluorinated surfactants on sediments*. Environmental Science and Technology 40 (23): 7251-7256.

ITRC. 2018. *Environmental Fate and Transport for Per- and Polyfluoroalkyl Substances*. March.

MNARNG. 2018. *Integrated Natural Resource Management Plan (INRMP). Camp Ripley Training Site.* Plan Period 2018-2022.

MNARNG. 2021. *Camp Ripley Drinking Water 2021 Consumer Confidence Report.* Website. Accessed 5 January 2023 at https://ecos.fws.gov/ecp/report/species-listings-by-current-range-county?fips=27097.

MWI. 2023. *Minnesota Well Index, Minnesota Department of Health*. Accessed 06 September 2023 at https://mnwellindex.web.health.state.mn.us/mwi/.

Quinn, John J. 2006. *Delineation of a Wellhead Protection Zone and Delineation of Flowpaths from Potential Groundwater Contaminant Source Areas at Camp Ripley, Little Falls, Minnesota.* Environmental Science Division, Argonne National Laboratory.

UMD. n.d. *Camp Ripley Aquifer Protection Plan.* Geological Sciences Department.

USACE. 2016. *Technical Project Planning Process*, EM-200-1-2. 26 February.

USACHPPM. 2000. Firing Range Study Number 32-EE-3330-00, *Conceptual Site Model for the Firing Range/Impact Area Risk Assessment, Camp Ripley, Minnesota*.

USAEHA. 1994. Groundwater Quality Survey Number 38-36-K2SY-94, Camp Ripley National Guard Training Area, Little Falls, Minnesota.

US Department of Health and Human Services. 2008. *Health Consultation, PFOS Detections in the City of Brainerd, Minnesota*. August.

USEPA. 1980. *Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)*.

USEPA. 1994. *National Oil and Hazardous Substances Pollution Contingency Plan (Final Rule)*. 40 CFR Part 300; 59 Federal Register 47384. September.

USEPA. 2001. *Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part D, Standardized Planning, Reporting, and Review of Superfund Risk Assessments)*. December.

USEPA. 2017. *National Functional Guidelines for Organic Superfund Data Review*. OLEM 9355.0-136, EPA-540-R-2017-002. Office of Superfund Remediation and Technology Innovation. January.

USFWS. 2023a. *Species by County Report, County: Morrison, Minnesota.* Environmental Conservation Online System. Accessed 20 April 2023 at https://ecos.fws.gov/ecp/report/species-listings-by-current-range-county?fips=27097.

USFWS. 2023b. *National Wetlands Inventory: Wetlands Mapper*. Accessed 16 May 2023 at https://fwsprimary.wim.usgs.gov/wetlands/apps/wetlands-mapper/.

World Climate. 2019. *Average Weather Data for Little Falls, Minnesota.* Accessed 13 December 2018 at http://www.worldclimate.com/climate/us/minnesota/little-falls.

Xiao, F., Simcik, M. F., Halbach, T. R., and Gulliver, J. S. 2015, Perfluorooctane sulfonate (PFOS) and perfluorooctanoate (PFOA) in soils and groundwater of a U.S. metropolitan area: Migration and implications for human exposure. Water Research 72: 64-74.