FINAL
Preliminary Assessment Report
Camp Grayling, Michigan

Perfluorooctane-Sulfonic Acid (PFOS) and Perfluorooctanoic Acid (PFOA) Impacted Sites
ARNG Installations, Nationwide

August 2018

Prepared for:

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

U.S. Army Corps of Engineers, Baltimore District
2 Hopkins Plaza
Baltimore, MD 21201

Prepared by:

AECOM
12420 Milestone Center Drive, Suite 150
Germantown, MD 20876
aecom.com

Contract Number: W912DR-12-D-0014
Delivery Order: W912DR17F0192

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Acronyms and Abbreviations

AECOM	AECOM Technical Services, Inc.
AFFF	aqueous film forming foam
AOI	area of interest
ARNG	Army National Guard
ASP	ammunition storage plant
bgs	below ground surface
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
cfs	cubic feet per second
CSM	conceptual site model
FOB	forward operating base
FTA	fire training area
GAAF	Grayling Army Airfield
IED	Installations and Environment Division
MATES	Maneuver Area Training Equipment Site
MDMVA	Michigan Department of Military & Veterans Affairs
MDNR	Michigan Department of Natural Resources
MIARNG	Michigan Army National Guard
PA	Preliminary Assessment
PFAS	per- and poly-fluoroalkyl substances
PFOA	perfluorooctanoic acid
PFOS	perfluorooctanesulfonic acid
SI	Site inspection
TCE	Trichloroethylene
US	United States
USACE	United States Army Corps of Engineers
USEPA	United States Environmental Protection Agency
VSI	visual survey inspection
WHPA	Wellhead protection area
WWTP	waste water treatment plant

Executive Summary

The United States (US) Army Corps of Engineers (USACE) Baltimore District on behalf of the Army National Guard (ARNG)-Installations & Environment Division (IED), Cleanup Branch contracted AECOM Technical Services, Inc. (AECOM) to perform Preliminary Assessments (PAs) and Site Inspections (SIs) for Perfluorooctanesulfonic acid (PFOS) and Perfluorooctanoic acid (PFOA) Impacted Sites at ARNG Facilities Nationwide. The ARNG is assessing potential effects on human health related to processes at facilities that used per- and poly-fluoroalkyl substances (PFAS) (a suite of related chemicals), primarily in the form of aqueous film forming foam (AFFF) released during firefighting activities or training, although other PFAS sources are possible. In addition, the ARNG is assessing businesses or operations adjacent to the ARNG facility (not under the control of ARNG) that could potentially be responsible for a PFAS release.

AECOM completed a PA for PFAS at Camp Grayling in Grayling, Michigan to assess potential PFAS release areas and exposure pathways to receptors. Established as a training camp in 1913, the footprint of Camp Grayling currently encompasses over 147,000 acres. Of the 147,000 acres, approximately 105,000 acres are owned or leased by the Michigan Department of Military & Veterans Affairs. Approximately 20,000 acres are leased from private owners, while the remaining approximately 22,000 acres are purchased, deeded, or federally owned property. Roughly 57,000 acres of land are leased in perpetuity from the Michigan Department of Natural Resources.

The performance of this PA included the following tasks:

- Reviewed data resources to obtain information relevant to suspected PFAS releases
- Conducted a 3-day site visit on February 27 and 28, and March 1, 2018
- Interviewed current and former personnel familiar with firefighting activities within the Camp Grayling area, including:
  - Current Camp Grayling Environmental Quality Specialist Kimberly Bolan
  - Former Camp Grayling firefighting personnel Kim Halstead, Roger Green, Paul Smith, and Steve Green
  - Current Grayling City Fire Department Chief Russell H. Strohpaul Jr.
  - Michigan Department of Natural Resources personnel Duane Brooks (retired), Susan Thiel, and Jim Fisher
- Completed visual survey inspections at known or suspected PFAS release locations and documented with photographs
- Developed a conceptual site model to outline the potential releases, pathways, and receptors of PFAS for Camp Grayling

Nineteen Areas of Interest (AOIs) related to PFAS releases were identified at Camp Grayling during the PA. The date of release for each AOI is estimated to be between the years of the 1970s and early 1980s, exact dates are unknown. The AOIs are shown on **Figures ES-1** through **ES-5** and described in the table below. The conceptual site model for the entirety of Camp Grayling is presented in **Figure ES-6**.

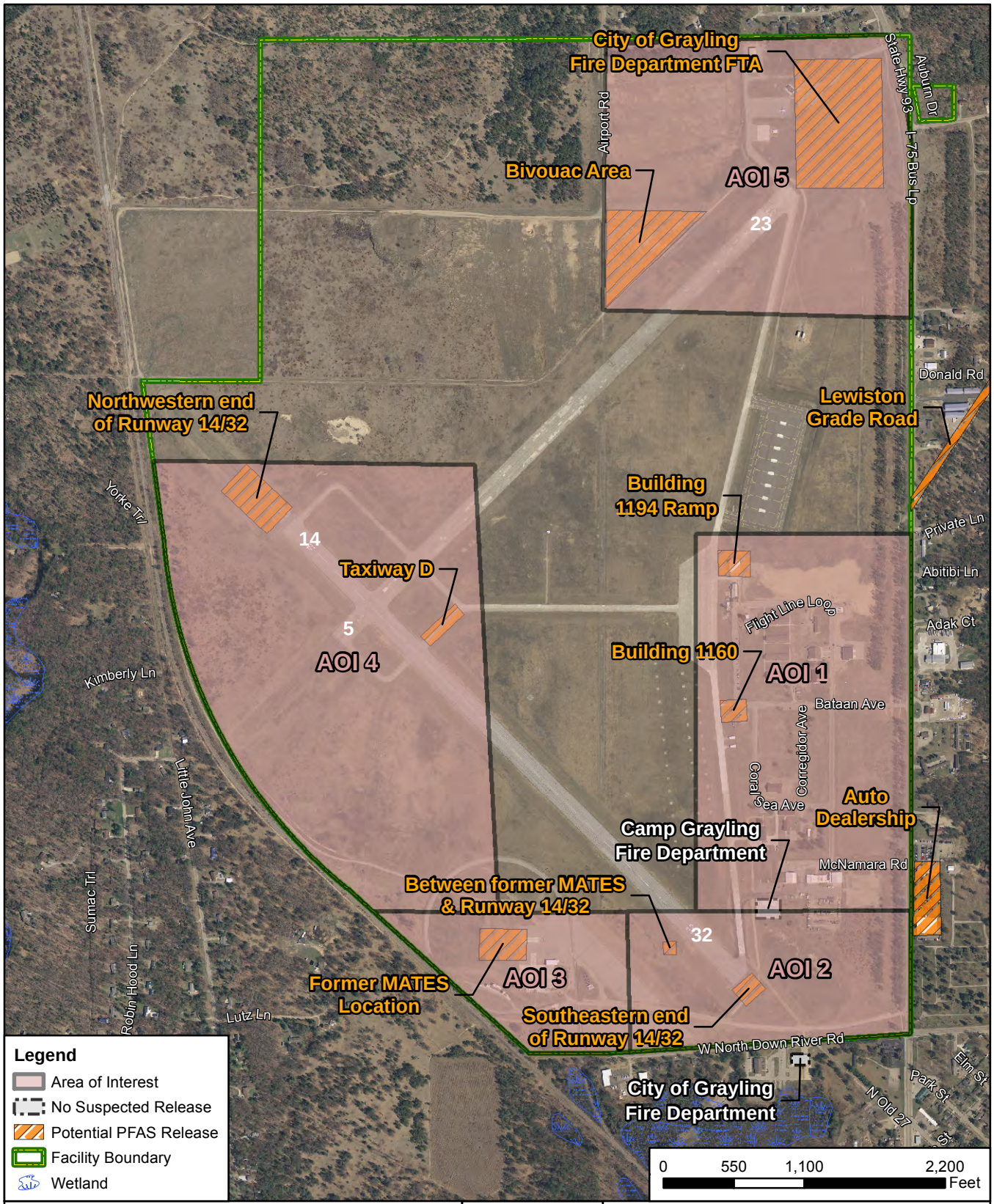
Area of Interest	Name	Used by	Release Dates
AOI 1 – AOI 5	Grayling Army Airfield (GAAF)	Michigan ARNG (MIARNG) and City of Grayling Fire Department	Frequently during the 1970s and early 1980s
AOI 6	Range 40 Complex	MIARNG	Occasionally during the 1970s and early 1980s
AOI 7	North Forward Operating Base	MIARNG	Approximately twice per year during the 1970s and early 1980s
AOI 8	Range 30 Complex	MIARNG	Occasionally during the 1970s and early 1980s
AOI 9	Lewiston Grade Road	MIARNG	Regularly during summer training in the 1970s and early 1980s
AOI 10	Range 8 – Multipurpose Machine Gun Range	MIARNG	As needed during the 1970s and early 1980s
AOI 11	Small Arms Ranges	MIARNG	As needed during the 1970s and early 1980s
AOI 12	Light Demolition Ranges	MIARNG	As needed during the 1970s and early 1980s
AOI 13	Range 15 Area	MIARNG	As needed during the 1970s and early 1980s
AOI 14	East Cantonment	MIARNG	Frequently during the 1970s and early 1980s
AOI 15	West Cantonment	MIARNG	Frequently during the 1970s and early 1980s
AOI 16	Wilson Hill	MIARNG	Occasionally during training in the 1970s and early 1980s
AOI 17	Former Ammunition Storage Plant	MIARNG	Early 1980s
AOI 18	Lake Margrethe	MIARNG	Regularly during the1970s and early 1980s
AOI 19	Howes Lake	MIARNG	Unknown

Three potential off-facility sources of PFAS were considered in the local area surrounding Camp Grayling. These include:

- An automotive dealership to the east of GAAF – may conduct waterproofing activities which may involve PFAS-containing chemicals

- The City of Grayling Fire Department to the south of GAAF – stored a small amount of AFFF for City use and support of Camp Grayling, no reported spills or releases
- Grayling Winter Recreation Area located to the east of the cantonment – ski and snowboard wax is a known source of PFAS
- Off-Facility House Fire – a private residence located adjacent to the main gate of the Camp Grayling cantonment burned down and may have been extinguished with AFFF

Based on the potential AFFF releases documented at Camp Grayling during the PA, there is potential for exposure to PFAS contamination in soil, groundwater, surface water, and sediment for the following potential receptors: site workers (e.g., Camp Grayling military and non-military staff and visitors), onsite construction workers, trespassers, and recreational users. In addition, residents using groundwater for drinking water surrounding the facility may potentially be exposed to migrating PFAS contamination via the nearby groundwater pathway. For GAAF and Lake Margrethe, the groundwater ingestion pathway is complete for off-facility residents. Receptors are less likely to be exposed to potential PFAS contamination through direct contact with soil and inhalation via air; however, some PFAS chemicals are water soluble and can migrate readily from soil to groundwater or surface water via leaching and run-off. Therefore, there is a potential for PFAS contamination in soil to migrate to groundwater and surface water systems.



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NOTES	Preliminary Assessment for PFAS at Camp Grayling, MI			
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SCALE	1:13,200	CHK BY	JL	7/31/2018
Base Map: Michigan Statewide Orthoimagery Program 2017		PM	RG	7/31/2018

Grayling Army Airfield
Summary of Findings

AECOM
12420 Milestone Center Drive
Germantown, MD 20876

Figure ES-1

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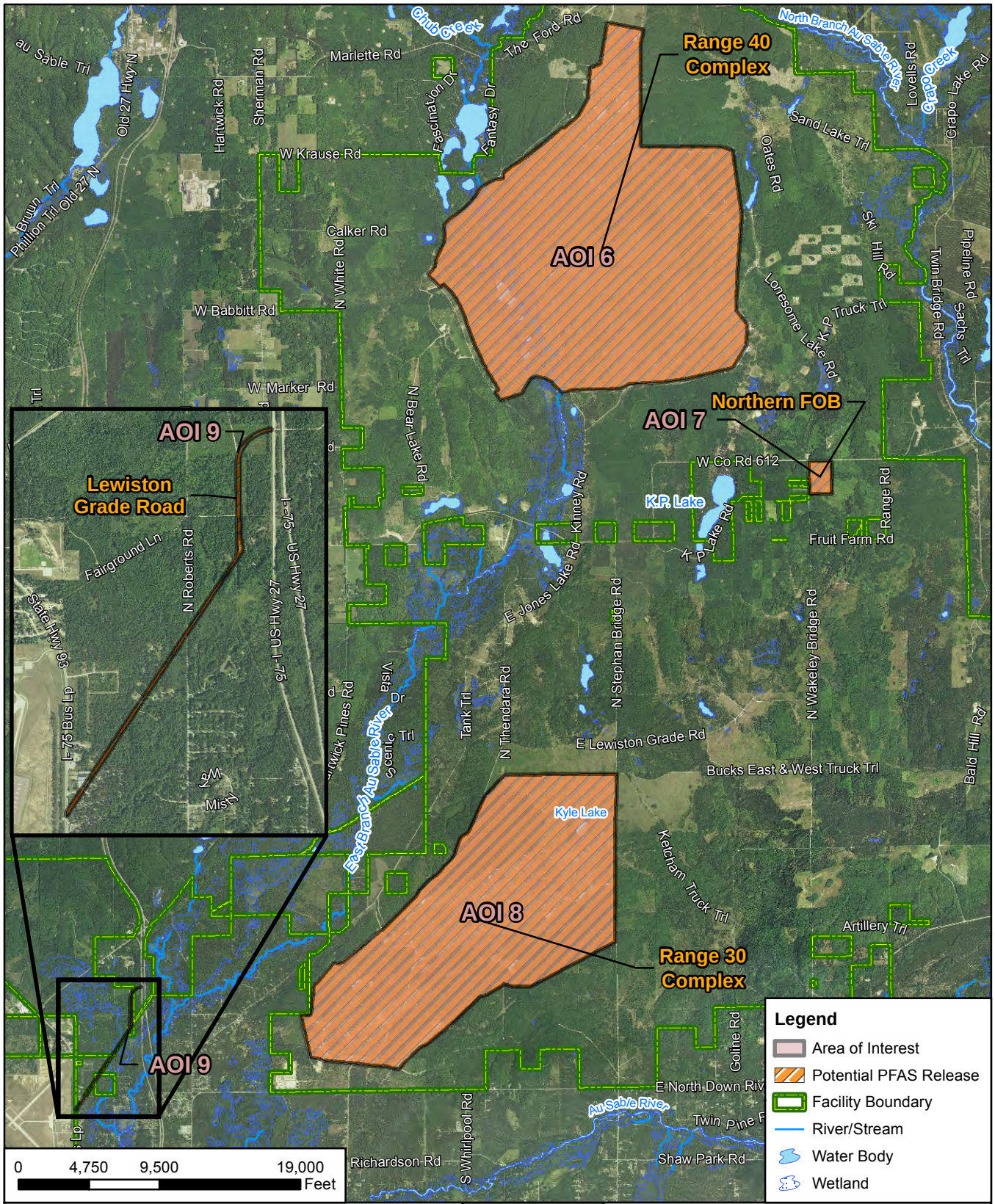

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SCALE	1:114,000	CHK BY	JL	7/31/2018
Base Map: National Agricultural Imagery Program, 2016		PM	RG	7/31/2018

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North Post Summary of Findings

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Figure ES-2

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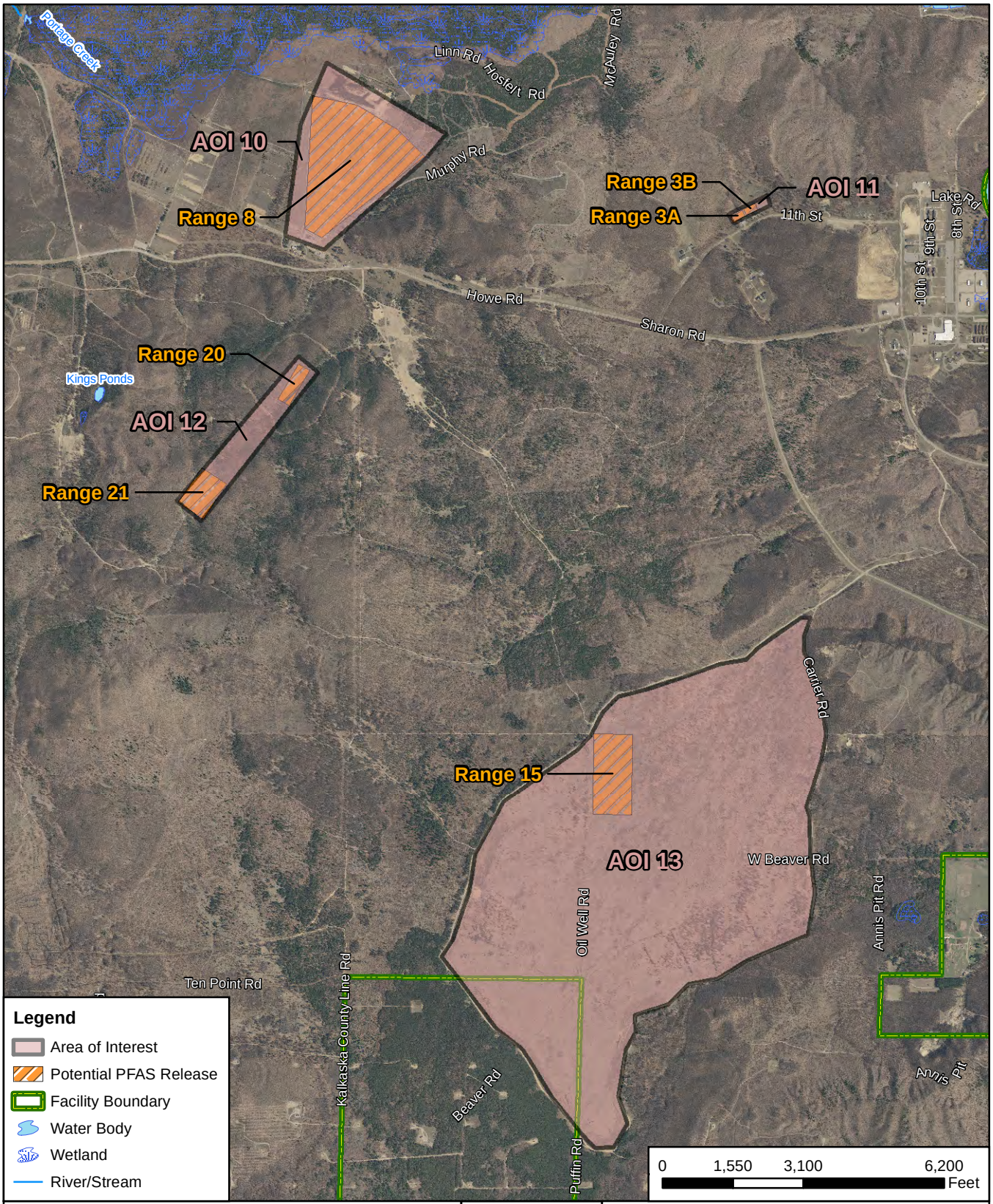

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Base Map: Michigan Statewide Orthoimagery Program 2017		PM	RG	8/7/2018

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South Post Summary of Findings

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Figure ES-3

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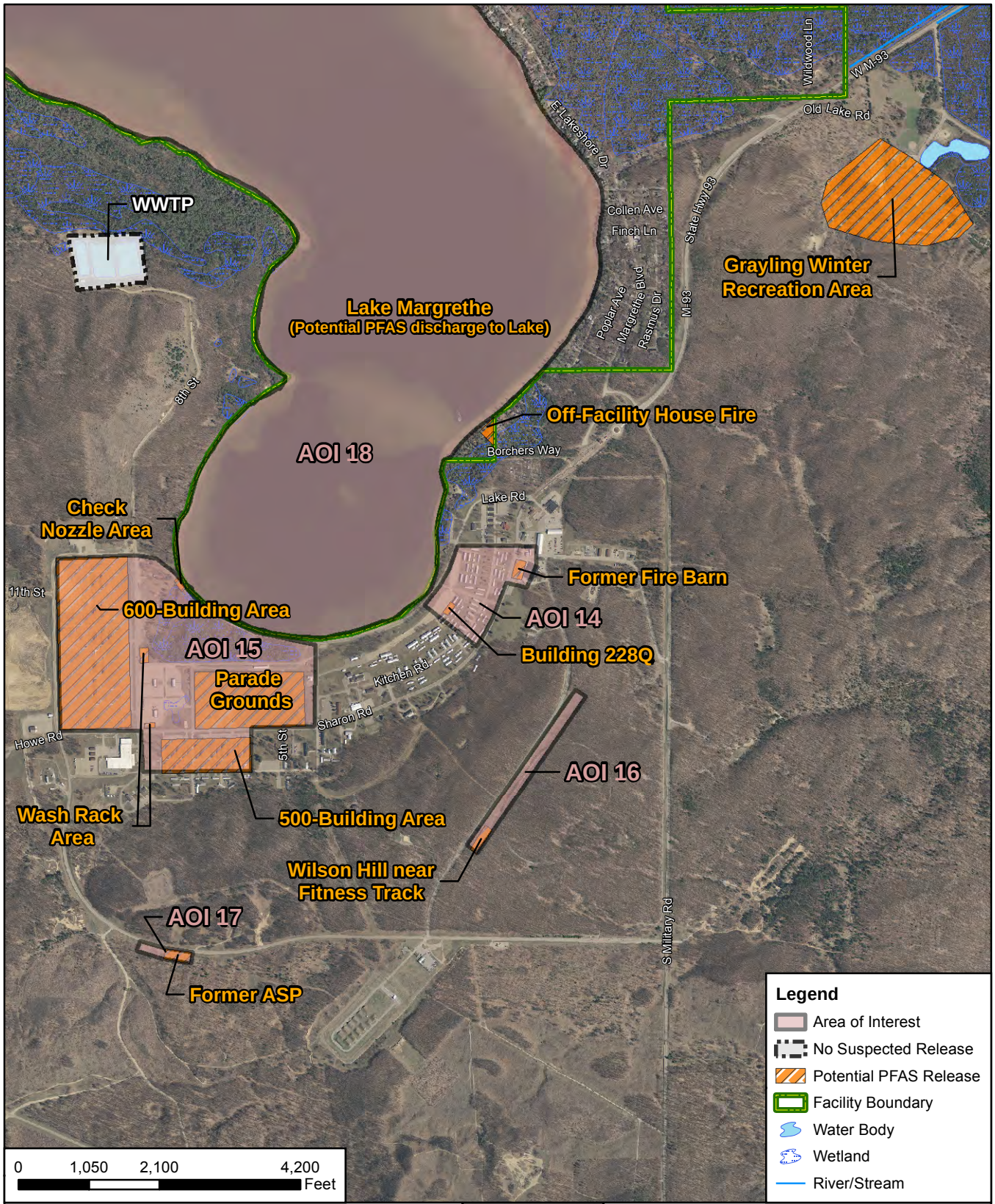

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Base Map: Michigan Statewide Orthoimagery Program 2017		PM	RG	8/6/2018

Cantonment Summary of Findings

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Figure ES-4

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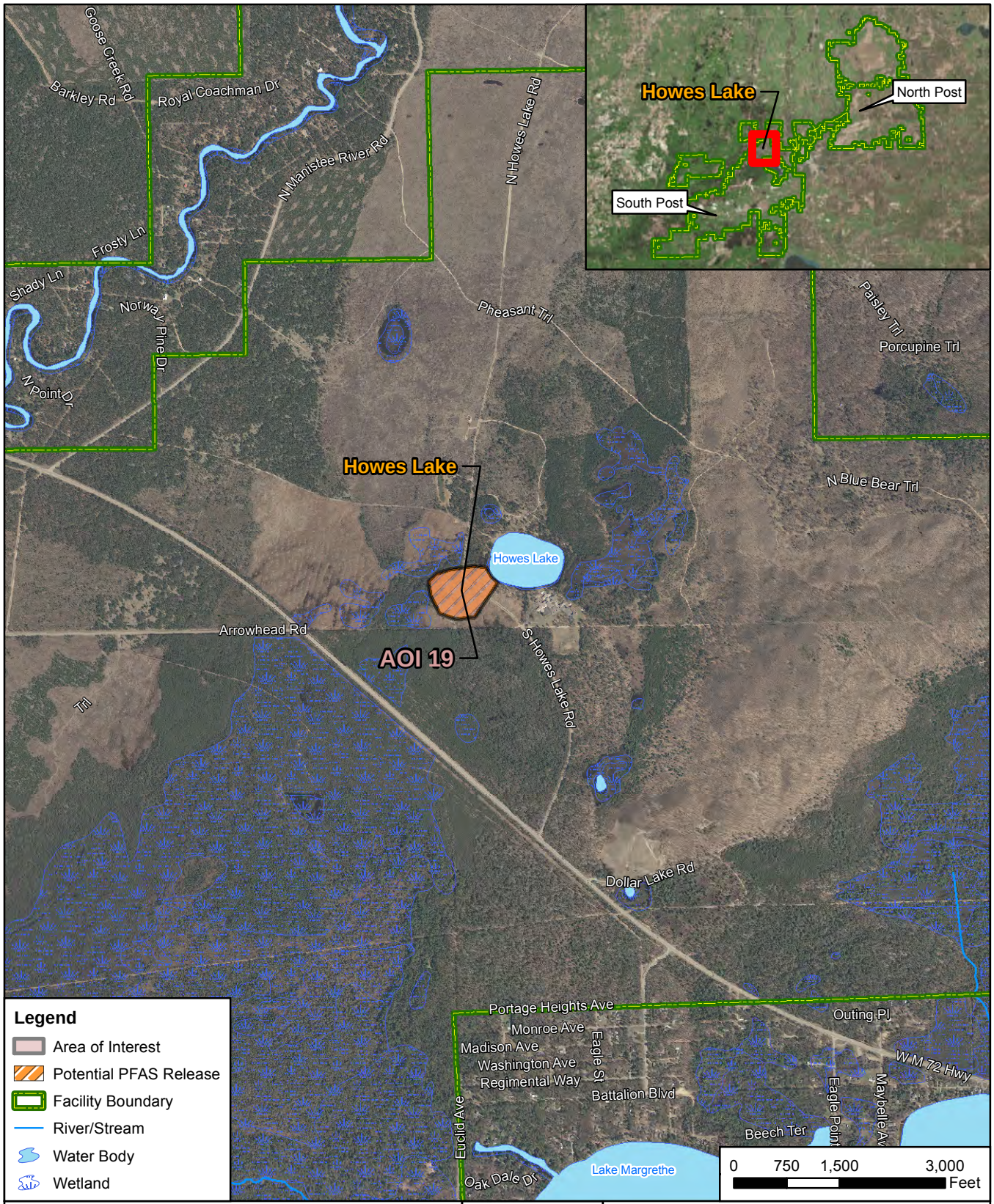

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Base Map: Michigan Statewide Orthoimagery Program 2017		PM	RG	7/31/2018

Howes Lake Summary of Findings

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Figure ES-5

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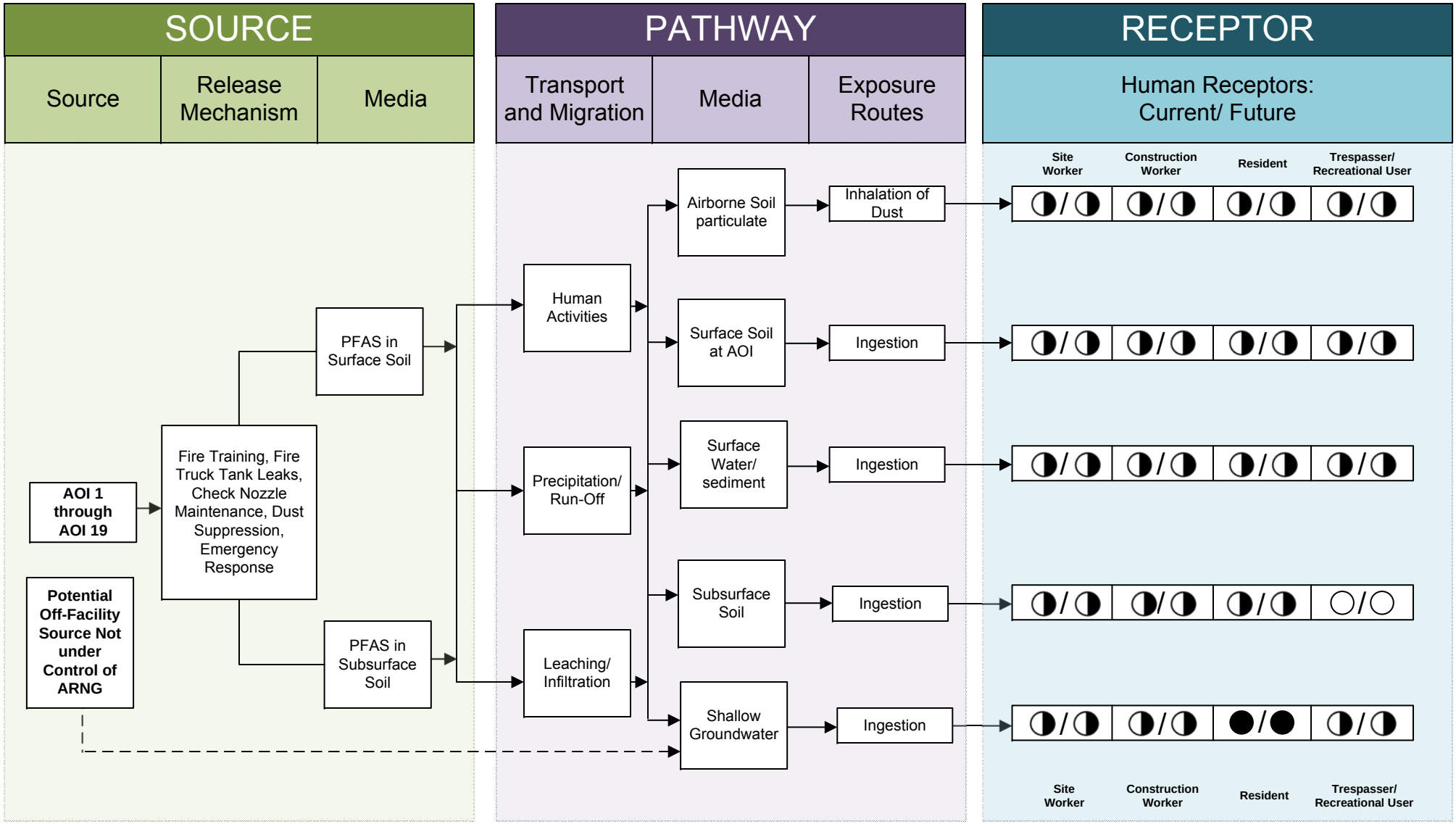


LEGEND

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

Figure ES-6
Conceptual Site Model
Camp Grayling

1. Introduction

1.1 Authority and Purpose

The United States (US) Army Corps of Engineers (USACE) Baltimore District on behalf of the Army National Guard (ARNG)-Installations & Environment Division (IED), Cleanup Branch contracted AECOM Technical Services, Inc. (AECOM) to perform Preliminary Assessments (PAs) and Site Inspections (SIs) for Perfluorooctanesulfonic acid (PFOS) and Perfluorooctanoic acid (PFOA) Impacted Sites at ARNG Facilities Nationwide under Contract Number W912DR-12-D-0014, Task Order W912DR17F0192, issued 11 August 2017, and Modification 01 issued 30 September 2017. The ARNG is assessing potential effects on human health related to processes at their facilities that used per- and poly-fluoroalkyl substances (PFAS) (a suite of related chemicals), primarily releases of aqueous film forming foam (AFFF) although other sources of PFAS are possible. In addition, the ARNG is assessing businesses or operations adjacent to the ARNG facility (not under the control of ARNG) that could potentially be responsible for a PFAS release.

PFAS are classified as emerging environmental contaminants that are garnering increasing regulatory interest due to their potential risks to human health and the environment. PFAS formulations contain highly diverse mixtures of compounds. Thus, the fate of these PFAS compounds in the environment varies. The regulatory framework at both federal and state levels continues to evolve. The US Environmental Protection Agency (USEPA) issued Drinking Water Health Advisories for PFOA and PFOS in May 2016, but there are currently no promulgated national standards regulating PFAS in drinking water. In the absence of federal maximum contaminant levels, some states have adopted their own drinking water standards for PFAS.

This report presents findings of a PA for PFAS at Camp Grayling in Grayling, Michigan in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended, the National Oil and Hazardous Substances Pollution Contingency Plan (40 Code of Federal Regulations [CFR] Part 300), and USACE requirements and guidance. This PA Report documents the known fire training areas (FTAs) as well as additional locations where PFAS may have been released into the environment at or near Camp Grayling. The term PFAS will be used throughout this report to encompass all PFAS chemicals being evaluated, including PFOS and PFOA, which are key components of AFFF.

1.2 Preliminary Assessment Methods

The performance of this PA included the following tasks:

- Reviewed data resources to obtain information relevant to suspected PFAS releases
- Conducted a 3-day site visit on February 27 and 28, and March 1, 2018
- Interviewed current and former personnel familiar with firefighting activities within the Camp Grayling area, including:
  - Current Camp Grayling Environmental Quality Specialist Kimberly Bolan
  - Former Camp Grayling firefighting personnel Kim Halstead, Roger Green, Paul Smith, and Steve Green
  - Current City of Grayling Fire Department Chief Russell H. Strohpaul Jr.

  - Michigan Department of Natural Resources personnel Duane Brooks (retired), Susan Thiel, and Jim Fisher
- Completed visual survey inspections at known or suspected PFAS release locations and documented with photographs
- Developed a conceptual site model (CSM) to outline the potential releases, pathways, and receptors of PFAS for Camp Grayling

1.3 Report Organization

This report has been prepared in accordance with the US Environmental Protection Agency's (USEPA) *Guidance for Performing Preliminary Assessments under CERCLA* (USEPA, 1991). The report sections and descriptions of each are:

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

1.4 Facility Location and Description

Camp Grayling is located in the city of Grayling, Michigan and covers portions of Crawford, Kalkaska, and Otsego counties (**Figure 1-1**). The camp is divided by Interstate Highway 75 and is approximately 200 miles northwest of Detroit and 80 miles south of Michigan's Upper Peninsula. The facility is located in the north-central portion of the Lower Peninsula and is bisected by the Au Sable River into two areas: the North Post and the South Post.

Camp Grayling is the National Guard's largest training post. It provides training facilities and support services for the ARNG, Air National Guard, US Army, US Army Reserve units, and allied

forces for live-fire weapons training, field training activities, light maneuver exercises, and heavy maneuver exercises.

The North Post of Camp Grayling includes two range complexes referred to herein as Range 40 Complex and Range 30 Complex. The Grayling Army Airfield (GAAF) will be addressed as a part of North Post for this report. The North Post operational areas are used primarily for artillery, tanks, and larger crew-served weapons. The South Post includes several training areas including a small arms range complex, Range 13 Complex, and light demolition areas. The cantonment area is also located in the South Post and includes housing and administrative buildings, a logistical support facility, wash racks/facilities, motor pools, ammunition storage point (ASP), recreational facilities, and parade grounds.

The training camp was established in 1913 when a Grayling lumber baron donated 13,754 acres of land at the south end of Portage Lake (now Lake Margrethe) to the State of Michigan for training of the State Militia, game preservation, and a forest reserve. The boundaries of the facility have undergone numerous changes over the past several decades as the facility has grown from the original land donation to its current footprint of over 147,000 acres. Of the 147,000 acres, around 105,000 acres are owned or leased by the Michigan Department of Military & Veterans Affairs (MDMVA). Approximately 20,000 acres are leased from private owners, while the remaining 22,000 acres are purchased, deeded, or federally owned property. Roughly 57,000 acres of land are leased in perpetuity from the Michigan Department of Natural Resources (MDNR). This lease was executed on 3 May 1948 and allows the land to be used for military purposes by the Military Board; however, the MDNR retains control for hunting, fishing, timber, and mineral extraction uses. On 11 October 1984, the MDMVA and the MDNR agreed to a 20-year lease covering over 42,000 acres. This lease differs from the 1948 lease because it has a cancellation clause and the MDNR does not need permission from MDMVA to manage or sell the leased lands' natural resources. This lease allows for an unlimited number of 10-year extensions if agreed upon by MDMVA and MDNR (MDMVA, 2007).

1.5 Facility Environmental Setting

Camp Grayling is located entirely within the Grayling Outwash Plain Regional Landscape Ecosystem of the Highplains District of Region II (Albert, 1995). This ecosystem is characterized as broad outwash plain including sandy ice-disintegration ridges; jack pine barrens, some white pine-red pine forest, and northern hardwood forest. Due to its inland location, northern latitude, and relatively high elevations, the Highplains District experiences the most severe climate in Lower Michigan.

Topography of the area has been shaped by glacial events that created two separate moraines at Camp Grayling: a southern moraine several hundred feet thick was deposited south of Lake Margrethe, and a northern moraine of similar thickness was deposited north of Lake Margrethe. Camp Grayling consists of portions of these two morainal highlands on the north and south with a low marshy plain in between (Eugene A. Hickok and Associates, 1986). The topography at Camp Grayling is show on **Figure 1-2**.

The southern moraine is marked by a series of detached ridges generally trending east-west. In this region, there are more than 30 named ridges and hills averaging 1,345 feet in height. The highest hills are southwest of the cantonment area: Cote Dame Marie at 1,524 feet, Portage Lake Lookout Tower at 1,525 feet, and the Three Sisters Range at 1,480 feet. The largest elevation difference in the South Post is 444 feet between Cote Dame Marie (1,524 feet) and the lowest elevation located near the Manistee River (1,080 feet) (Eugene A. Hickok and

Associates, 1986). The northern moraine is a more gently rolling plateau that is cut by numerous streams.

1.5.1 Geology

Camp Grayling is located in the north-central portion of the Michigan Basin; a symmetrical circular sedimentary basin in the Central Interior Platform of the US. During the Pleistocene epoch, four successive continental glaciers moved across parts of the Michigan Basin. The movement of the glaciers scoured the bedrock surface, deepening valleys and rounding hills. Advancing glaciers transported large quantities of glacial sediments, and when the ice melted, it deposited the glacial drift to a maximum thickness of 1,400 feet in the basin.

Camp Grayling is underlain by unconsolidated glacial sediments (i.e., glacial drift) that overlie sedimentary bedrock consisting of Middle to Late Mississippian Age bedrock from the Coldwater and Michigan formations. These interbedded layers of shale, sandstone, and limestone range in total thickness from 500 to 600 feet. They were formed 325 to 350 million years ago from the deposition of marine sediments. The glacial deposits include lacustrine clay, sand, and gravel outwash plains with glacial till providing highly variable discontinuous layers. The glacial drift is reported to extend to at least 600 feet below ground surface (bgs). The glaciers created two separate moraines on-facility. A southern moraine several hundred feet thick was deposited south of Lake Margrethe, and a northern moraine of similar thickness was deposited north of Lake Margrethe (National Guard Bureau & MDMVA, 1994; Parsons, 2001).

Soils at Camp Grayling are largely derived from glaciofluvial parent materials with extensive deposits of sands and gravels that originated as glacial and ice-contact outwash (Zorn & Sendek, 2001). Intersecting fluvial deposits from the Au Sable are present within the North Post and GAAF areas. The surficial soils are predominantly sandy soils that are somewhat excessively to excessively drained. These soils exhibit relatively low fertility and vegetation production potentials but a high tolerance to the compaction and erosion impacts of tracked and wheeled vehicle use. The rest of the soils present on Camp Grayling range from very poorly to well drained soils. These can be found on the outwash, as well as in the wetland and low areas (MDMVA, 2007).

There are three primary soil series and four soil groups within Camp Grayling. The three distinct soil series, which comprise approximately 70 percent of the facility, are the Graycalm (28 percent), Grayling (23 percent of the facility and 15 percent in soil complexes), and Rubicon (4.8 percent of the facility and 4.9 percent in soil complexes) soil series. In general, the soils at Camp Grayling have a high wind erosion and low water erosion potential.

1.5.2 Hydrogeology

Regional and local groundwater flow throughout the facility appears to generally follow surface water drainage patterns. Regional groundwater divides most likely correlate to the major surface water divides for the Manistee, Au Sable, and Muskegon rivers. Rainfall infiltration recharging groundwater likely follows a shallow flow system that discharges to lakes and streams supporting their water levels (MDMVA, 2007). Due to the extreme permeability of the sandy soils, nearly all precipitation infiltrates to the water table and flows underground towards stream channels (Zorn & Sendek, 2001; Rozich, 1998).

The North Post contains unconfined aquifers within the glacial outwash sediments consisting of sands, silts, and gravels. Predominant sediments consist of fine to medium grained sands that

are moderately to excessively drained. Several domestic wells penetrate these sediments, indicating that the formation likely has good water yields. Depth to water within the northern area of the North Post varies from 0 to 200 feet bgs. Groundwater in this area flows generally in a south to southeasterly direction. Local variations in groundwater flow are the result of surface drainage and topographic features including some north to northeast flow toward the North Branch Au Sable River in far northern portions of the North Post (**Figure 1-3**). Groundwater flow velocity in the northern area of the North Post is approximately 1 to 1.5 feet per day (MDMVA, 2007).

Information gathered from wells located at the Maneuver Training Equipment Site (MATES) in the southern portion of the North Post indicates depth to water ranges from 5 to 10 feet bgs. Well logs indicate sand and gravels from the surface to a depth of 40 feet, where a clay layer is present ranging in thickness from 2 to 12 feet. Groundwater flow direction in this area is to the south-southwest at a calculated flow rate of 0.22 feet per day (MDMVA, 2007). Groundwater flows generally to the south and discharges to the main branch of the Au Sable River.

GAAF is located between the main stem and East Branch of the Au Sable River. Although reliable groundwater elevation data for the area are not yet available, preliminary data suggest the presence of a groundwater divide at the airfield between the river branches. Generalized groundwater flow for the eastern and southern portions of the airfield is anticipated to flow in an east to southeastern direction towards the East Branch of the Au Sable. Flow within the central and western areas of the airfield is presumed to flow in a westerly direction towards the main stem.

Groundwater in the South Post area occurs in the glacial drift, primarily in unconfined aquifers of varying thickness. The underlying soils are generally composed of very fine to coarse grained sands, with both gravel and clay lenses. Several clay lenses have been identified immediately south of Lake Margrethe, in the cantonment area, at depths ranging from 20 feet to over 100 feet. These lenses are generally thin (less than 10 feet); however, clay units up to approximately 50 feet thick have been logged in several areas. The elevations and lateral extent of the clay lenses have not been examined extensively (MDMVA, 2007). Depth to groundwater in the main cantonment area varies from 9 to 35 feet bgs. In the hills south of the cantonment, depth to groundwater is approximately 164 feet bgs. Groundwater flow direction in the cantonment is generally to the north, towards Lake Margrethe (**Figure 1-4**), with an average flow velocity of approximately 1.16 feet per day (Parsons, 2001; MDMVA, 2007).

A Wellhead Protection Plan was implemented in 2001 to protect potable drinking water systems at Camp Grayling's MATES (in the southern portion of the North Post) and the cantonment area in the South Post (Parsons, 2001). The cantonment area wellhead protection area (WHPA) has two wells (Well B410 and B552) that serve as the potable water source for the main base population (approximately 5,000 people during peak usage). Well B410 was drilled in the 1950s to an approximate depth of 220 feet bgs, with the well screen depth estimated to be from approximately 155 to 175 feet bgs. Well B552 was drilled in 1970 to 190 feet bgs, with the well screen depth estimated to be from approximately 160 to 190 feet bgs. The MATES WHPA has two wells (Well B1400 and MATES Backup) that serve as the potable water source for approximately 125 people who work at the MATES facility. Both wells were drilled in the late 1980s to approximately 180 feet and are reported to be equipped with pumps capable of pumping at 500 gpm. Also, the well screens are reported to be 143 to 183 feet bgs and 152 to 177 feet bgs (MDMVA, 2007).

1.5.3 Hydrology

Camp Grayling is situated within three major watersheds: the Au Sable, the Manistee, and Beaver Creek. These three watersheds contain over 147,000 acres of MDMVA lands drained by a 185-mile stream network (MDMVA, 2007). Surface water features are presented for the North Post on **Figure 1-5** and the South Post on **Figure 1-6**.

The Au Sable River is a major tributary to Lake Huron. Approximately 88,800 acres of Camp Grayling lands are in the Au Sable River watershed, which includes the majority of the North Post. Mean discharge for the main stem of the Au Sable at Grayling is 76.1 cubic feet per second (cfs). Most of the North Post lies between the East Branch Au Sable River, a second-order stream, and the North Branch Au Sable River (MDMVA, 2007). The Au Sable River at Grayling has one of the most stable flow regimes in the country with little variation in flow between days and among months (Zorn & Sendek, 2001).

Lands used by MDMVA at Camp Grayling that are in close proximity to the Au Sable River include a small portion of the Au Sable main stem, the East Branch of the Au Sable, and the North Branch of the Au Sable. The latter two sub-basins contain the bulk of Au Sable waters influenced by Camp Grayling activities. The East Branch originates in the impact area of Range 40 on the North Post. Chub Creek and the North Branch of the Au Sable lie adjacent to the North Post boundary and follow the boundary, in an arc, for a total of about 21 miles. Far southern portions of South Post drain towards Beaver Creek which is a tributary of the South Branch Au Sable.

The Manistee River is a major tributary to Lake Michigan. Approximately 53,086 acres of Camp Grayling lands are in the Manistee watershed, which includes the majority of the South Post. This land area, about 36 percent of Camp Grayling, is drained by a stream network totaling approximately 100 miles. The mean discharge at Manistee is 2,049 cfs. Prominent tributaries located on the South Post include Big Cannon Creek, Black Creek, and Portage Creek. Portage Creek is formed from the outflow of Lake Margrethe and associated wetlands (MDMVA, 2007). Similar to the Au Sable, the Manistee River has one of the most stable flow regimes of any stream in the country. Daily flow, however, can fluctuate at Portage Creek due to an active lake-level control structure at Lake Margrethe that discharges to the creek. Large volumes of water are released to Portage Creek from Lake Margrethe when lake levels rise above target thresholds (Rozich, 1998).

Approximately 5,000 acres of Camp Grayling lands are in the Muskegon watershed. There are no streams or lakes located in the Camp Grayling portion of the Muskegon watershed (MDMVA, 2007).

There are 19 lakes within Camp Grayling borders that comprise approximately 2,379 acres of surface area and 65 miles of shoreline in the Manistee and Au Sable watersheds. Lake Margrethe, located immediately north of the cantonment, is the largest lake within the camp boundaries, however, approximately half of the lake's shore is privately owned. The lake is a large kettle lake, formed by an ice block buried in sandy outwash over clay lacustrine deposits (MDMVA, 2007). Lake level is controlled by an active, dam like, lake-level control structure operated seasonally by the Lake Margrethe Property Owners Association (LMPOA, 2018). During winter months, the dam is opened and level of the lake is dropped to prevent ice damage to the shoreline.

1.5.4 Climate

Camp Grayling's climate is predominantly continental in character as a result of its interior mid-Michigan location. The prevailing winds are westerly during the summer, as the Bermuda high pressure center pushes into the southeastern US. Secondary wind directions include the northwest through the southwest quadrants. Northeasterly winds are observed relatively infrequently. The annual mean wind speed is nine miles per hour (mph); however, wind speeds of 40 mph have been observed during January, June, and November. The day- to-day weather is a result of the movement of pressure systems across the country; therefore, Camp Grayling and its vicinity does not often experience long periods of hot, humid summer weather or extreme cold weather. However, climatic effects of Lake Michigan and Lake Huron are still discernible in their influence on snowfall and cloud cover during the late fall and early winter months (National Guard Bureau & MDMVA, 1994).

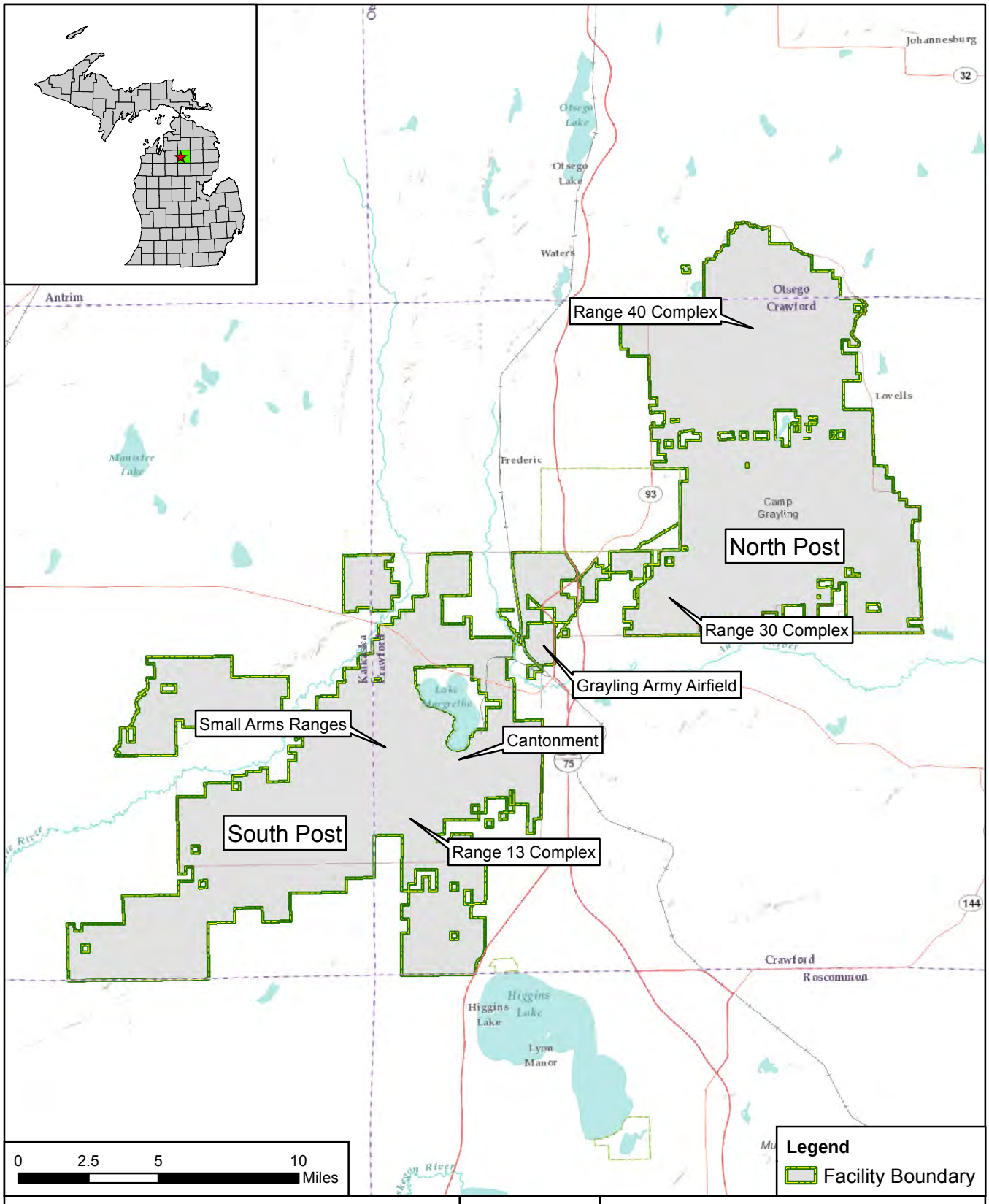
The annual mean temperature at Grayling is 42.4 degrees Fahrenheit. The average summer high temperature is 77.6 degrees Fahrenheit and the average winter low temperature is 10.6 degrees Fahrenheit. The total mean annual precipitation is 33.61 inches. February is the driest month, with an average of 1.28 inches of precipitation, while August is the wettest month with 3.78 inches. Afternoon showers and thunderstorms are the major sources of summer precipitation. The average annual snowfall at Grayling is 105.1 inches (NOAA, 2018).

1.5.5 Current and Future Land Use

According to a 2001 Land Condition-Trend Analysis Facility Report for Camp Grayling (Envirologic Technologies, Inc., 2003), the majority of Camp Grayling land is used for tracked and wheeled vehicle maneuvering. Numerous active live-fire training ranges also occupy significant portions of the North and South Post. GAAF supports both public and military airport use. Non-Military land uses at Camp Grayling include MDNR forestry activities, hunting, fishing, timber, and mineral extraction uses. Sand, gravel, and clay extraction is managed by MDNR with consultation of Camp Grayling (MDMVA, 2007). Extreme northern and southern areas within facility boundaries have been developed for oil and gas production. Administration of oil and gas development is provided by both MDNR and Michigan Department of Environmental Quality (MDEQ) (MDNR, 2013). Active training areas (including ranges), the cantonment, and GAAF have controlled access while the remaining areas are open access to the public.

The predominant land use outside the camp boundaries is public lands, especially public forest lands. Private lands and residences abut portions of the camp including the City of Grayling located east and southeast of GAAF and the north and eastern shores of Lake Margrethe. Numerous residences that are occupied seasonally and permanently are present along the banks of the Au Sable River and Lake Margrethe. Both water bodies are heavily used for recreational activities including swimming, canoeing, and fishing. Light industrial and heavy industrial zoning is found in portions of the City of Grayling and Grayling Township. These zonings apply to various kinds of manufacturing or value-added activities (MDMVA, 2007).

Reasonably anticipated future land use is not expected to change from the current land use described above.



CLIENT	ARNG			
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REVISED	7/31/2018	GIS BY	MS	7/31/2018
SCALE	1:316,800	CHK BY	JL	7/31/2018
Base Map: Sources: Esri, DeLorme, USGS, NPS Sources: Esri, USGS, NOAA		PM	RG	7/31/2018

Camp Grayling Site Location

AECOM
12420 Milestone Center Drive
Germantown, MD 20876

Figure 1-1

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South Post

North Post

CAMP GRAYLING MILITARY RESERVATION

PERE MARQUETTE STATE FOREST

HARTWICK PINES STATE PARK

KALKASKA CO
MISSAUKEE CO
CRAWFORD CO
ROSCOMMON CO
OTSEGO CO
CRAWFORD CO

0 5,900 11,800 23,600 Feet

0 5,350 10,700 21,400 Feet

CLIENT	ARNG			
PROJECT	Preliminary Assessment for PFAS at Camp Grayling, MI			
REVISED	8/2/2018	GIS BY	MS	8/2/2018
SCALE	1:141,600	CHK BY	JL	8/2/2018
Base Map: Michigan Statewide Authoritative Imagery & LiDAR (MiSAIL) program		PM	RG	8/2/2018

Legend

Facility Boundary

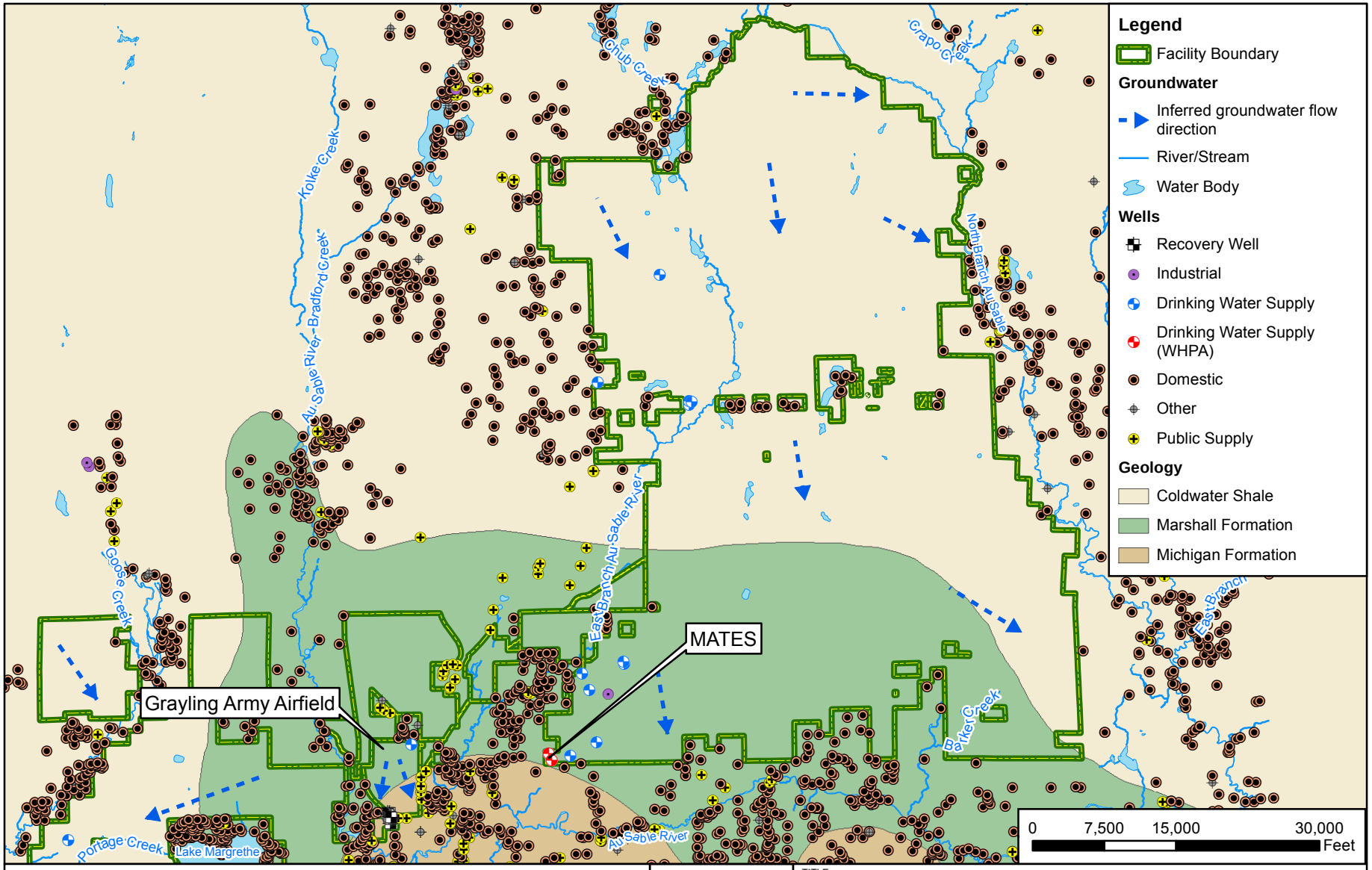
N

Camp Grayling Topographic Features

AECOM 12420 Milestone Center Drive Germantown, MD 20876

Figure 1-2

Q:\Projects\ENV\GEARS\GEO\ARNG PFAS\900-CAD-GIS\920-GIS or Graphics\MXD\MI\Grayling\PA_Figures\Fig_1-2_Grayling_Topographic_Features.mxd



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REVISED	7/31/2018	GIS BY	MS	7/31/2018
SCALE	1:180,000	CHK BY	JL	7/31/2018
		PM	RG	7/31/2018

N

TITLE

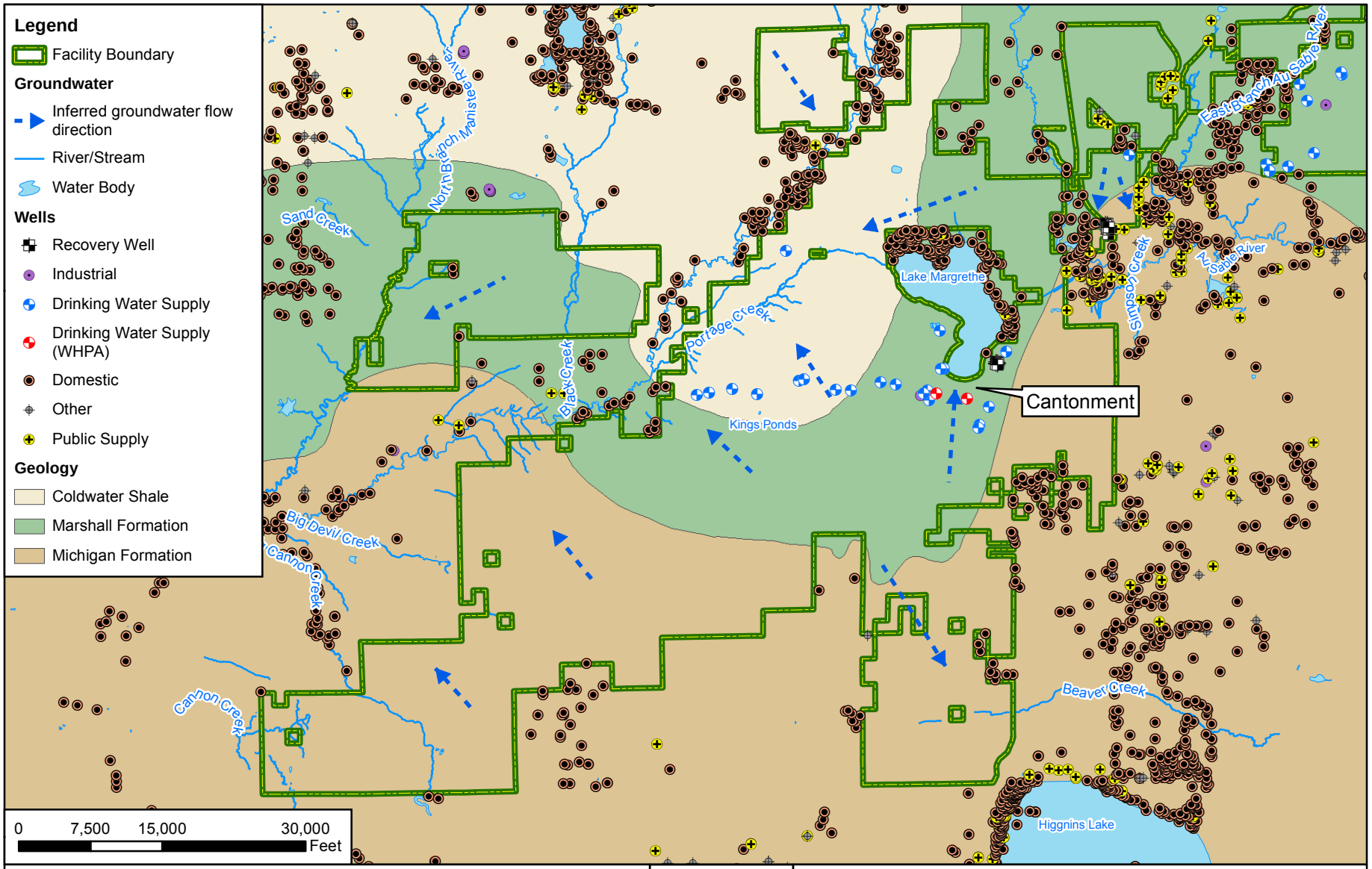
North Post Groundwater Features

AECOM

12420 Milestone Center Drive
Germantown, MD 20876

Figure 1-3

Q:\Projects\ENV\GEARS\GEO\MAES 2012 Unrestricted\Fort Meade\E. Data Management\GIS\MXDs\Chisholm_6th\March2017\ Fig_1-3_Grayling_North_Post_Groundwater_Features.mxd



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PROJECT	Preliminary Assessment for PFAS at Camp Grayling, MI			
REVISED	7/31/2018	GIS BY	MS	7/31/2018
SCALE	1:180,000	CHK BY	JL	7/31/2018
		PM	RG	7/31/2018

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TITLE

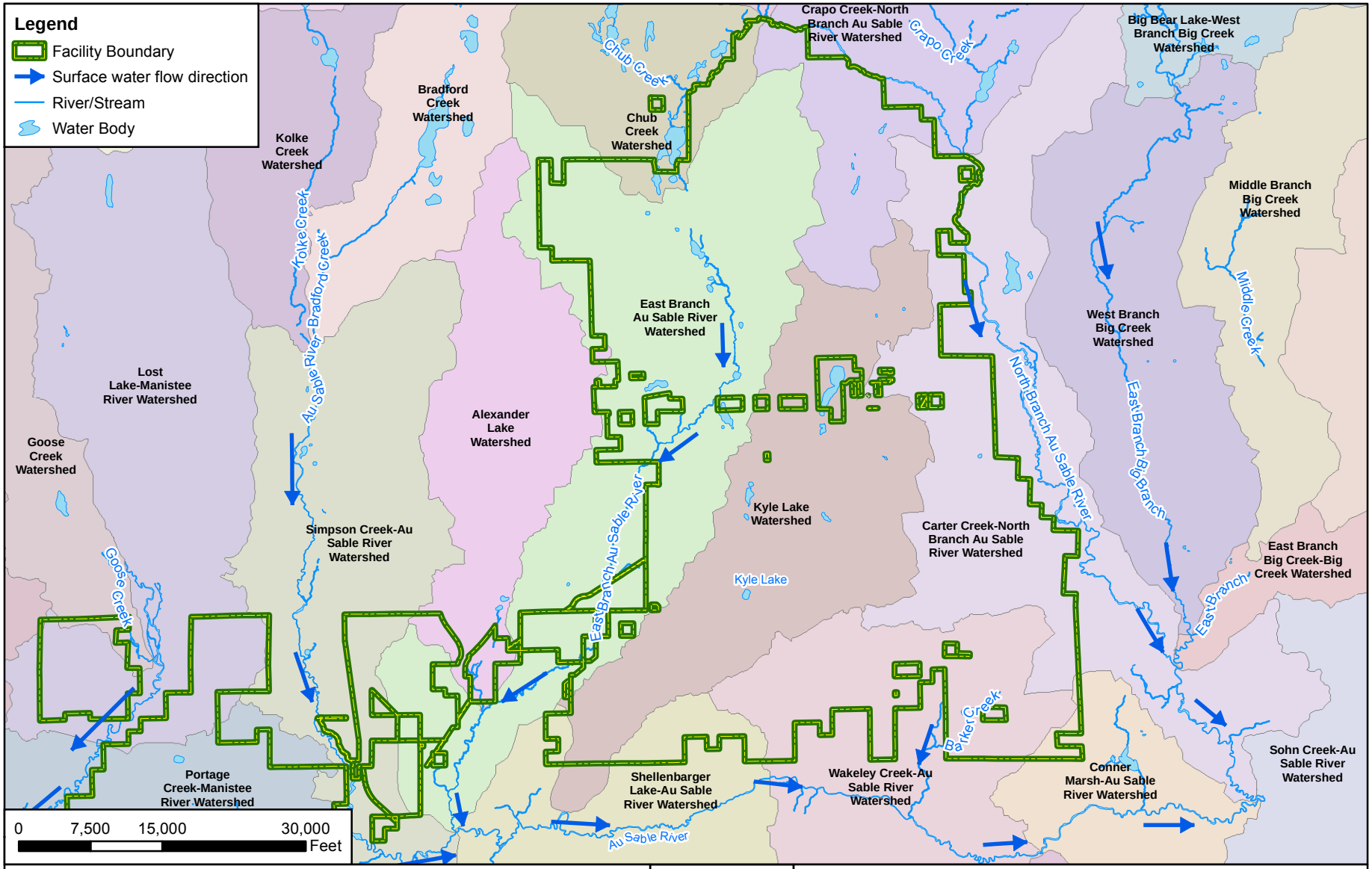
South Post Groundwater Features

AECOM

12420 Milestone Center Drive
Germantown, MD 20876

Figure 1-4

Q:\Projects\ENV\GEARS\GEO\MAES 2012 Unrestricted\Fort Meade\E. Data Management\GIS\MXDs\Chisholm_6th\March2017\ Fig_1-4_Grayling_South_Post_Groundwater_Features.mxd



CLIENT	ARNG			
PROJECT	Preliminary Assessment for PFAS at Camp Grayling, MI			
REVISED	7/31/2018	GIS BY	MS	7/31/2018
SCALE	1:180,000	CHK BY	JL	7/31/2018
		PM	RG	7/31/2018

TITLE

North Post Surface Water Features

AECOM

12420 Milestone Center Drive
Germantown, MD 20876

Figure 1-5

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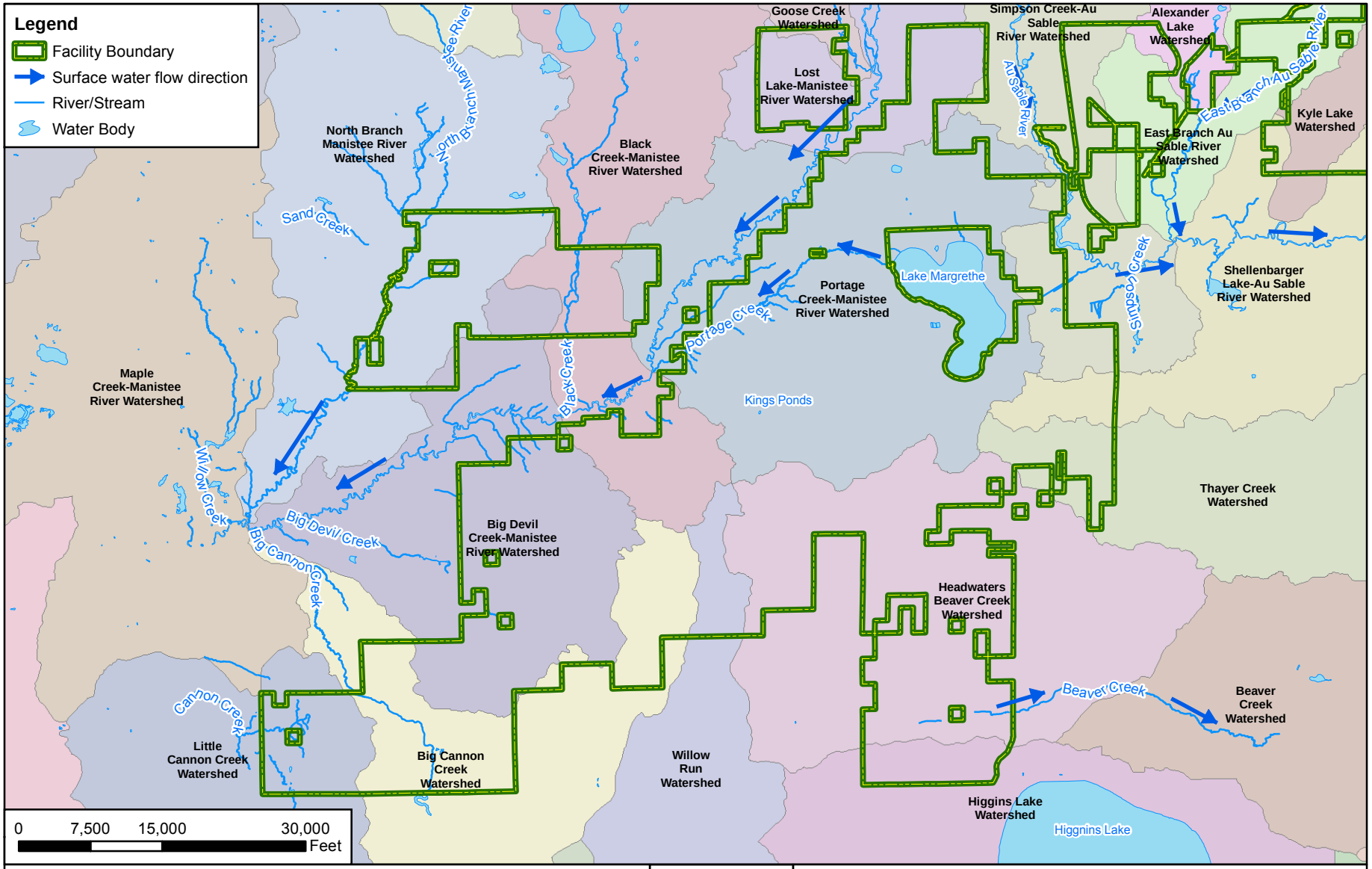

CLIENT	ARNG			
PROJECT	Preliminary Assessment for PFAS at Camp Grayling, MI			
REVISED	7/31/2018	GIS BY	MS	7/31/2018
SCALE	1:180,000	CHK BY	JL	7/31/2018
		PM	LS	7/31/2018

TITLE

South Post Surface Water Features

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Germantown, MD 20876

Figure 1-6

Q:\Projects\ENV\GEARS\GEO\MAES 2012 Unrestricted\Fort Meade\E. Data Management\GIS\MXDs\Chisholm_6th\March2017\ Fig_1-6_Grayling_South_Post_Surfacewater_Features.mxd

2. Fire Training Areas

Twelve FTAs were identified at GAAF and the cantonment areas of Camp Grayling during the PA. During the 1970s and 1980s, Camp Grayling firefighting personnel (1439th and 1440th units) routinely trained with AFFF. Although the Camp Grayling Fire Department did not have specialized equipment for AFFF use (i.e., mixing nozzles), firefighting personnel reportedly mixed AFFF with water in tanker trucks to create what was referred to by interviewees as "wet water." The term "wet water" is a colloquial term used by firefighters and has reportedly been mixed using different formulations and wetting agents (e.g., AFFF concentrate, Class A foam concentrate, or dish washing soap) by different entities. Where appropriate, this report will make the distinction between "AFFF 'wet water'", where the formulation may have included the use of AFFF, and other wetting agents or foams. AFFF "wet water" ceased being stored in fire truck tanks in approximately 1988 due to leaking and the use of the truck's water tanks for non-firefighting activities, after a new fire chief took over operations in 1986.

At Camp Grayling, AFFF was never discarded; all AFFF, including off-specification or expired lots, was used for training purposes. Former Camp Grayling firefighters reported the frequency of Camp Grayling fire training as "intense," occurring two weekends per month at various locations at the airfield and the cantonment in the South Post. A description of each FTA is presented below, and the FTA locations are shown on **Figures 2-1** and **2-2**. Photographs of the FTAs appear in **Appendix C**.

2.1 Grayling Army Airfield (GAAF)

GAAF is located immediately west and northwest of the City of Grayling at the intersection of I-75 and West North Down River Road between the North and South Post of Camp Grayling. The general geographic coordinates for the center of the airfield are 44°40′49″N and 84°43′44″W. FTA locations at GAAF are shown on **Figure 2-1**.

GAAF is an approximate 921-acre active public and military operated airfield with two runways: Runway 5/23 and Runway 14/32. Access to the facility is restricted by controlled gates. GAAF has several support buildings and facilities located along its eastern boundary including the control tower, barracks, vehicle storage, and the Camp Grayling Fire Department. The former location of the Camp Grayling MATES is located on the southwestern portion of the airfield at what is now a Bulk Fuel Area. The former MATES was historically served by railroad tracks that run along the western boundary of the airfield and surrounded the former MATES area.

The frequency, volume, and concentration of AFFF used at each individual location is unknown. Interview records are located in **Appendix B**.

2.1.1 Taxiway D

According to the City of Grayling Fire Department Chief, joint training with Camp Grayling fire units was conducted at GAAF approximately twice between 1984 and 1986 near Taxiway D where runways 5/23 and 14/32 cross. The approximate geographic coordinates are 44°40'45.87"N and 84°43'54.19"W. Joint training was also conducted at this location, between Camp Grayling units and Ohio and Indiana National Guard units, periodically between approximately 1978 and the late 1980s. Training reportedly consisted of igniting approximately 5 gallons of "Jet Propellant 8" jet fuel, or a mix of gasoline and diesel fuel, spread on the ground or within a brush pit and using AFFF to extinguish the resulting fire.

2.1.2 Other GAAF FTAs

A variety of fire training activities were historically conducted at several locations at the airfield during the period of active AFFF use in the 1970s through 1980s. The following areas were specifically identified by former firefighters during interviews:

- Southeastern end of Runway 14/32; the geographic coordinates are 44°40'17.32"N and 84°43'21.69"W
- Between the former MATES and Runway 14/32; the geographic coordinates are 44°40'20.922"N and 84°43'30.542"W
- Former MATES Location; the geographic coordinates are 44°40'21.77"N and 84°43'49.25"W
- Northwestern end of Runway 14/32; the geographic coordinates are 44°40'57.02"N and 84°44'14.98"W
- Building 1160 (Operations Building) on the eastern side of GAAF; the geographic coordinates are 44°40'38.94"N and 84°43'23.17"W

Prior to in-person interviews, former firefighters indicated during a pre-interview that fire training activities also occurred in the vicinity of the northern end of Runway 5/23; however, this location was later recanted. During follow-on interviews with former Camp Grayling Firefighters, an area immediately north of the northern end of Runway 5/23, now developed for use by the municipal airport, was identified as a location where the City of Grayling Fire Department performed fire training a few times during the late 1970's to early 1980's. The pattern of training at GAAF seems to have predominantly occurred at the end of the runways. Because of this, and groundwater sampling results from the GAAF boundary (see below for discussion), training may also have occurred in this northern area near geographic coordinates 44°41'24.56"N and 84°43'10.75"W.

No historical PFAS remediation activities have occurred at GAAF. There is, however, an active groundwater pump and treat system (air stripper) providing remediation of a trichloroethylene (TCE) groundwater plume, originating from the former location of the Camp Grayling MATES, now the Bulk Fuel Area (labeled "Former MATES Location" on **Figure 2-1**). This remediation system is located in the south-western corner of the GAAF property. A network of monitoring wells associated with the TCE remediation is also in place.

In October and December of 2016, MIARNG collected groundwater samples from the monitoring wells immediately downgradient of the ongoing TCE remediation area and analyzed them for 23 perfluorinated compounds including PFOS and PFOA analytes. PFOS/PFOA were detected in these groundwater samples above the USEPA Drinking Water Health Advisory Level (70 parts per trillion) in two sampling locations. Subsequent sampling of groundwater along the west, east, and southern GAAF boundaries was conducted in March and August of 2017. PFOS and/or PFOA were identified in groundwater collected at 11 of the 38 boundary locations sampled, and in one sample collected from a location in the west-central area of the airfield. PFOS and/or PFOA were not detected in groundwater samples collected from the north-central area of GAAF (Amec Foster Wheeler, 2017) (**Appendix A**).

2.2 Cantonment

The Camp Grayling cantonment area borders the southern end of Lake Margrethe within the north eastern portion of the South Post, located approximately 3 miles southwest of GAAF. The geographic coordinates for the main gate at the cantonment are 44°38'4.11"N and 84°46'21.73"W. FTA locations at the cantonment are shown on **Figure 2-2**.

The cantonment contains support facilities including barracks, range control, officers club, Post Exchange, parade grounds, athletic fields, and administrative buildings. Recreational areas and cabins are also present along the shore of Lake Margrethe within the cantonment. Access to the area is controlled by guarded gate entry. Several FTAs within the cantonment were identified by former Camp Grayling firefighters (**Appendix B**). For each FTA, the frequency training, concentration of AFFF, and volume used is not known.

2.2.1 Former Ammunition Storage Point (ASP)

The former ASP was located in the southwestern portion of the cantonment. The location of the former ASP is a wooded area adjacent to the site of a former Quonset hut off South Access Road. The approximate geographic coordinates are 44°36'50.95"N and 84°47'48.14"W.

Camp Grayling's Environmental Quality Specialist reported in an interview that the former ASP building was demolished via burning and used for firefighting training purposes in the early 1980s; AFFF was reportedly used during this training. Following the demolition, brush piles were reportedly collected in the area and burned; AFFF was also reportedly used to extinguish those fires.

2.2.2 Building 228Q, 500-Buildings, and 600-Buildings

During interviews, several individual training locations within the cantonment were identified by former Camp Grayling firefighters, who also provided photographs taken of fire training activities that confirmed the following locations: Building 228Q, the 500-Building area, and the 600-Building area. Photographic log can be found in **Appendix C**.

Building 228Q is one of several barracks areas within the cantonment. It is located immediately adjacent to Lake Margrethe off of 2nd Street. The geographic coordinates are 44°37'41.22"N and 84°46'50.90"W. One photograph reviewed for this report showed several firefighters using a ground hose to spray an unidentified liquid next to Building 228Q. AFFF concentrate and AFFF "wet water" were routinely kept on and in fire truck tanks; therefore, it is possible the retardant used contained AFFF, so Building 228Q may be a potential source area.

The 500-Building series are additional barracks and operations buildings located in the south western area of the cantonment, south of the parade grounds, off of 7th Street. The approximate geographic coordinates are 44°37'20.76"N and 84°47'46.79"W. Interviews with former Camp Grayling firefighters, along with reviewed photographs, confirmed that the 500-Building area was used for fire training and may be a potential source area.

The 600-Building series was also confirmed as a heavily used FTA during interviews with former Camp Grayling firefighters. The area is located in the western portion of the cantonment, west of 8th Street. At the time (i.e., the 1970's through early 1980's), the area was referred to as "tent city." As of February 2018, new housing buildings are being built in this area. The approximate geographic coordinates are 44°37'37.59"N and 84°47'57.73"W.

2.2.3 Wash Rack Areas

Two wash racks that are located on the eastern side of 8th Street, adjacent to the 600-Building area were identified as frequently used FTAs. The smaller wash rack has one bay and is located on the corner of Howe Road and 8th Street. Its geographic coordinates are 44°37'24.66"N and 84°47'52.91"W. The larger wash rack has two bays and is located on the corner of Parade Road and 8th Street. Its geographic coordinates are 44°37'35.04"N and 84°47'53.78"W. The wash racks drain to the Camp Grayling waste water treatment plan (WWTP) that was built in 1991 and is located north of the cantonment. Both wash racks were identified by interviewees as being locations of former fire training activities. During fire training, fuel was reportedly poured on the concrete areas of the wash racks and ignited. AFFF was reportedly used to extinguish the fires during these training activities. **Appendix C** includes photographs that show the use of AFFF at the location of one of the wash racks near a Quonset hut in the 600-Building area.

2.2.4 Wilson Hill near Fitness Track

The southern portion of the cantonment is a topographical high point referred to as Wilson Hill. A fitness track is located in the southeastern area of Wilson Hill. The approximate geographic coordinates are 44°37'18.19"N and 84°46'35.37"W. Former Camp Grayling firefighters reported that fire training was routinely conducted in this area and provided photographs showing training activities with blue 5-gallon buckets of AFFF in the back of trucks. The exact location of training within the area is unknown.

2.3 Howes Lake

Howes Lake is located approximately 1.5 miles north of Lake Margrethe, within the boundaries of the South Post. The area surrounding the lake is largely rural and undeveloped with the exception of the Shawono Center, a State run juvenile treatment facility, located on the southeastern shore of the lake. During follow-on interviews, a former Camp Grayling firefighter recalled that training activities had historically been conducted at Howes Lake. Camp Grayling's Environmental Quality Specialist recalled such training including bridging activities on the lake. It was not known if activities included firefighting training or resulted in emergency response to wildfires. The exact location and dates of training within the area is uncertain. A review of historical aerial photographs revealed an area of frequent disturbance, located on the southwestern shore of the lake; this area may have been where training occurred. Approximate geographic coordinates for that area of disturbance are 44°41'11.05"N and 84°49'5.15"W. The potential FTA area is shown on **Figure 2-3**.

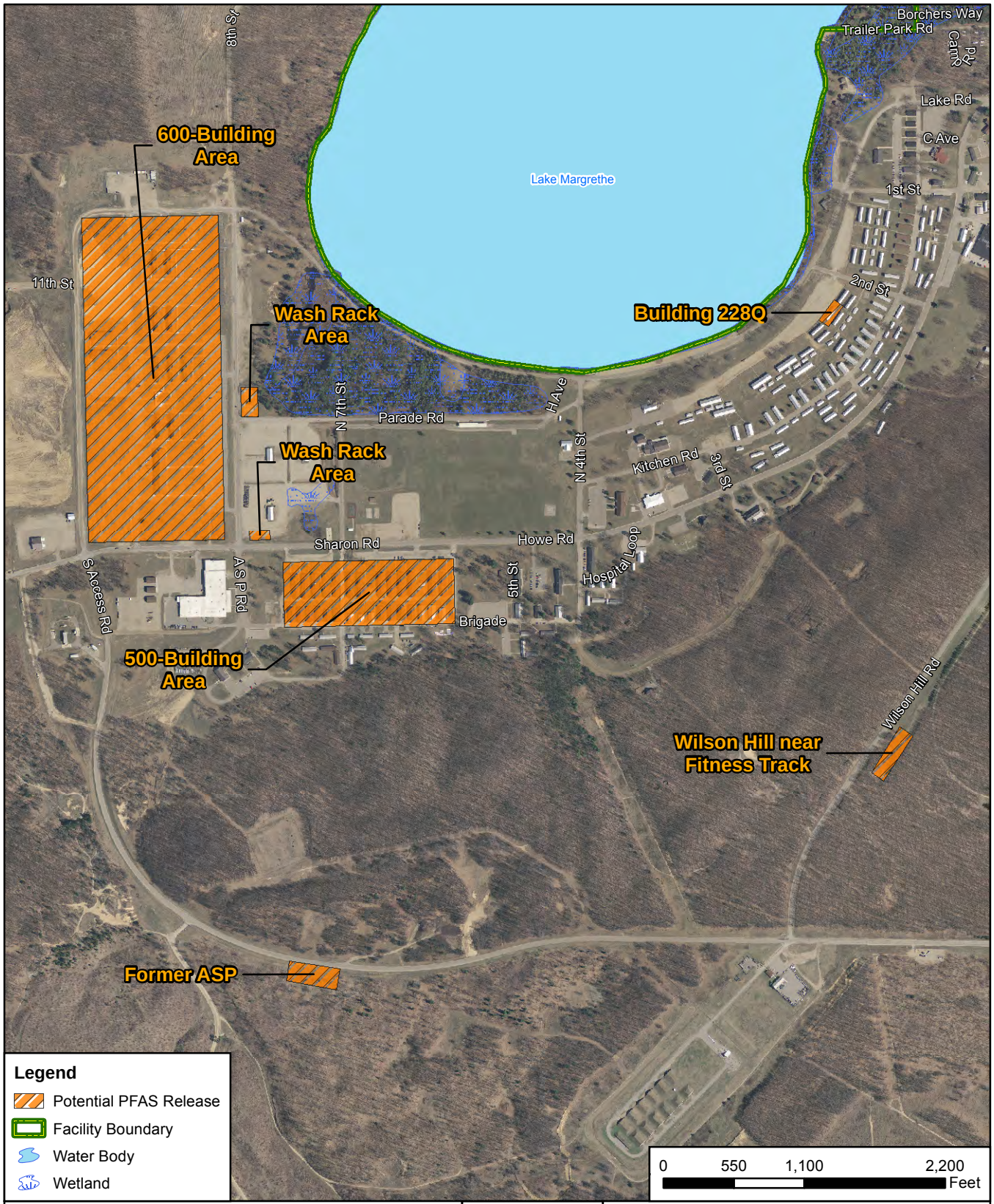
CLIENT	ARNG			
NOTES	Preliminary Assessment for PFAS at Camp Grayling, MI			
REVISED	7/31/2018	GIS BY	MS	7/31/2018
SCALE	1:13,200	CHK BY	JL	7/31/2018
Base Map: Michigan Statewide Orthoimagery Program 2017		PM	RG	7/31/2018

Grayling Army Airfield
Fire Training Areas

AECOM
12420 Milestone Center Drive
Germantown, MD 20876

Figure 2-1

Q:\Projects\ENV\GEARS\GEO\ARNG PFAS\900-CAD-GIS\920-GIS or Graphics\MXD\MI\Grayling\PA_Figures\Fig_2-1_Grayling_Army_Airfield_FTAs.mxd



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REVISED	7/31/2018	GIS BY	MS	7/31/2018
SCALE	1:13,200	CHK BY	JL	7/31/2018
Base Map: Michigan Statewide Orthoimagery Program 2017		PM	RG	7/31/2018

Cantonment Fire Training Areas

AECOM
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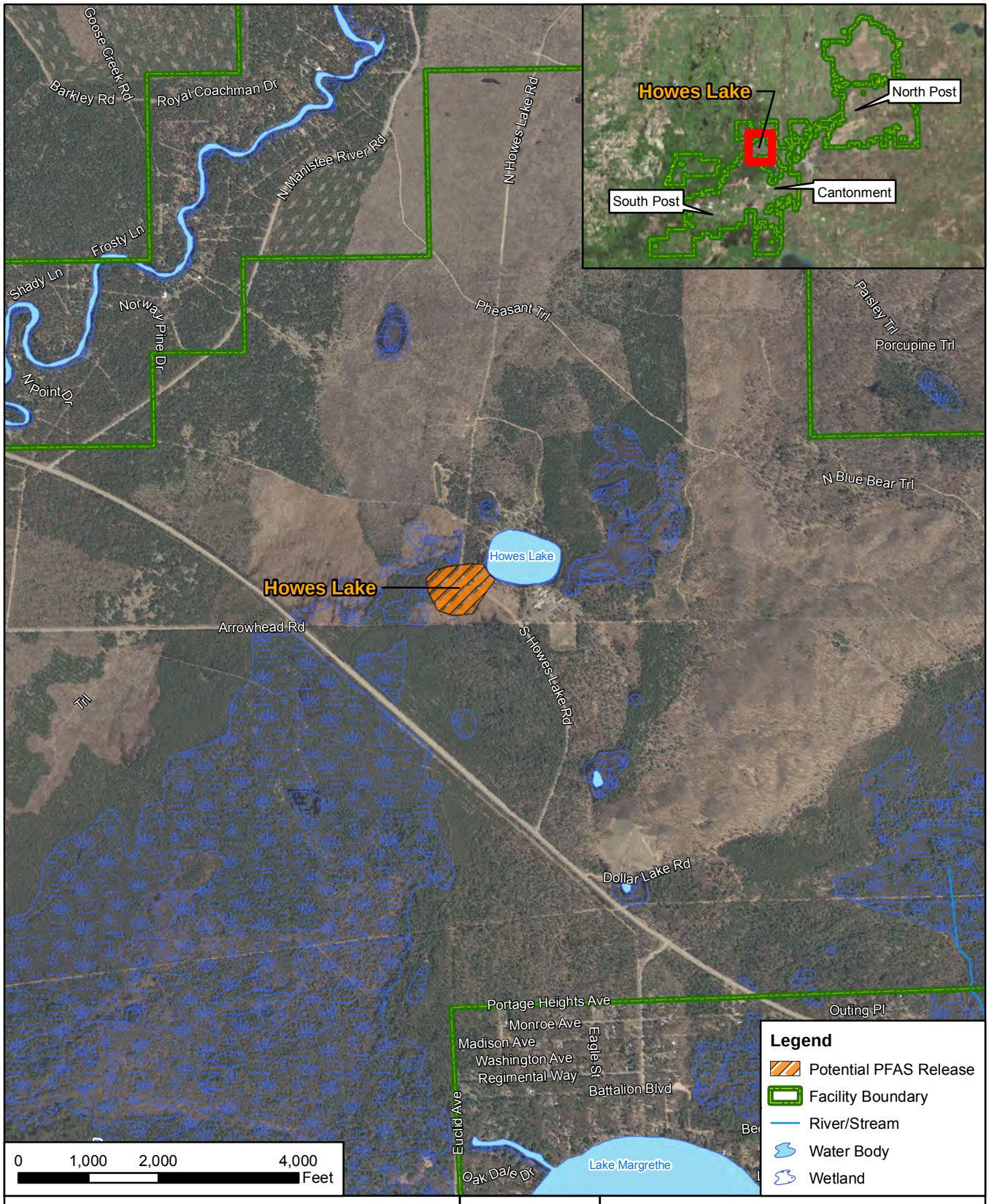
Figure 2-2

Q:\Projects\ENV\GEARS\GEO\ARNG PFAS\900-CAD-GIS\920-GIS or Graphics\MXD\MI\Grayling\PA_Figures\Fig_2-2_Grayling_Cantonment_FTAs.mxd



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SCALE	1:24,000	CHK BY	JL	7/31/2018
Base Map: Michigan Statewide Orthoimagery Program 2017		PM	RG	7/31/2018

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Howes Lake Fire Training Area

AECOM
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Germantown, MD 20876

Figure 2-3

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3. Non-Fire Training Areas

Several potential non-FTAs were assessed during the PA. Of those, eight non-FTAs were identified where AFFF may have been released. A description of each non-FTA assessed is presented below, and shown on **Figures 3-1**, **3-2**, and **3-3**. Photographs of the non-FTAs appear in **Appendix C**.

3.1 Grayling Army Airfield (GAAF)

Three non-FTAs were assessed at GAAF during the PA. Two of these areas were identified as having a potential PFAS release and one was determined to have no suspected release. A full description of GAAF can be found in **Section 2.1**. Non-FTAs at GAAF are shown on **Figure 3-1**.

3.1.1 GAAF Building 1194 Ramp

Building 1194 is designated as a hangar and is located approximately midway along the eastern side of the airfield. The geographic coordinates of the building are 44°40'50.14"N and 84°43'22.94"W. There is no AFFF fire suppression system within the hangar.

Former Camp Grayling firefighters reported that during the 1970s and 1980s, Camp Grayling fire trucks routinely parked on standby on the ramp adjacent to Building 1194. Fire truck holding tanks reportedly leaked approximately 80 gallons of their contents each day and were topped off every night with AFFF (unknown concentration) and water. Although the capacity of the tanker trucks that leaked was not known, new trucks acquired in the late 1980's were reported to have 1,500 gallon capacity tanks. The frequency at which the trucks were parked in this area is unknown; however, since the Camp Grayling Fire Department building (Building 1150) was not built at the airfield until 2006, it is suspected that trucks containing AFFF were present in this area during all active training seasons from the early 1970's through approximately 1986.

3.1.2 Bivouac Area

A former Camp Grayling firefighter reported that the forested area located in the northern portion of the GAAF was used as a bivouac for a 2-week period during the summers of two separate years. The exact years and concentration of AFFF were not known. During this time, fire trucks would be stationed on stand-by within the area to quickly respond to fires. The exact years, concentration of any potential AFFF stored or used, the precise location where the bivouac activities occurred, and where fire trucks were parked is not known. During a follow-on interview, a former Camp Grayling firefighter recalled being able to see the runway from where the trucks were stationed on stand-by and identified an area on the northwestern side of runway 5/23. The approximate geographic coordinates are 44°41'15.26"N and 84°43'33.24"W; however, the precise bivouac area is unknown.

3.1.3 Camp Grayling Fire Department

The Camp Grayling Fire Department is currently located at GAAF in Building 1150, which was built in 2006. Firefighting foam was reported to be currently stored in the building. During the PA site visit, multiple 5-gallon buckets and 55-gallon drums of Class A firefighting foam concentrate (0.1 to 1.0 percent proportioning) was observed. No AFFF was observed in the building during PA site visit activities.

Former Camp Grayling firefighters indicated that AFFF “wet water” ceased being stored in fire trucks after a new fire chief took over operations in 1986. It was reported during interviews that AFFF was no longer stored in the trucks by approximately 1988 due to leaking and the use of the truck’s water tanks for non-firefighting activities. Because AFFF is not stored at the current Camp Grayling Fire Department and since the building was built after AFFF was no longer kept in fire truck tanks, Building 1150 is not considered a potential source area.

3.2 Dust Suppression Areas

During interviews, former Camp Grayling firefighters reported that an AFFF “wet water” mixture was sprayed on unpaved roads within the North Post to suppress dust resulting from heavy vehicles and tank traffic. The volume and concentration of AFFF used is not known. Non-FTAs in the North Post are shown on **Figure 3-2**.

Specifically, the 1.8 mile stretch of West Lewiston Grade Road from I-75 Business Loop (immediately east of GAAF) to the I-75 overpass was reportedly sprayed with regular frequency during active summer training during the 1970s and 1980s. This portion of Lewiston Grade Road is part of a tank trail that connects South Post and North Post training areas. The practice continued until AFFF “wet water” was no longer co-mingled in water trucks in approximately 1988. The approximate geographic coordinates are 44°41'31.88"N and 84°42'27.80"W.

The former Camp Grayling Fire Chief also recalled AFFF “wet water” being used for dust suppression one to two times per year (exact dates unknown) when training occurred at the northern Forward Operating Base (FOB) and identified a location southeast of the corner of North Wakeley Bridge Road and West County Road 612 within the North Post. The approximate geographic coordinates are 44°47'48.41"N and 84°30'52.37"W.

3.3 Cantonment

Five non-FTAs were assessed within the cantonment during the PA. Four of these areas were identified as having a potential PFAS release and one was determined to have no suspected release. A full description of cantonment can be found in **Section 2.2**. Non-FTAs within the cantonment are shown on **Figure 3-3**.

3.3.1 Former Fire Barn – Building 39

Prior to construction of the current Fire Department building located at GAAF, the Camp Grayling Fire Barn occupied Building 39 in the cantonment, located on the corner of Howe Road and Beaver Creek Road. During the 1970s and 1980s, AFFF concentrate (5-gallon buckets; unknown concentration) was stored at the Fire Barn. A former Camp Grayling firefighter reported that a mock drill of a helicopter crash was conducted, and AFFF was used, behind the fire barn; additional training was recalled near the south end of an adjacent building to the north. Former firefighters also reported that fire truck tanks would occasionally be discharged until emptied at the Fire Barn at the end of a training day (see Photographic Log in **Appendix C**). Building 39 and adjacent buildings exist present day. The geographic coordinates of Building 39 are 44°37'47.09"N and 84°46'36.43"W.

3.3.2 Check Nozzle Area

Camp Grayling firefighters performed nozzle checks on equipment as part of routine maintenance activities. The process involved pumping an undefined quantity of tank contents through hose lines and nozzles to observe performance and flush the lines. Interviews and photographs confirmed that this activity predominantly occurred in the western area of the cantonment on Lake Road along the shore of Lake Margrethe. Hoses and nozzles were discharged into or towards the lake between 7th Street North and 8th Street North. During the 1970s and 1980s, fire truck tanks reportedly contained AFFF "wet water" of an unknown concentration that may have been discharged in this area. The approximate geographic coordinates are 44°37'45.20"N and 84°47'45.57"W.

3.3.3 Lake Margrethe

Lake Margrethe is located immediately north of the cantonment in the South Post. During interviews, Camp Grayling firefighters reported that fire truck tanks were washed out into Lake Margrethe as regular practice during routine maintenance. The frequency and quantity of tank washout is not known. Since AFFF was regularly used as "wet water" in truck tanks during the 1970s and 1980s, PFAS may have been directly washed into the lake.

3.3.4 Waste Water Treatment Plant (WWTP)

The Camp Grayling WWTP is located north of the cantonment on the western shore of Lake Margrethe. According to the Integrated Contingency Plan for the Cantonment Area (Amec Foster Wheeler, 2013) the WWTP receives all sanitary sewer outflow from the cantonment; stormwater is largely discharged to Lake Margrethe via a separate storm sewer system. Camp Grayling's Environmental Quality Specialist stated that the WWTP currently spray irrigates effluent towards the west of the WWTP ponds. It is unclear when the irrigation system was installed; however, the WWTP was completed in 1991 (MDMVA, 2007). The WWTP is not considered a source area because the period of active AFFF use at Camp Grayling (1970s to early 1980s) did not overlap when the WWTP became active. Biosolids have not been dredged from the ponds and there have been no reported releases of AFFF to the sanitary sewers.

3.3.5 Parade Grounds

The Parade Grounds are located within the western central area of the cantonment. The grounds contain several athletic fields, a fitness center, and a helicopter landing pad. The approximate geographic coordinates are 44°37'28.49"N and 84°47'30.17"W. Camp Grayling unit capabilities were demonstrated more than once on the Parade Grounds during the period of active AFFF use (1970s and 1980s). Camp Grayling firefighting units (1439th and 1440th) reportedly used AFFF during these demonstrations. The exact number of demonstrations and concentration of AFFF is unknown. Several photographs of Camp Grayling firefighters using AFFF from tanker trucks were provided and included in **Appendix C**.

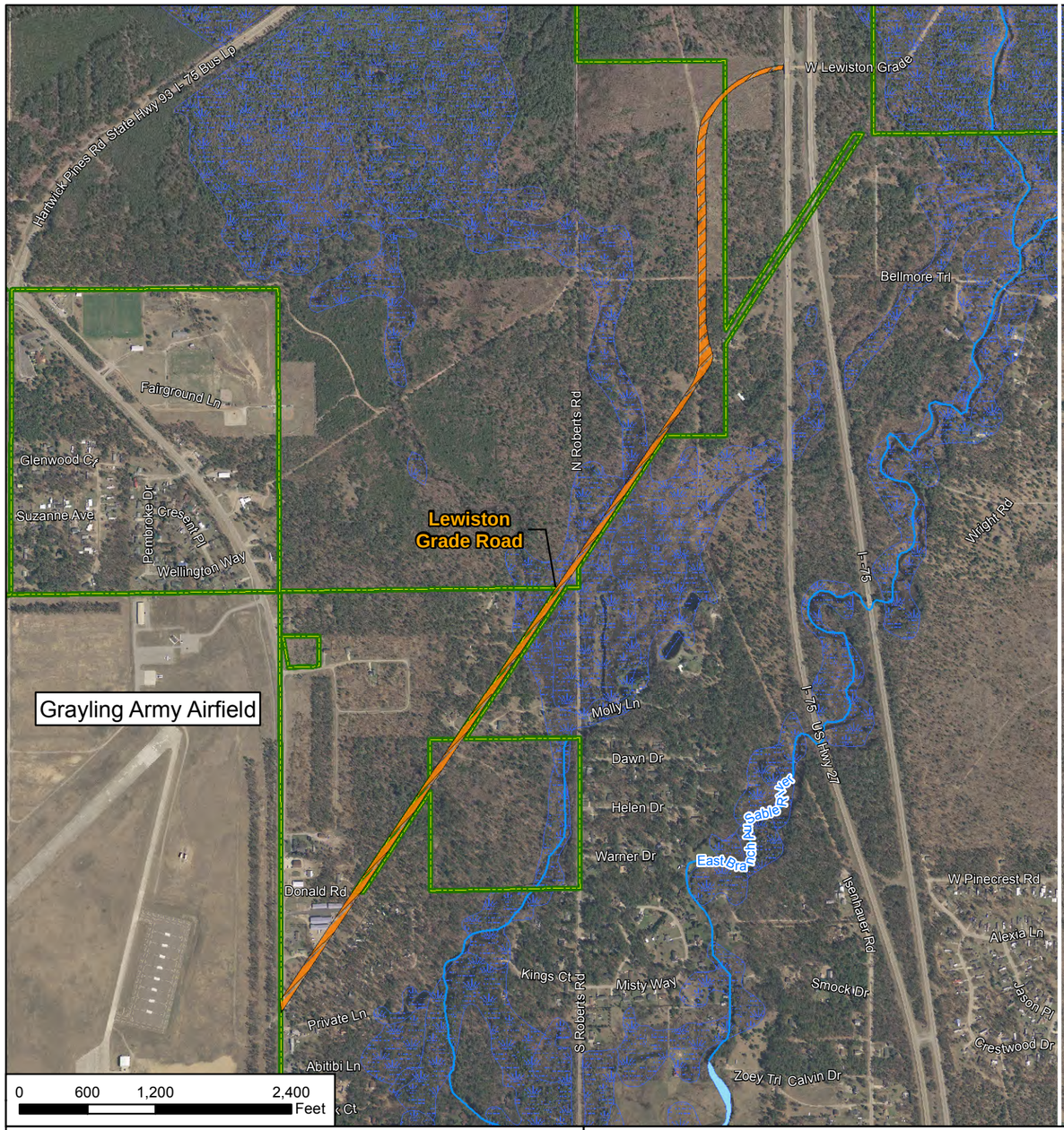
CLIENT	ARNG			
NOTES	Preliminary Assessment for PFAS at Camp Grayling, MI			
REVISED	7/31/2018	GIS BY	MS	7/31/2018
SCALE	1:13,200	CHK BY	JL	7/31/2018
Base Map: Michigan Statewide Orthoimagery Program 2017		PM	RG	7/31/2018

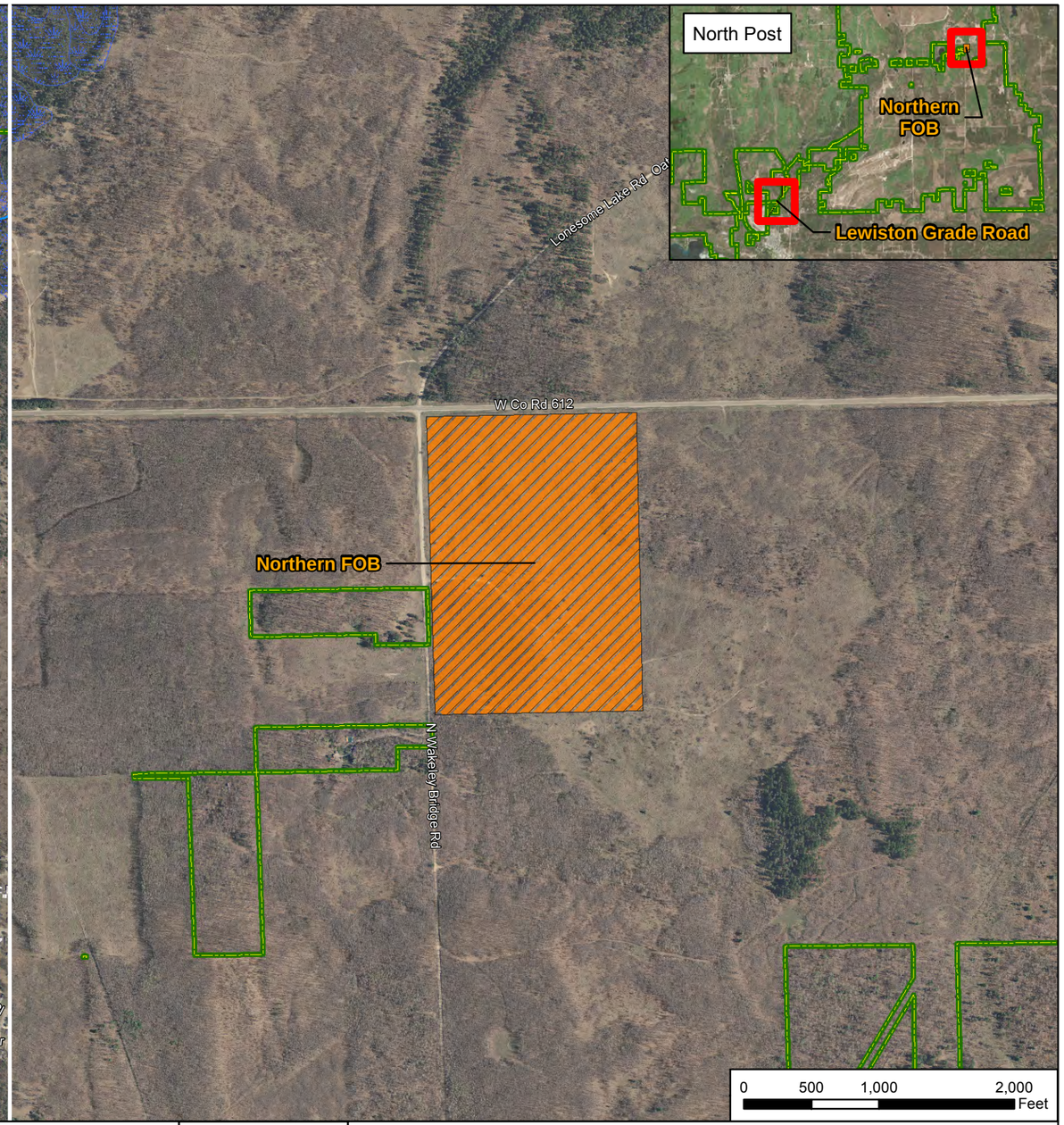
Grayling Army Airfield
Non-Fire Training Areas

AECOM
12420 Milestone Center Drive
Germantown, MD 20876

Figure 3-1

Q:\Projects\ENV\GEARS\GEO\ARNG PFAS\900-CAD-GIS\920-GIS or Graphics\MXD\MI\Grayling\PA_Figures\Fig_3-1_Grayling_Army_Airfield_Non-FTAs.mxd





CLIENT	ARNG			
PROJECT	Preliminary Assessment for PFAS at Camp Grayling, MI			
REVISED	7/31/2018	GIS BY	MS	7/31/2018
SCALE	1:12,000	CHK BY	JL	7/31/2018
Base Map: Michigan Statewide Authoritative Imagery & LiDAR (MiSAIL) program		PM	RG	7/31/2018

Legend

- Potential PFAS Release
- Facility Boundary
- Water Body
- Wetland
- River/Stream

N

North Post Non-Fire Training Areas

AECOM
12420 Milestone Center Drive
Germantown, MD 20876

Figure 3-2

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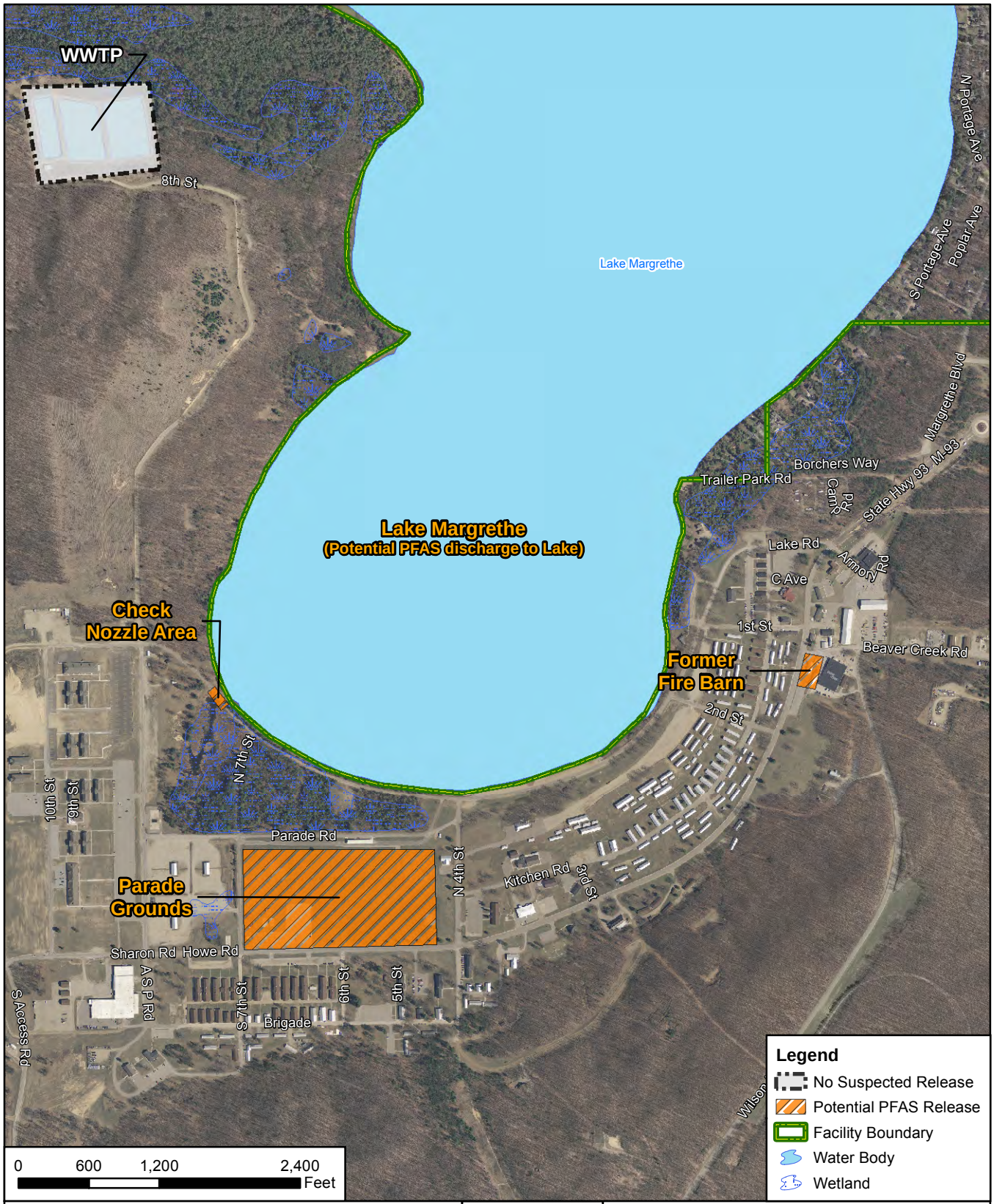

CLIENT	ARNG			
NOTES	Preliminary Assessment for PFAS at Camp Grayling, MI			
REVISED	8/6/2018	GIS BY	MS	8/6/2018
SCALE	1:14,400	CHK BY	JL	8/6/2018
Base Map: Michigan Statewide Orthoimagery Program 2017		PM	RG	8/6/2018

N

Cantonment Non-Fire Training Areas

AECOM
12420 Milestone Center Drive
Germantown, MD 20876

Figure 3-3

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4. Emergency Response Areas

Eight emergency response locations potentially involving the use of AFFF (of unknown concentration) were identified by interviewees and assessed during the PA. Seven of these areas were identified as having a potential PFAS release and one was determined to not be a source area. The emergency response areas are shown on **Figure 4-1** and **4-2** for the North and South Post respectively; photographs appear in **Appendix C**.

4.1 Range 40 Complex

The Range 40 Complex includes a 7,390-acre fenced impact area used for air to ground training, helicopter gunnery, artillery, and mortars. The approximate geographic coordinates are 44°50'13.00"N and 84°34'40.33"W. Training activities occasionally resulted in the ignition of wildfires within the impact area. Due to the danger from unexploded ordnance, fire is managed at the fence line with brush clearing and prescribed burns. However, AFFF was reportedly used by the Camp Grayling Fire Department to respond to at least one fire on range during the 1970s or early 1980s. An interviewee who was a former City of Grayling Fire Chief and MDNR supervisor recounted that MDNR was responsible for wildfires and was supported by the Camp Grayling Fire Department. AFFF “wet water” was reportedly used routinely by Camp Grayling firefighters to control prescribed burns along the fence line of the Range 40 Complex. MDNR assisted Camp Grayling with such prescribed burns to minimize the potential for wildfires and historically used a US Forest Service approved Class A foam or wetting agent (also colloquially referred to as “wet water” but of a different formulation) to extinguish the fires according to MDNR staff interviewed. The wetting agent used in these instances by MDNR was very similar in chemical composition to Class A foam but did not have the foaming abilities of AFFF. Historically, dish washing liquid mixed with water had also been used by MDNR as a wetting agent (**Appendix B** and **C**). The number of emergency responses to the complex is not known, although fire was described as a routine occurrence during the active fire season by former firefighters. Reportedly, as many as 26 individual fires were responded to in the area during one weekend. The location of the Range 40 Complex emergency response area is shown on **Figure 4-1**.

4.2 Range 30 Complex

The Range 30 Complex, located in the southern part of North Post, includes a fenced area of approximately 5,260 acres that contains the Multi-Purpose Range Complex (MPRC). Prior to construction of the MPRC in 1997, the Range 30 Complex included a tank range and World War II era armor training range (MDMVA, 2007). Travel is restricted to roads within the range. Similar to the Range 40 Complex, training activities occasionally resulted in the ignition of wildfires within different portions of the Complex. AFFF “wet water” was reportedly used by Camp Grayling firefighters to extinguish wildfires and control prescribed burns during the active period of AFFF use in the 1970s and 1980s. MDNR assisted Camp Grayling with prescribed burns, in the same capacity as for the Range 40 Complex, with the use of Class A foams and wetting agents. The number of emergency responses to the complex is not known. The approximate geographic coordinates for the center of the complex are 44°42'35.97"N and 84°37'21.44"W (**Figure 4-1**).

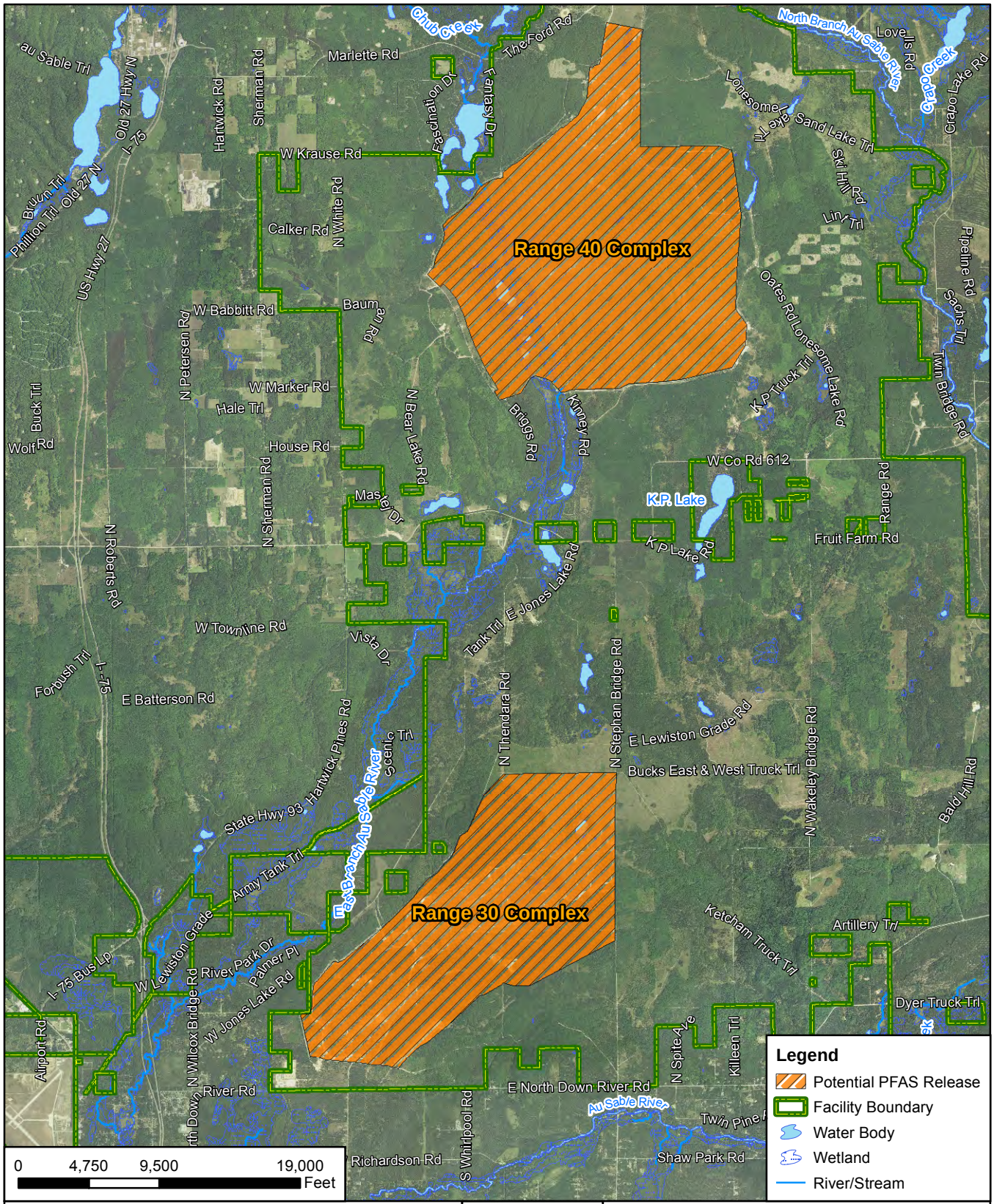
4.3 South Post Ranges

AFFF “wet water” was reportedly used by Camp Grayling firefighters to control occasional fires that resulted from normal training activities and prescribed burns at several training ranges located in the South Post. MDNR assisted Camp Grayling with controlled burns and wildfires with the use of Class A foams and wetting agents. The number of instances of emergency response to each range is not known nor is the quantity of AFFF “wet water” used. The following ranges were identified during PA interviews. Emergency Response Areas in the South Post are shown on **Figure 4-2**.

- Range 8 – Multipurpose Machine Gun Range; approximate geographic coordinates are 44°37'54.89"N and 84°51'1.01"W
- Ranges 3A and 3B – 10m-25m Zero Ranges; geographic coordinates for Range 3A are 44°37'45.03"N and 84°49'2.02"W; Range 3B coordinates are 44°37'46.42"N and 84°48'57.95"W
- Ranges 20 and 21 – Light Demolitions; geographic coordinates for Range 20 are 44°37'8.60"N and 84°51'17.02"W; Range 21 coordinates are 44°36'44.74"N and 84°51'44.33"W
- 13 Complex specifically Range 15 – Grenade Launcher Range; the majority of fires responded to in the 13 Complex were reported to be at Range 15; geographic coordinates for Range 15 are 44°35'45.64"N and 84°49'37.30"W

4.4 Off-Facility Car Accident

Camp Grayling firefighters supported the City of Grayling Fire Department through a joint use agreement with the MDNR and the City of Grayling Fire Department. In 1979, a car accident on the corner of South Military Road and West Beaver Road was responded to by the Camp Grayling Fire Department. AFFF was reportedly used to extinguish the car fire. **Appendix C** presents on-scene photographs taken and show firefighters applying AFFF. The single release of AFFF at this location is not considered a potential source area.



CLIENT	ARNG			
NOTES	Preliminary Assessment for PFAS at Camp Grayling, MI			
REVISED	7/31/2018	GIS BY	MS	7/31/2018
SCALE	1:114,000	CHK BY	JL	7/31/2018
Base Map: National Agricultural Imagery Program, 2016		PM	RG	7/31/2018

North Post Emergency Response Areas

AECOM
12420 Milestone Center Drive
Germantown, MD 20876

Figure 4-1

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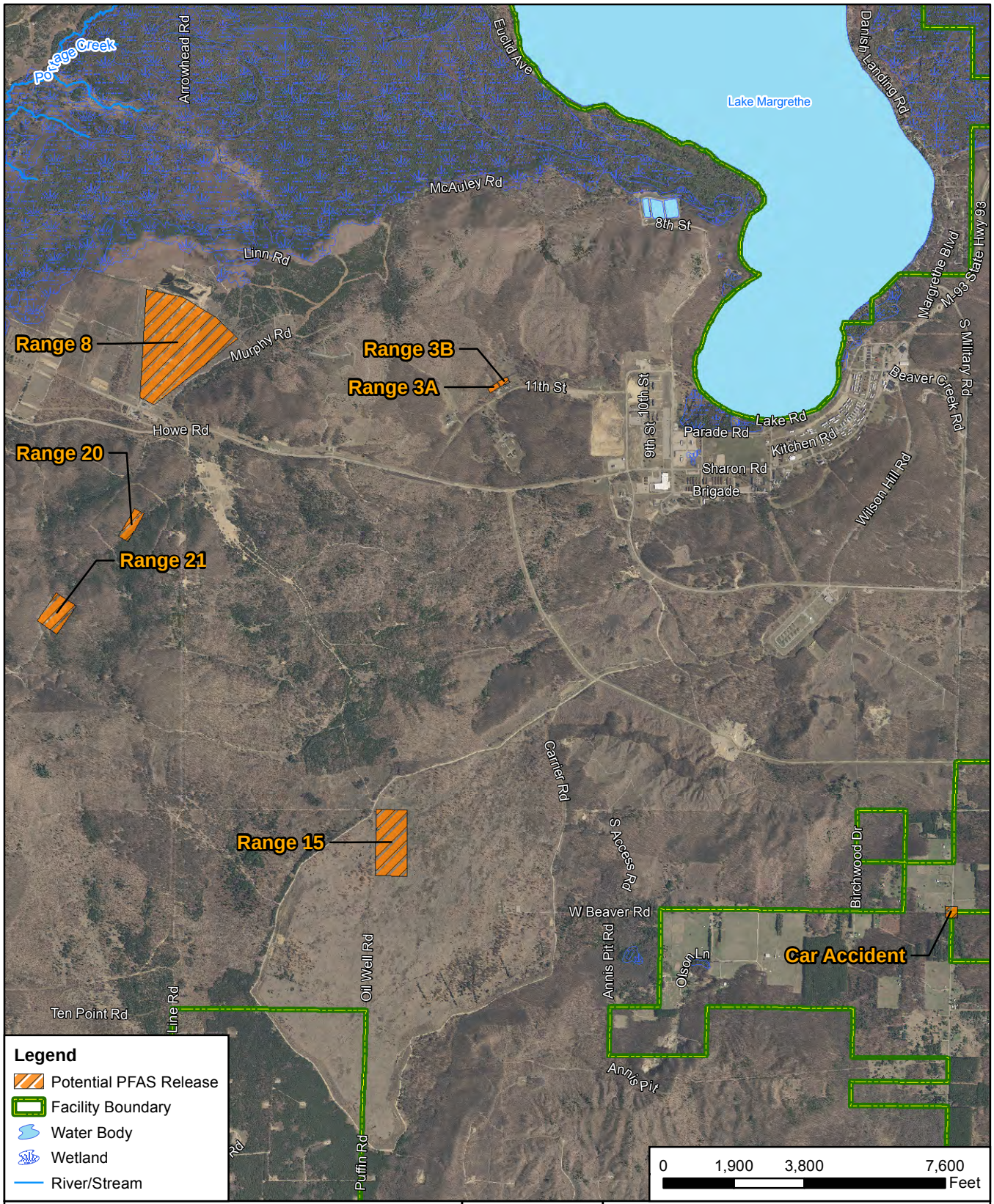

CLIENT	ARNG			
NOTES	Preliminary Assessment for PFAS at Camp Grayling, MI			
REVISED	7/31/2018	GIS BY	MS	7/31/2018
SCALE	1:45,600	CHK BY	JL	7/31/2018
Base Map: Michigan Statewide Orthoimagery Program 2017		PM	RG	7/31/2018

N

South Post Emergency Response Areas

AECOM
12420 Milestone Center Drive
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Figure 4-2

Q:\Projects\ENV\GEARS\GEO\ARNG PFAS\900-CAD-GIS\920-GIS or Graphics\MXD\MI\Grayling\PA_Figures\Fig_4-2_Grayling_South_Post_ERAs.mxd

5. Adjacent Sources

Three potential off-facility PFAS sources were identified adjacent to portions of Camp Grayling during the PA. The locations of potential off-facility source areas are shown on **Figure 5-1**.

5.1 Automotive Dealership

During PA interviews, several local interviewees noted that a car dealership is located along the southeast boundary of GAAF on I-75BL. There was some conjecture that the dealership may perform detailing services for automobiles and questioned whether those services may have included upholstery waterproofing with PFAS containing materials. It is unknown whether upholstery waterproofing is performed at the dealership.

5.2 City of Grayling Fire Department

As part of the joint use agreement with the Camp Grayling Fire Department through the MDNR, the City of Grayling Fire Department participated in joint training activities and stored smaller amounts of AFFF at their fire station. The City of Grayling Fire Department is located immediately south of GAAF off of North Down River Road, approximate geographic coordinates are 44°40'12.12"N and 84°43'16.57"W. In an interview, the current Fire Chief indicated that AFFF was not spilled or intentionally released at the fire station. AFFF was only used during joint training with Camp Grayling at GAAF.

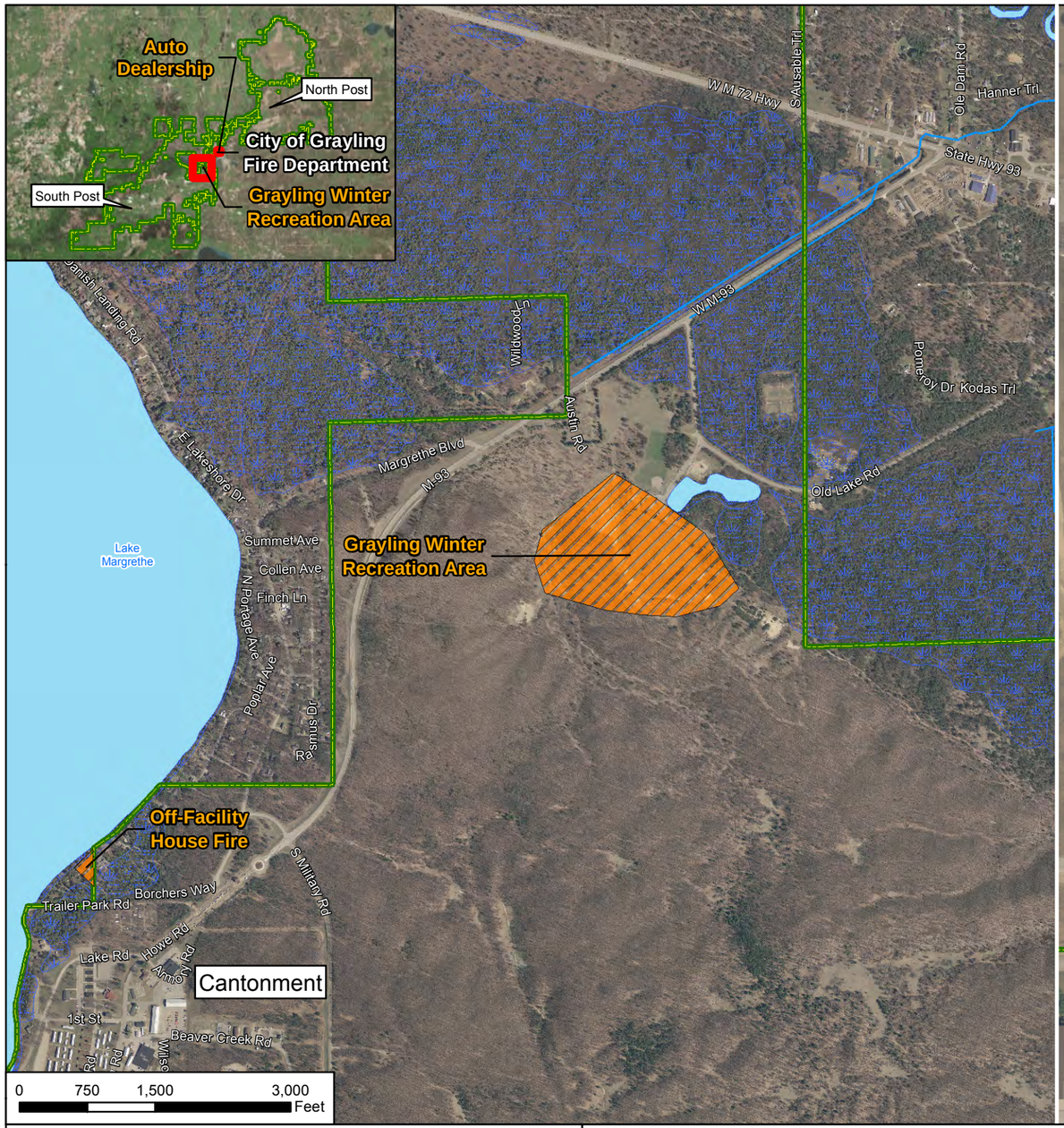
5.3 Grayling Winter Recreation Area

Established in 1929, the Grayling Winter Sports Park, now Hanson Hills Recreation Area and Winter Sports Park, was the first downhill ski area in Michigan and the second to open in the Midwest (Hansonhills, 2018). It is located approximately 1 mile northeast of the cantonment at the following geographic coordinates 44°38'39.67"N and 84°45'20.54"W. Although the land is controlled by the State of Michigan's Military Board and located within Camp Grayling facility boundaries, the park is operated by the Grayling Recreation Authority (a consortium made up of township and county entities) and is not controlled or operated by MIARNG.

Commercial ski and snowboard waxes contain PFAS. Surface water and snowmelt have been shown to have measureable PFAS impacts downgradient of ski areas (Kwok et. al., 2013). Due to the proximity of the recreation area to Lake Margrethe, the Hanson Hills Recreation Area and Winter Sports Park may be considered an off-facility source area.

5.4 Off-Facility House Fire

During follow-on interviews, MIARNG discovered that a private residence located adjacent to the main gate of the cantonment, outside facility boundaries, had historically burned down. It was reported that foam was used to extinguish the fire. However, the type of foam (Class A or AFFF) and concentration used, as well as the date of the fire, is not known. As a part of MDEQs off-facility PFAS sampling efforts, PFAS were detected in drinking water at residences located at and around the location of the house fire; one well exceeded the USEPA Drinking Water Health Advisory Level (70 parts per trillion). The approximate geographic coordinates for the area are 44°38'7.14"N and 84°46'42.18"W.



CLIENT	ARNG			
PROJECT	Preliminary Assessment for PFAS at Camp Grayling, MI			
REVISED	7/31/2018	GIS BY	MS	7/31/2018
SCALE	1:18,000	CHK BY	JL	7/31/2018
Base Map: Michigan Statewide Authoritative Imagery & LiDAR (MiSAIL) program		PM	RG	7/31/2018

Legend

- No Suspected Release
- Potential PFAS Release
- Facility Boundary
- Water Body
- Wetland
- River/Stream

N

Adjacent Sources

AECOM
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Germantown, MD 20876

Figure 5-1

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6. Conceptual Site Model

Based on the PA findings, the release areas were grouped into several areas of interest (AOIs). The AOIs are shown on **Figures 6-1**, **6-3**, **6-6**, **6-10**, and **6-15**. The following sections describe the CSM components and the specific CSMs developed for each AOI. The CSM identifies the three components necessary for a potentially complete exposure pathway: (1) source, (2) pathway, and (3) receptor. If any of these elements are missing, the pathway is considered incomplete.

In general, the potential PFAS exposure pathways are ingestion and inhalation. Dermal contact is not considered to be a potential exposure pathway as studies have shown very limited absorption of PFAS through the skin (NGWA, 2018). Receptors at Camp Grayling include site workers (e.g., camp staff and visiting soldiers), construction workers, fulltime and part time residents outside the facility boundary, trespassers, and recreational users. The CSMs for each AOI indicate which specific receptors could potentially be exposed to PFAS.

The Michigan Department of Health and Human Services (MDHHS) issued “Eat Safe Fish” guidelines for fish caught from Lake Margrethe and the Au Sable River (from Grayling to Mio, MI) on 15 March 2018 (MDHHS, 2018). The guidelines resulted from PFAS being found in the tissue of select species of game fish caught in these water bodies. A copy of the updated guidelines is included in Appendix A. Potentially complete pathways are present for the consumption of game fish by recreational users of both Lake Margrethe and the Au Sable River.

6.1 AOI 1 – AOI 5: GAAF

During the time period of the 1970s into the 1980s, AFFF was reportedly released to soil at several locations within the boundary of GAAF. Based on preliminary data and assumed groundwater flow directions, five different AOIs are identified within GAAF. Ground-disturbing activities at these AOIs could result in site worker, construction worker, and trespasser exposure to potential PFAS contamination via inhalation of dust or ingestion of surface soil. Ground-disturbing activities to subsurface soil also could result in site and construction worker exposure. The following table describes each AOI and the potential release areas associated with each.

Area of Interest	Potential PFAS Release Areas
AOI 1	• Building 1194 Ramp (non-FTA) • Building 1160 (FTA)
AOI 2	• Southeastern end of Runway 14/32 (FTA) • Between former MATES and Runway 14/32 (FTA)
AOI 3	• Former MATES Location (FTA)
AOI 4	• Taxiway D (FTA) • Northwestern end of Runway 14/32 (FTA)
AOI 5	• Bivouac Area (non-FTA) • City of Grayling Fire Department (FTA)

In their anionic forms, PFAS are water soluble and can migrate readily from soil to groundwater or surface water via leaching and run-off. Given the length of time since the potential AFFF releases (i.e. greater than 30 years), the average precipitation at the facility, high degree of soil permeability, and preliminary boundary sampling data, potential PFAS contamination at the

GAAF AOIs may have migrated from the soil to groundwater and nearby surface water bodies via infiltration. The main stem and East Branch of the Au Sable River lay to the west and east of the GAAF boundary, respectively, off-facility. Preliminary data suggest the presence of a groundwater divide at the airfield between the river branches. Infiltration of rainfall recharges groundwater and likely follows a shallow flow system that discharges to either branch of the river, supporting water levels. Therefore, the ingestion exposure pathways for surface water and sediment are potentially complete for residents and recreational users of the Au Sable and the East Branch Au Sable (e.g., swimming and fishing).

Previous sampling activities have identified PFAS in groundwater at GAAF and in off-facility residential wells in the City of Grayling to the east and west of GAAF. Drinking water is supplied to GAAF and residents located south of North Down River Road by the City of Grayling. Municipal drinking water comes from one of two deep Type I water wells (screened approximately between 100 and 210 feet bgs) located along the western bank of the East Branch Au Sable River on either side of North Down River Road. Trace levels of PFAS compounds have been detected in these wells during previous sampling events in 2017 and 2018 (State of Michigan, 2018). Residents to the north of North Down River Road and to the west of GAAF are supplied by, typically, shallow private wells; PFAS have been detected in several of these private wells. Therefore, the ingestion exposure pathway for groundwater is complete for off-facility residents and recreational users. The GAAF AOIs (AOI 1 through AOI 5) are shown on **Figure 6-1** and the CSM is presented on **Figure 6-2**.

6.2 North Post AOIs

The four AOIs identified in separate areas of the North Post are shown on **Figure 6-3**.

6.2.1 AOI 6: Range 40 Complex

AFFF “wet water” was reportedly routinely used along the fence line of the Range 40 Complex to control wildfires and maintain fire breaks by Camp Grayling firefighters. In approximately two-thirds of the Range 40 Complex, the groundwater discharges to the North Branch Au Sable River to the east. In the remaining third to the west, groundwater flow discharges to the headwaters of the East Branch Au Sable River. Access to the interior of the complex is restricted by a fence due to the risk of unexploded ordnance; however, trespassers occasionally breach the fence to salvage scrap metal on the range. Maintenance or construction activities at the fence line may include ground-disturbing activities that could result in site worker, construction worker, and trespasser exposure to potential PFAS contamination via inhalation of dust or ingestion of surface soil. Additionally, ground-disturbing activities to subsurface soil could also result in site and construction worker exposure.

Given the length of time since the potential AFFF releases (greater than 30 years) and the high degree of soil permeability, potential PFAS contamination at the fence line, and potentially within the range complex, may have migrated from the soil to groundwater and nearby surface water bodies via infiltration. Therefore, the ingestion exposure pathways for surface water and sediment are potentially completed for site workers, construction workers, and trespassers. Rainfall infiltration recharges groundwater that discharges to either the North Branch Au Sable and the East Branch Au Sable and associated lakes. Therefore, the ingestion exposure pathways for surface water and sediment are potentially complete for residents and recreational users off the North Branch Au Sable and East Branch Au Sable and associated lakes (e.g., swimming and fishing).

Several private residential drinking water wells are located in the town of Lovells to the east of the AOI and along the shore of KP Lake, which is to the south of Range 40. The ingestion exposure pathway for groundwater is potentially complete for these residents. AOI 6 is shown on **Figure 6-3** and the CSM is presented on **Figure 6-4**.

6.2.2 AOI 7: North FOB

AFFF "wet water" was reported to have been used for dust suppression within the area identified as the North FOB. This area is currently inactive, open land that is well-vegetated with the exception of a few small dirt roadways. Ground-disturbing activities could result in site worker, construction worker, and trespasser exposure to potential PFAS contamination via inhalation of dust or ingestion of surface soil. Ground-disturbing activities to subsurface soil could result in site and construction worker exposure.

Potential PFAS contamination may have migrated from soil to groundwater, and subsequently nearby surface water bodies via infiltration. The AOI is located approximately 1 mile east of KP Lake and 2 miles west of the North Branch Au Sable River. Groundwater likely flows in a predominantly east to southeastern direction towards North Branch Au Sable River, although it is not known if any localized flow towards KP Lake is present. Therefore, the ingestion exposure pathways for surface water and sediment are potentially completed for site workers, construction workers, trespassers, residents, and recreational users of the North Branch Au Sable River and KP Lake (e.g., swimming and fishing).

Two private residential wells are located approximately 1 mile southeast of the AOI. Additionally, several household wells are located to the west along the shore of KP Lake. The ingestion exposure pathway for groundwater is potentially complete for off-facility residents. AOI 7 is shown on **Figure 6-3** and the CSM is presented on **Figure 6-4**.

6.2.3 AOI 8: Range 30 Complex

Wildfires, ignited by training activities, were reportedly extinguished with AFFF "wet water" during the period of active AFFF use. The majority of the AOI is vegetated; however, all roads within the complex are unpaved and several active training areas are exposed bare ground. Site workers, construction workers, and trespassers may be exposed to potential PFAS contamination in disturbed soil via inhalation of dust or ingestion of surface soil. Ground-disturbing activities to subsurface soil could also result in site and construction worker exposure.

Given the length of time since the potential AFFF releases (greater than 30 years) and the high degree of soil permeability, potential PFAS contamination within the range complex may have migrated from the soil to groundwater and nearby surface water bodies via infiltration. Therefore, the ingestion exposure pathways for surface water and sediment are potentially completed for site workers, construction workers, and trespassers. The Range 30 Complex lies approximately 1.5 miles north of the Au Sable River; Kyle Lake is located within the foot print of the range complex in the northern portion of the AOI. Shallow groundwater flows in a general southern direction towards the Au Sable River. The extent of localized groundwater flow towards Kyle Lake is not known within the northern portion of the AOI. Potential PFAS contamination may have infiltrated shallow groundwater and migrated to these nearby surface water bodies. The ingestion exposure pathways for surface water and sediment are potentially complete for residents and recreational users of the Au Sable River (e.g., swimming and fishing) and training users of Kyle Lake.

Two Type II (non-community public water supply) water wells are located at the current MATES, in the southwest corner of the Range 30 Complex. One well is used as a backup drinking water supply well and the other for vehicle washing. Several household wells are located to the south of the Range 30 Complex, between the Au Sable River and the Range boundary. The ingestion exposure pathway for groundwater is potentially complete for off-facility residents within this area and site workers at the MATES. AOI 8 is shown on **Figure 6-3** and the CSM is presented on **Figure 6-5**.

6.2.4 AOI 9: Lewiston Grade Road

AFFF "wet water" was reportedly used as dust suppression along a 1.8 mile unpaved stretch of Lewiston Grade Road from I-75 Business Loop (immediately east of GAAF) to the I-75 overpass until the late 1980s. The road is unpaved and fugitive dust from surface soil is possible from normal use; however, given the time of initial application to the road surface the potential release from fugitive dust is unlikely. Ground-disturbing activities could result in site worker, construction worker, resident, and trespasser exposure to potential PFAS contamination via inhalation of dust or ingestion of surface soil. Ground-disturbing activities to subsurface soil could result in site and construction worker exposure.

Lewiston Grade Road parallels the East Branch Au Sable River approximately 0.5 miles to the northwest. An unnamed tributary of the East Branch Au Sable River is located approximately 1,000 feet from the road. The road is mostly rural with a few private residences located off of it. Based on aerial imagery, a few of these residences on the south side of Lewiston Grade Road have small private lakes. Shallow groundwater likely flows in a southeastern direction towards the river. Potential PFAS contamination along the road may have infiltrated shallow groundwater and migrated to these nearby surface water bodies. The ingestion exposure pathways for surface water and sediment are potentially complete for residents and recreational users of the East Branch Au Sable River and the private lakes (e.g., swimming and fishing).

The MDEQ, via Wellogic, shows 19 household wells located between the Lewiston Grade Road AOI and the East Branch Au Sable River (MDEQ, 2018). An additional two household wells are located immediately on the northern side of the AOI road. The ingestion exposure pathway for groundwater is potentially complete for off-facility residents. AOI 9 is shown on **Figure 6-3** and the CSM is presented on **Figure 6-6**.

6.3 South Post AOIs

The four AOIs identified in separate areas of the South Post are shown on **Figure 6-7**

6.3.1 AOI 10: Range 8

AFFF "wet water" was reportedly used in an emergency response capacity to control fires that resulted from normal training activities with tracer ammunition. The approximate 109-acre range is mostly vegetated with interspersed un-vegetated areas within; no habitable structures are located within the range. Site worker, construction workers, and trespassers may be exposed to potential PFAS contamination in disturbed soil via inhalation of dust or ingestion of surface soil. Ground-disturbing activities to subsurface soil could result in site and construction worker exposure.

Located in the northern portion of the South Post, Range 8 drains to the north towards a large forested/shrub wetland area that ultimately drains to Portage Creek, a tributary of the Manistee River. Potential PFAS contamination from the range may have infiltrated shallow groundwater and migrated north towards the wetland and potentially Portage Creek which drains Lake Margrethe. The ingestion exposure pathways for surface water and sediment are potentially complete for residents and recreational users of the Portage Creek (e.g., swimming and fishing).

Two drinking water wells are located immediately upgradient of the AOI; no wells are present downgradient. PFOA/PFOS was not detected in drinking water from these wells during 2017 MIARNG sampling. Therefore, the ingestion exposure pathway for groundwater is incomplete for the Range 8 AOI. AOI 10 is shown on **Figure 6-7** and the CSM is presented on **Figure 6-8**.

6.3.2 AOI 11: Small Arms Ranges

AFFF “wet water” was supposedly used in an emergency response capacity to control fires that resulted from normal training activities with tracer ammunition. The ranges are predominantly vegetated with the exception of berm backstops. Ground-disturbing activities could result in site worker, construction worker, and trespasser exposure to potential PFAS contamination via inhalation of dust or ingestion of surface soil. Ground-disturbing activities to subsurface soil could result in site and construction worker exposure.

The Small Arms Ranges AOI is less than 1 mile to the west of Lake Margrethe and is located within a topographical low point between two hill systems to the north and south that have an approximate 100 foot elevation difference from their peaks down to AOI 11. Shallow groundwater likely flows in an easterly direction towards the western area of the cantonment and the lake. Potential PFAS contamination from the range may have infiltrated shallow groundwater and migrated towards Lake Margrethe. The ingestion exposure pathways for surface water and sediment are potentially complete for residents and recreational users (e.g., swimming and fishing) of Lake Margrethe (see **Section 6.4.6** for discussion of Lake Margrethe AOI).

One potable well is located downgradient of the AOI, immediately adjacent to Lake Margrethe on-facility. This well was tested by the MIARNG and found to have detections of PFAS; the well is not in use and is scheduled to be abandoned according to the Camp Grayling Environmental Quality Specialist. Therefore, the ingestion exposure pathway for groundwater is incomplete for the Small Arms Range AOI. AOI 11 is shown on **Figure 6-7** and the CSM is presented on **Figure 6-8**.

6.3.3 AOI 12: Light Demolition Ranges

AFFF “wet water” was used to control occasional fires that resulted from light demolition training activities at these two ranges. The active portions of the ranges are predominantly un-vegetated. Ground-disturbing activities could result in site worker, construction worker, and trespasser exposure to potential PFAS contamination via inhalation of dust or ingestion of surface soil. Ground-disturbing activities to subsurface soil could result in site and construction worker exposure.

Kings Ponds are located roughly 0.5 miles to the west of the AOI area. Groundwater flows in a northwestern direction towards Portage Creek, located over 4.5 miles to the northwest, and the Manistee River. Shallow groundwater originating from the southern Light Demolitions Range potentially flows towards and discharges to Kings Ponds. Potential PFAS contamination may

have infiltrated shallow groundwater and migrated to these ponds. Due to size and restricted access, recreational users are unlikely at these ponds, however, if future training activities are conducted at the ponds (i.e., bridging) the ingestion exposure pathways for surface water and sediment are potentially complete for site workers.

Three drinking water wells are located approximately 1 to 2 miles downgradient of the AOI areas within and near the Southern FOB. According to MIARNG data, these wells are described as being in active use. The ingestion exposure pathway for groundwater is potentially complete for site and construction workers at the South FOB and adjacent training site. AOI 12 is shown on **Figure 6-7** and the CSM is presented on **Figure 6-9**.

6.3.4 AOI 13: Range 15 Area

AFFF “wet water” was reportedly used to control occasional fires that resulted from training activities predominantly at Range 15 within the Range 13 Complex; emergency response may have been conducted within other areas of the 13 Complex on a less regular basis. Ground-disturbing activities could result in site worker, construction worker, and trespasser exposure to potential PFAS contamination via inhalation of dust or ingestion of surface soil. Ground-disturbing activities to subsurface soil could result in site and construction worker exposure.

No surface water bodies are present within the AOI. According to a 2013 Phase II Assessment of the range (URS Group Inc., 2013), groundwater flows in a southeastern direction. The closest surface water body located downgradient of Range 15 is Beaver Creek which is approximately 5 miles to the southeast. Due to the distance present to the potential source area, the ingestion exposure pathway for surface water and sediment pathways are incomplete for the Range 15 AOI.

The MDEQ, via Wellogic, shows that the closest drinking water wells to the Range 15 AOI are over 5 miles away to the east along Military Road (MDEQ, 2018). An additional two household wells are identified approximately 3 miles south from the AOI ; however, these locations are associated with oil production wells, no household structures are present within the identified area. Therefore, the ingestion exposure pathway for groundwater is incomplete for the Range 15 AOI. AOI 13 is shown on **Figure 6-7** and the CSM is presented on **Figure 6-10**.

6.4 Cantonment AOIs

The five AOIs identified in separate areas of the cantonment are shown on. **Figure 6-11**.

6.4.1 AOI 14: East Cantonment

AOI 14 includes the potential AFFF release at and within the vicinity of Building 39, the former Fire Barn, and fire training activities in the area of Building 228Q during the 1970s and 1980s. The areas surrounding the buildings are mostly vegetated or paved with the exception of an earthen parking area on the northwestern side of Building 228Q. Ground-disturbing activities could result in site worker, construction worker, and trespasser exposure to potential PFAS contamination via inhalation of dust or ingestion of surface soil. Ground-disturbing activities to subsurface soil could result in site and construction worker exposure.

The East Cantonment AOI is located immediately adjacent to Lake Margrethe. Groundwater flows to the west and discharges to the lake. Potential PFAS contamination from the cantonment may have infiltrated shallow groundwater and migrated to the lake. The ingestion

exposure pathways for surface water and sediment are potentially complete for site workers, construction workers, residents, trespassers, and recreational users of Lake Margrethe (e.g., swimming and fishing).

No drinking water wells are located downgradient of the AOI. However, several household wells, located immediately off-facility, and the main gate well are located approximately 1,400 feet to the north and northeast of the AOI (respectively). Because it is not known if water from Lake Margrethe influences shallow groundwater adjacent to the shoreline, the ingestion exposure pathway for groundwater is potentially complete for off-facility residents and on-facility site workers. AOI 14 is shown on **Figure 6-11** and the CSM is presented on **Figure 6-12**.

6.4.2 AOI 15: West Cantonment

AFFF may have been released within the AOI 15 area during training activities at the Parade Grounds, Wash Racks, Building 500 and 600 areas, and the check nozzle area. As a whole, the area of the AOI is mostly vegetated or paved. Some un-vegetated parking areas are present along 8th Street. Ground-disturbing activities in release areas could result in site worker, construction worker, and trespasser exposure to potential PFAS contamination via inhalation of dust or ingestion of surface soil. Ground-disturbing activities to subsurface soil could result in site and construction worker exposure.

The West Cantonment AOI is located immediately adjacent to Lake Margrethe. Groundwater flows to the north and northeast towards an unnamed stock pond that connects to Lake Margrethe. Potential PFAS contamination from the cantonment may have infiltrated shallow groundwater and migrated to the pond and lake. The ingestion exposure pathways for surface water and sediment are complete for site workers, construction workers, residents, trespassers, and recreational users of Lake Margrethe (e.g., swimming and fishing).

A Type II public well is located immediately south (upgradient) of the AOI. However, no drinking water wells are present within or downgradient of the West Cantonment AOI. Therefore, the ingestion exposure pathway for groundwater is incomplete at this AOI. Similar to AOI 14, because it is not known if water from Lake Margrethe influences shallow groundwater adjacent to the shoreline, the ingestion exposure pathway for groundwater is potentially complete for off-facility residents. AOI 15 is shown on **Figure 6-11** and the CSM is presented on **Figure 6-12**.

6.4.3 AOI 16: Wilson Hill

AFFF may have been released during training activities in the vicinity of the fitness track near Wilson Hill. Ground-disturbing activities at the AOI could result in site worker, construction worker, and trespasser exposure to potential PFAS contamination via inhalation of dust or ingestion of surface soil. Ground-disturbing activities to subsurface soil could result in site and construction worker exposure.

No surface water bodies are present within the AOI; Lake Margrethe is located approximately 0.5 miles to the northwest. Groundwater likely flows in a northwesterly direction towards the lake. Potential PFAS contamination from training activities may have infiltrated shallow groundwater and migrated towards the lake. The ingestion exposure pathways for surface water and sediment are potentially complete for site workers, construction workers, residents, trespassers, and recreational users of Lake Margrethe (e.g., swimming and fishing).

One household well is reported to be present downgradient of the Wilson Hill AOI; however, no structures are present in the area of the coordinates of the well given by MDEQ via Wellogic (MDEQ, 2018). Therefore, the ingestion exposure pathway for groundwater is incomplete for this AOI. AOI 16 is shown on **Figure 6-11** and the CSM is presented on **Figure 6-13**.

6.4.4 AOI 17: Former ASP

AFFF was reportedly used to extinguish a controlled structure fire during training activities and to control brush fires at the location of the former ASP. Ground-disturbing activities at the AOI could result in site worker, construction worker, and trespasser exposure to potential PFAS contamination via inhalation of dust or ingestion of surface soil. Ground-disturbing activities to subsurface soil could result in site and construction worker exposure.

No surface water bodies are present within the AOI; Lake Margrethe is located approximately 1 mile to the north, past Wilson Hill. Groundwater likely flows in a predominantly northern direction towards the lake; however, shallow groundwater may be influenced by local topographical features, namely Wilson Hill, and flow in a northwesterly direction. Although potential PFAS contamination from training activities may have infiltrated shallow groundwater and migrated in the direction of the lake, due to topographical influences and the distance to the lake from the potential source area, surface water and sediment pathways are considered incomplete for AOI 17.

Three drinking water wells (Type II and Type III) are located approximately 1,800 feet north (downgradient) of AOI 17 on the other side of Wilson Hill. The ingestion exposure pathway for groundwater is potentially complete for site and construction workers. AOI 17 is shown on **Figure 6-11** and the CSM is presented on **Figure 6-14**.

6.4.5 AOI 18: Lake Margrethe

AFFF was potentially released into Lake Margrethe during check nozzle maintenance activities. Additionally, PFAS contamination, from other potential releases of AFFF within the cantonment, may have infiltrated shallow groundwater and migrated to Lake Margrethe.

Lake Margrethe discharges to Portage Creek, located in the northwestern portion of the lake. The ingestion exposure pathways for surface water and sediment are potentially complete for site workers, construction workers, residents, trespassers, and recreational users of Lake Margrethe and Portage Creek (e.g., swimming and fishing). The degree of communication between surface water from Lake Margrethe and groundwater immediately adjacent to its shore is unknown; therefore, the ingestion exposure pathway for groundwater is potentially complete for off-facility residents of the Lake Margrethe shoreline. AOI 18 is shown on **Figure 6-11** and the CSM is presented on **Figure 6-15**.

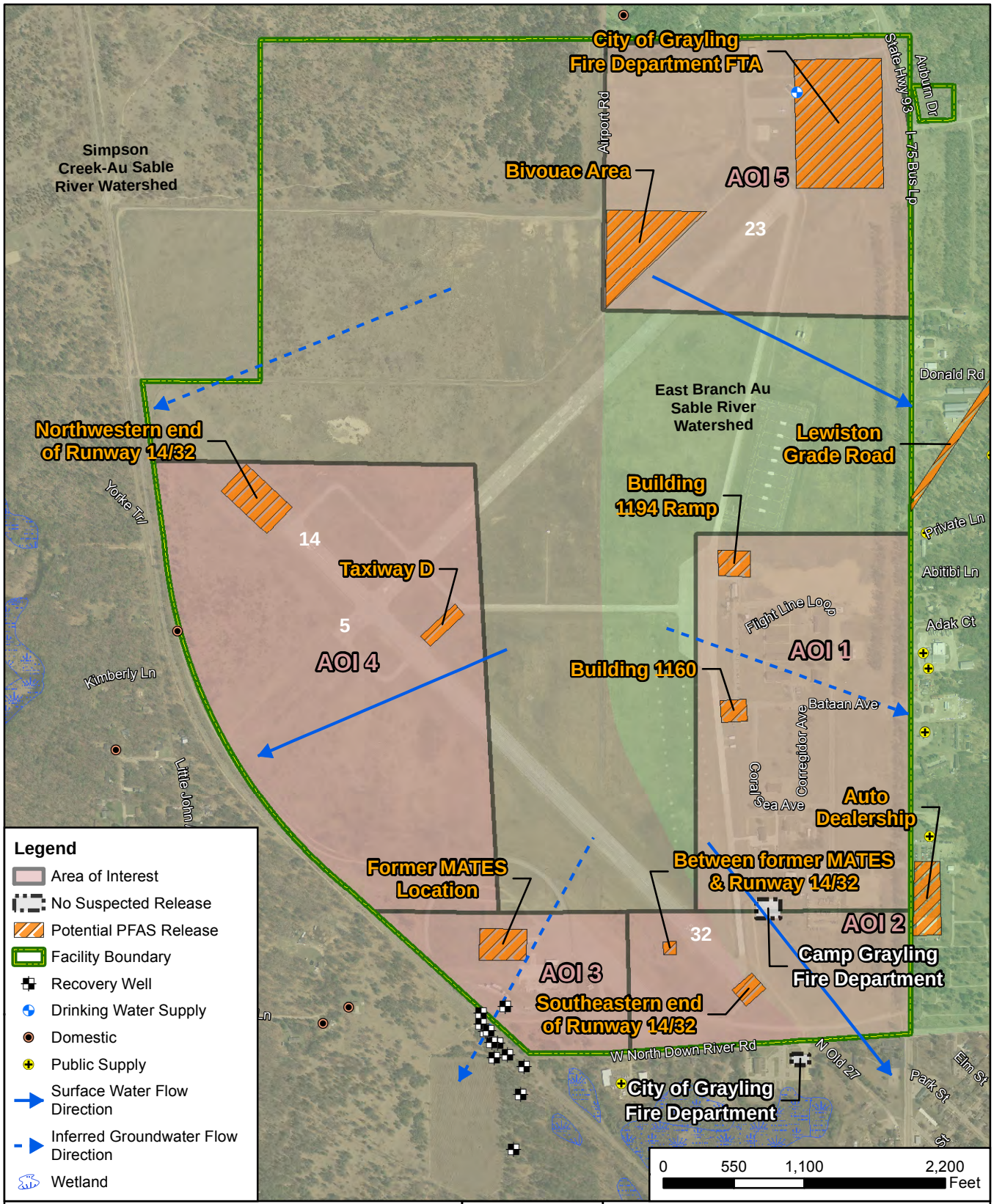
6.5 AOI 19: Howes Lake

Camp Grayling historically conducted training activities at Howes Lake; however, it is not known if such activities included fire training or required emergency response with AFFF. Because Camp Grayling firefighters reportedly used AFFF “wet water” for different applications during the 1970’s and early 1980’s, there is a possibility that AFFF may have been released. The area identified as the potential training area is sparsely vegetated with grasses and some small stands of trees. Ground-disturbing activities in the area could result in site worker, construction

worker, recreational user, and trespasser exposure to potential PFAS contamination via inhalation of dust or ingestion of surface soil. Ground-disturbing activities to subsurface soil could result in site and construction worker exposure.

The AOI is located along the southwestern shore of Howes Lake. Groundwater likely flows in a general west to southwest direction towards a large freshwater forested shrub wetland and the Manistee River. Because there is uncertainty regarding the location of training, surface water and sediment at Howes Lake may also have been affected. The ingestion exposure pathways for surface water and sediment are potentially complete for site workers, construction workers, trespassers, and recreational users of Lake Margrethe (e.g., swimming and fishing).

According to the MDEQ Wellogic database, several Type I public wells, associated with the Shawono Center, are located immediately to the east (upgradient) of the Howes Lake AOI. The closest downgradient residential wells are located approximately 1.2 miles to the west of the AOI. The ingestion exposure pathway for groundwater is potentially complete for site workers and residents at the Shawono Center. AOI 19 is shown on **Figure 6-16** and the CSM is presented on **Figure 6-17**.



CLIENT	ARNG			
NOTES	Preliminary Assessment for PFAS at Camp Grayling, MI			
REVISED	7/31/2018	GIS BY	MS	7/31/2018
SCALE	1:13,200	CHK BY	JL	7/31/2018
Base Map: Michigan Statewide Orthoimagery Program 2017		PM	RG	7/31/2018

Grayling Army Airfield Areas of Interest

AECOM
12420 Milestone Center Drive
Germantown, MD 20876

Figure 6-1

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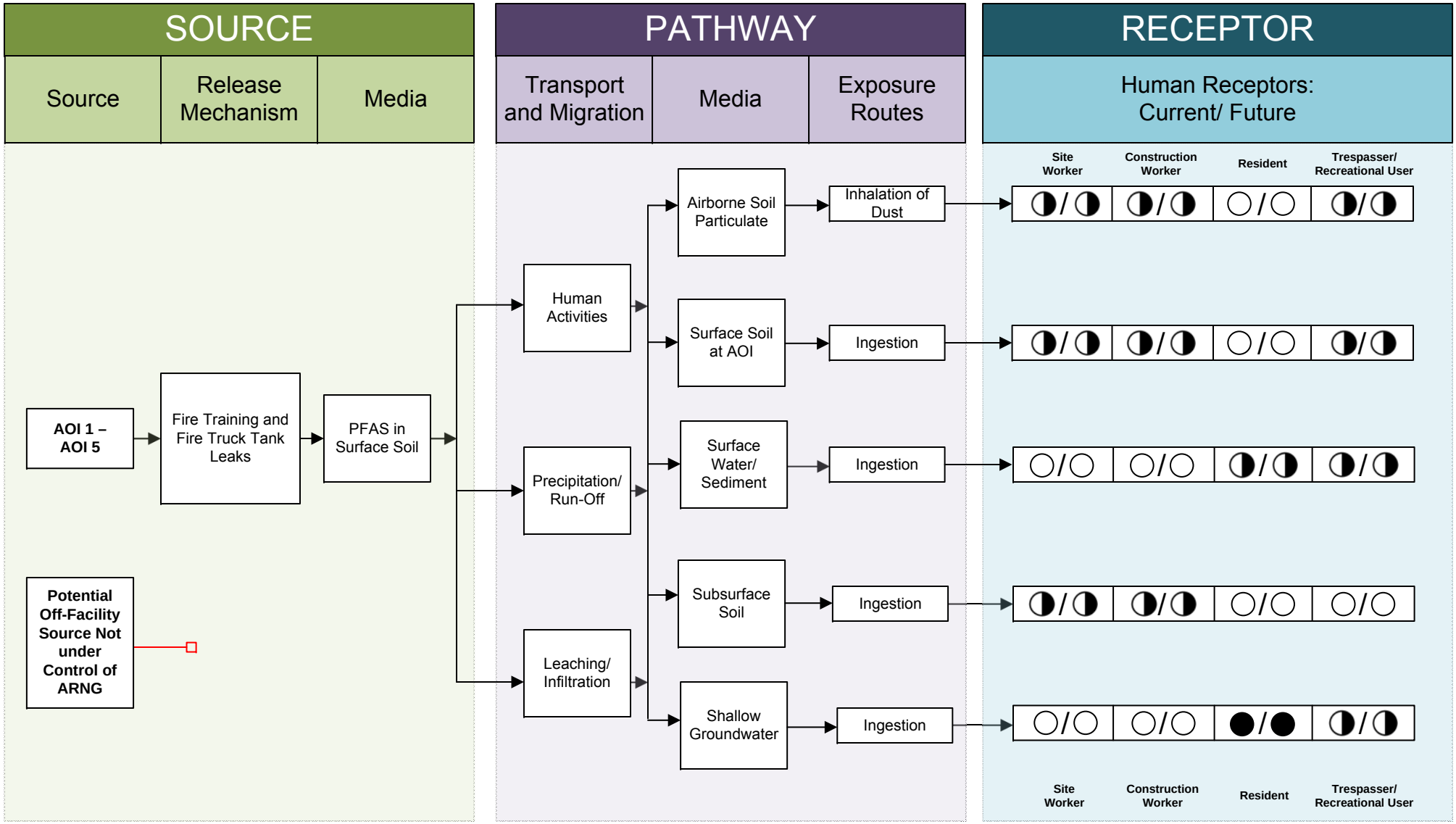
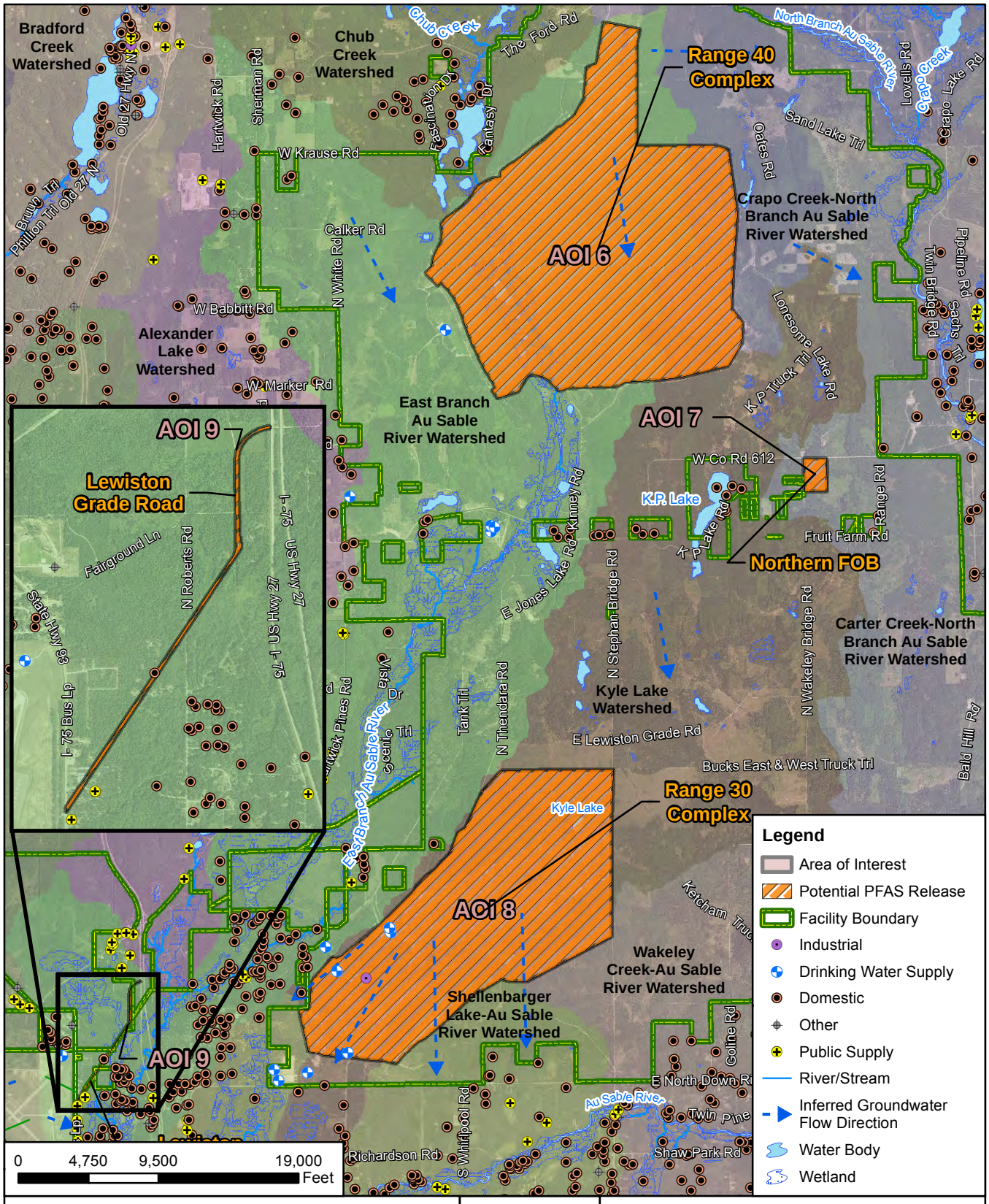


Figure 6-2
Conceptual Site Model
AOI 1-AOI 5 Grayling Army Airfield



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SCALE	1:114,000	CHK BY	JL	7/31/2018
Base Map: National Agricultural Imagery Program, 2016		PM	RG	7/31/2018

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North Post Areas of Interest

AECOM
12420 Milestone Center Drive
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Figure 6-3

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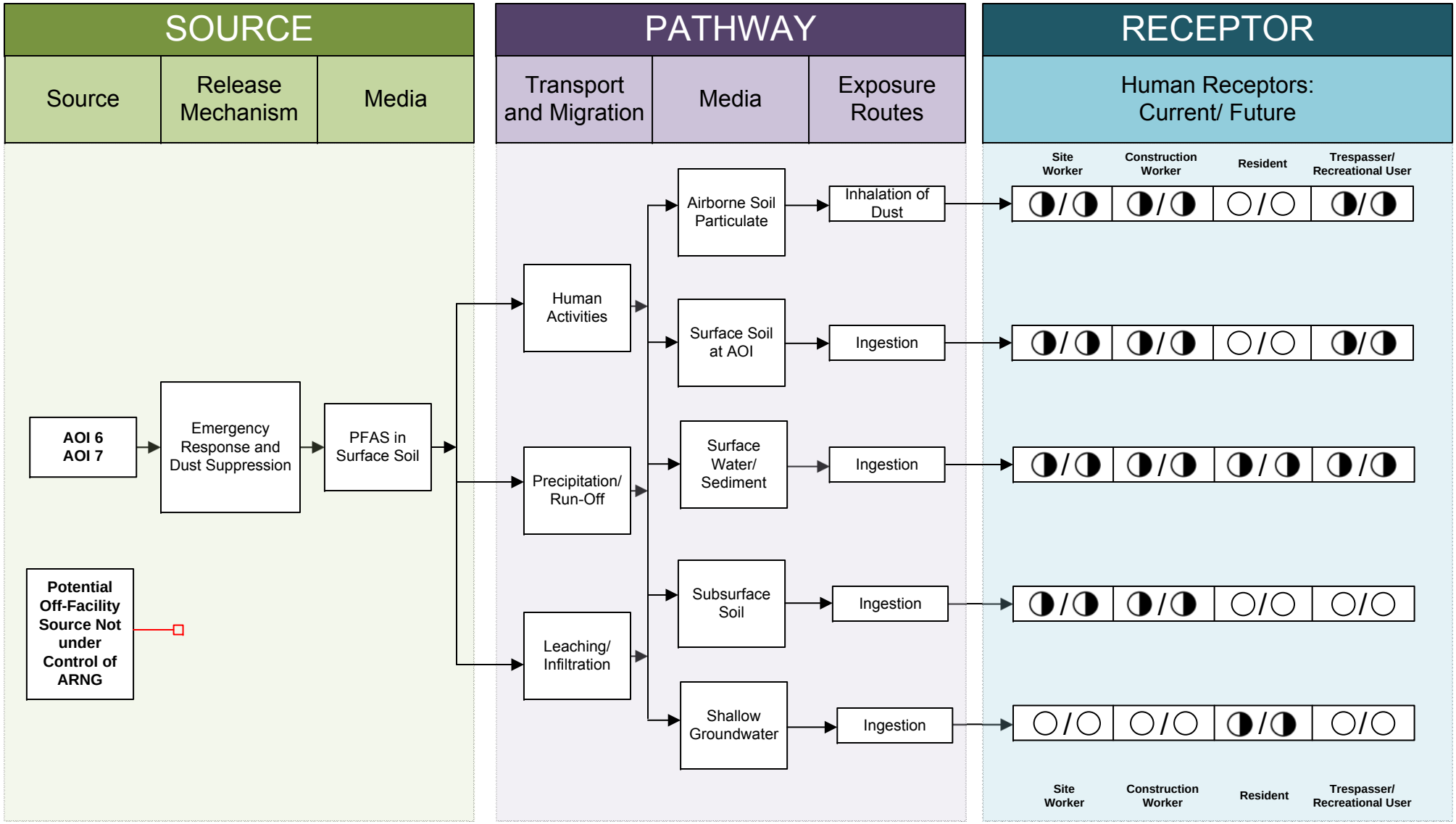

LEGEND

- Flow-Chart Stops
- Flow-Chart Continues
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- Potentially Complete Pathway
- Complete Pathway

Figure 6-4
Conceptual Site Model
AOI 6 & AOI 7 North Post

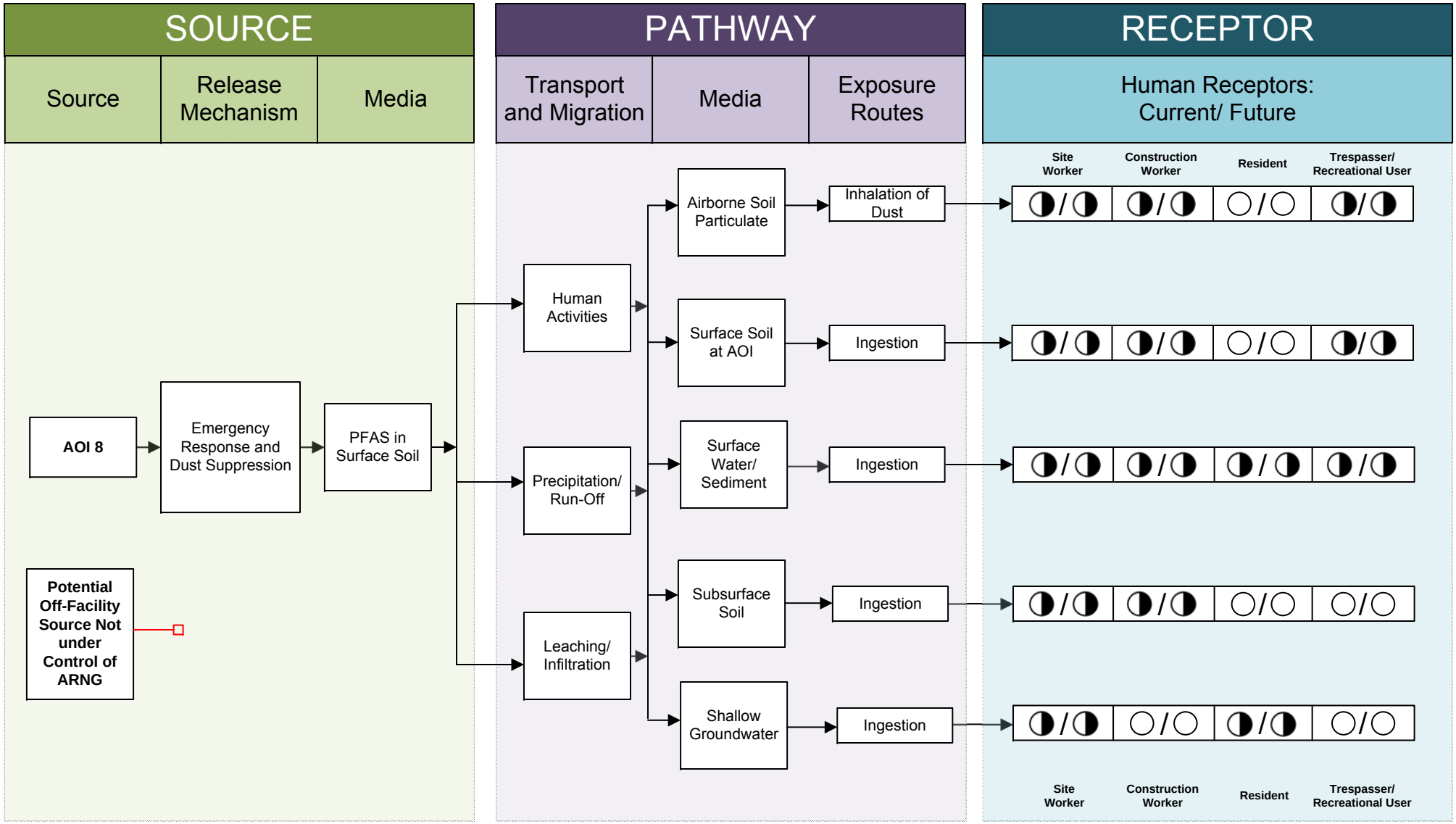

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Figure 6-5
Conceptual Site Model
AOI 8 Range 30 Complex

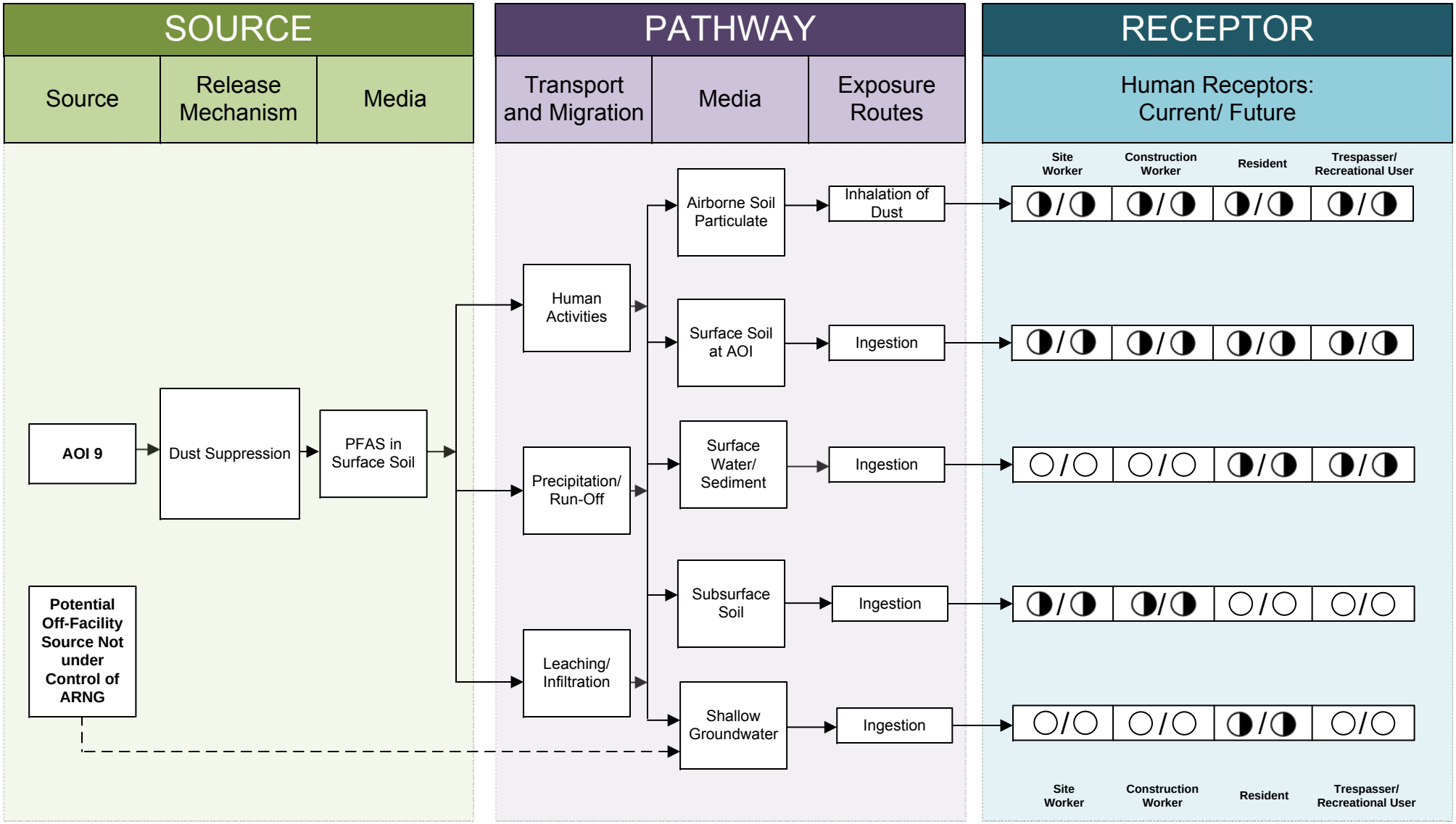

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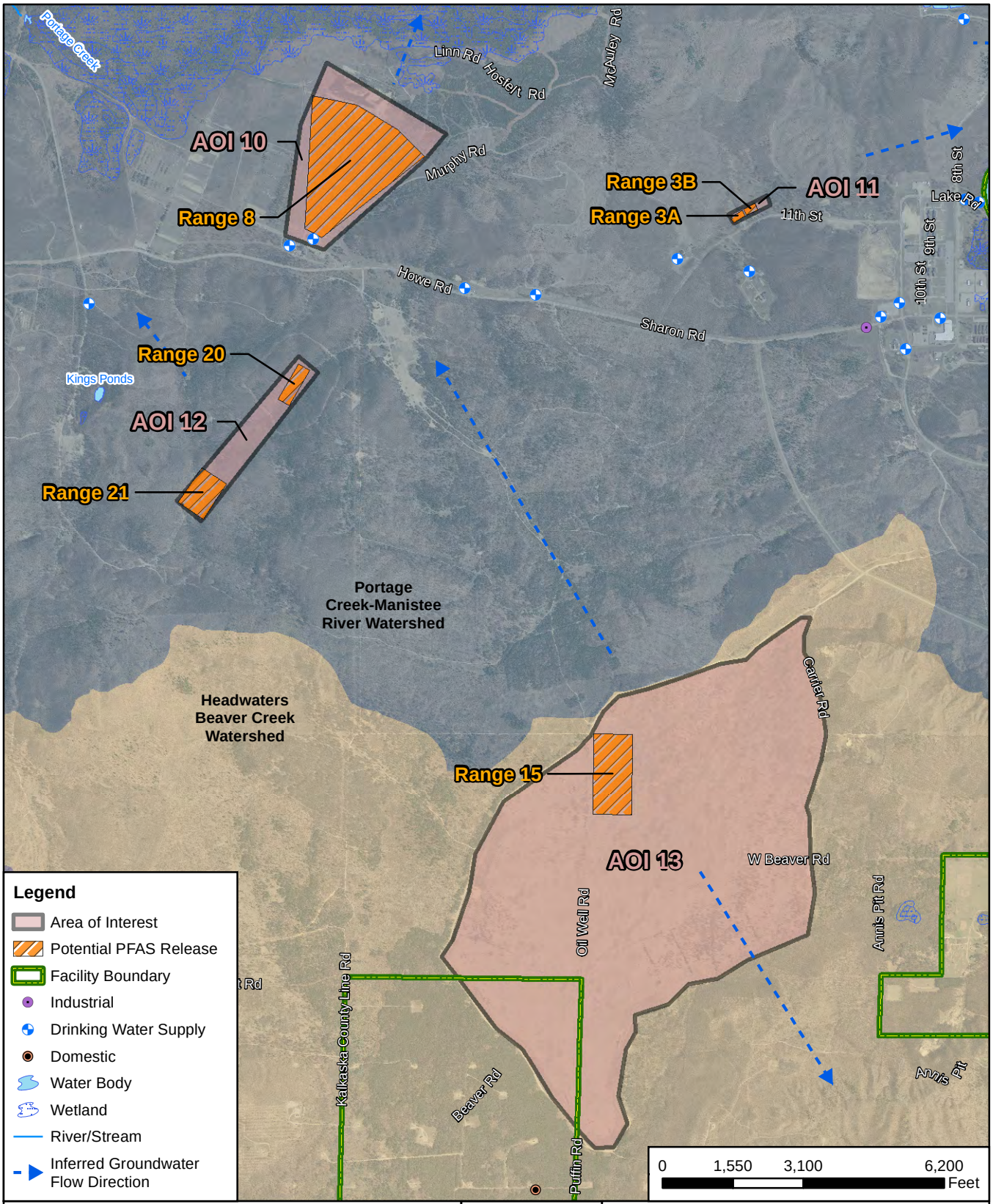
Figure 6-6
Conceptual Site Model
AOI 9 Lewiston Grade Road



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NOTES	Preliminary Assessment for PFAS at Camp Grayling, MI			
REVISED	8/7/2018	GIS BY	MS	8/7/2018
SCALE	1:37,200	CHK BY	JL	8/7/2018
Base Map: Michigan Statewide Orthoimagery Program 2017		PM	RG	8/7/2018

South Post Areas of Interest

AECOM
12420 Milestone Center Drive
Germantown, MD 20876

Figure 6-7

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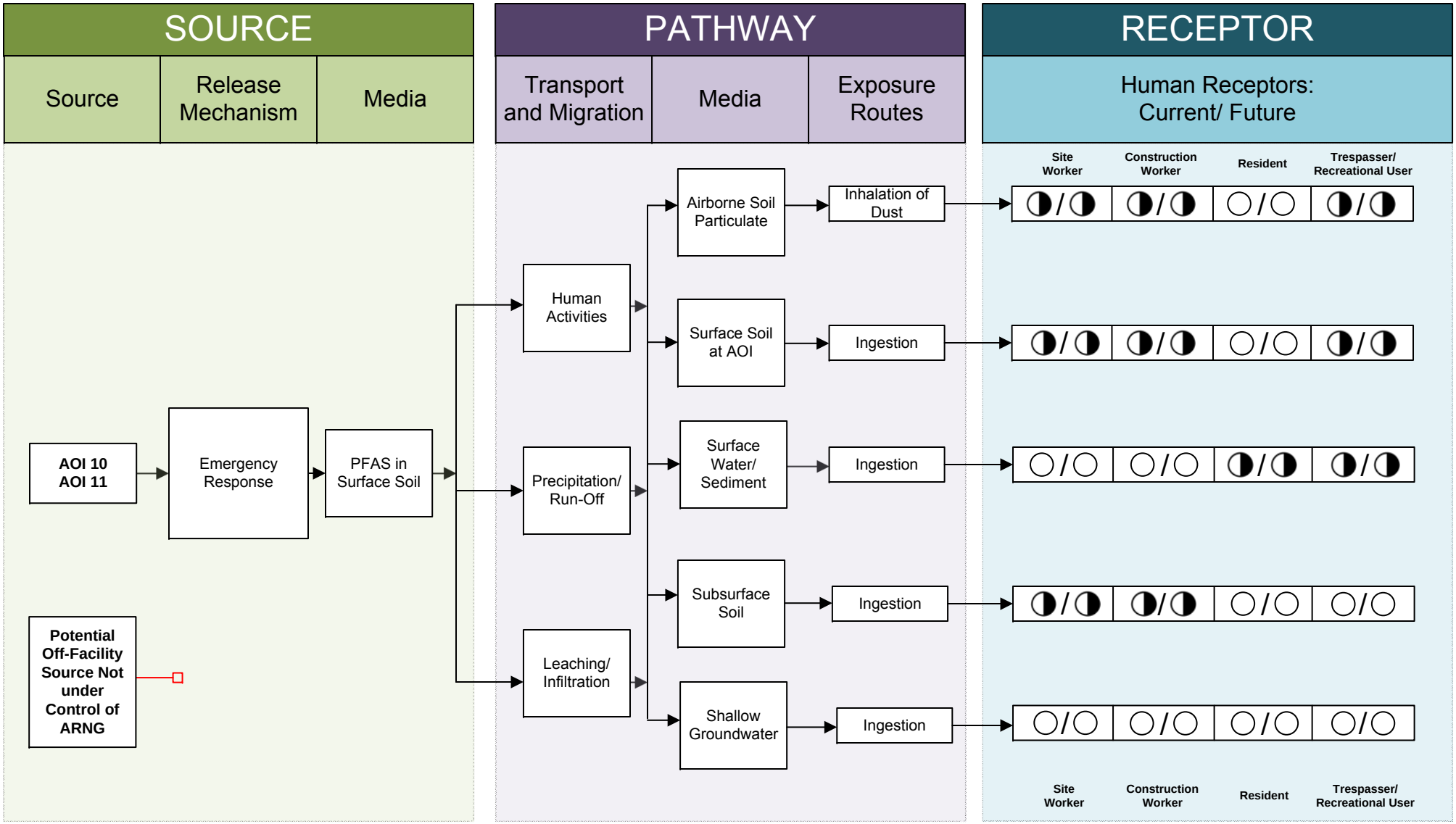

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Figure 6-8
Conceptual Site Model
AOI 10 & AOI 11 Range 8 and Small Arms Ranges

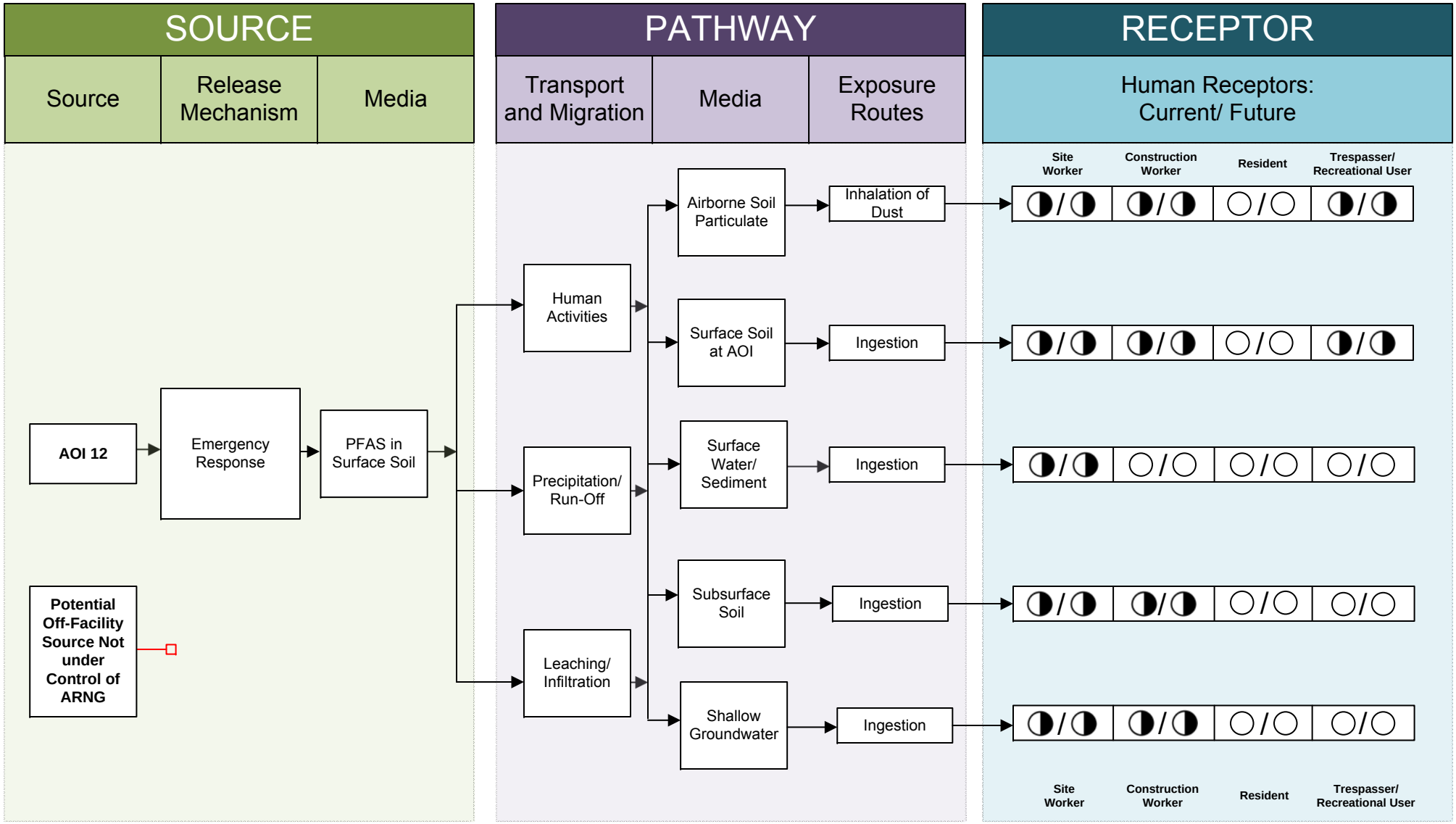

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Figure 6-9
Conceptual Site Model
AOI 12 Light Demolition Ranges

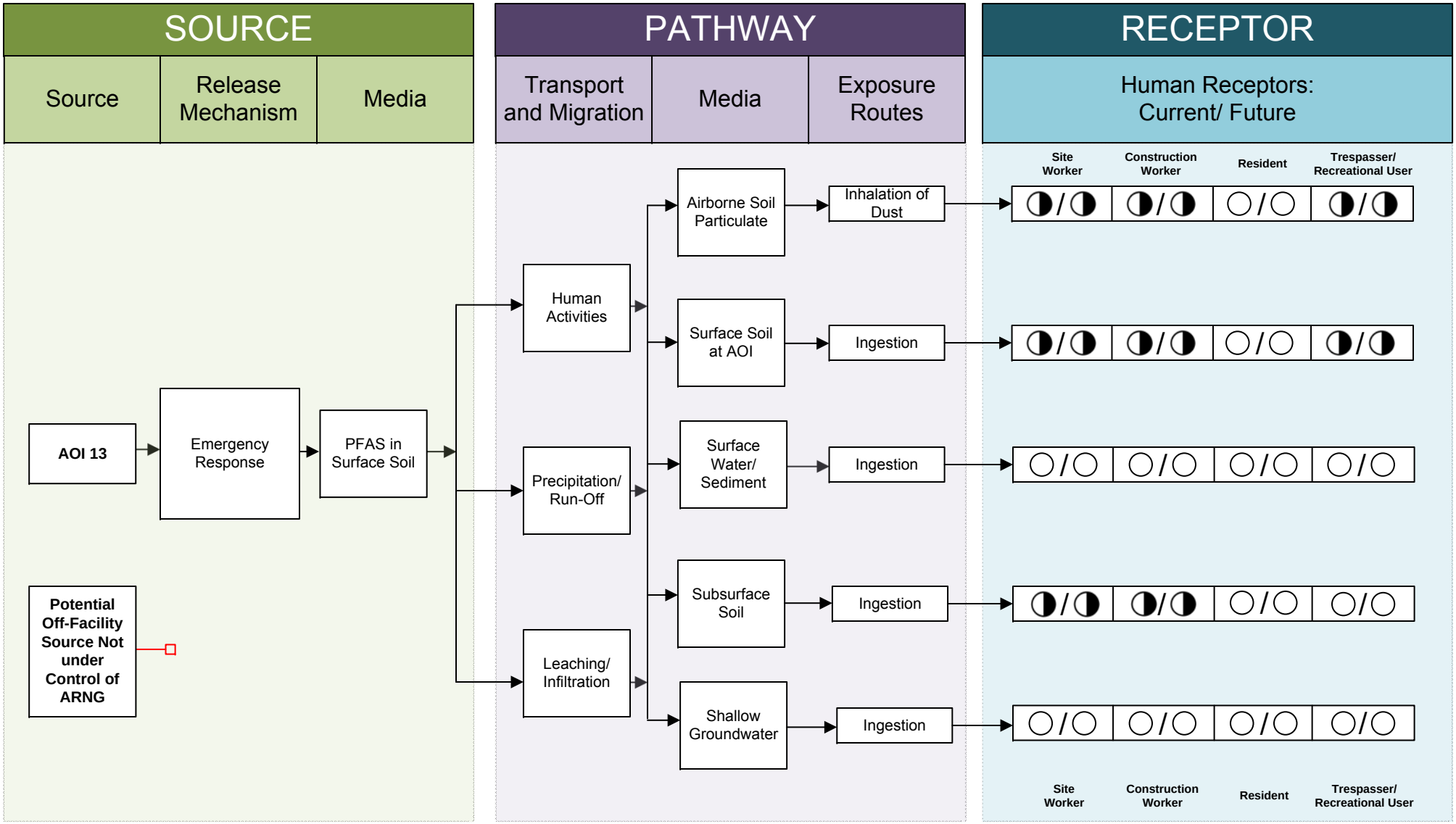

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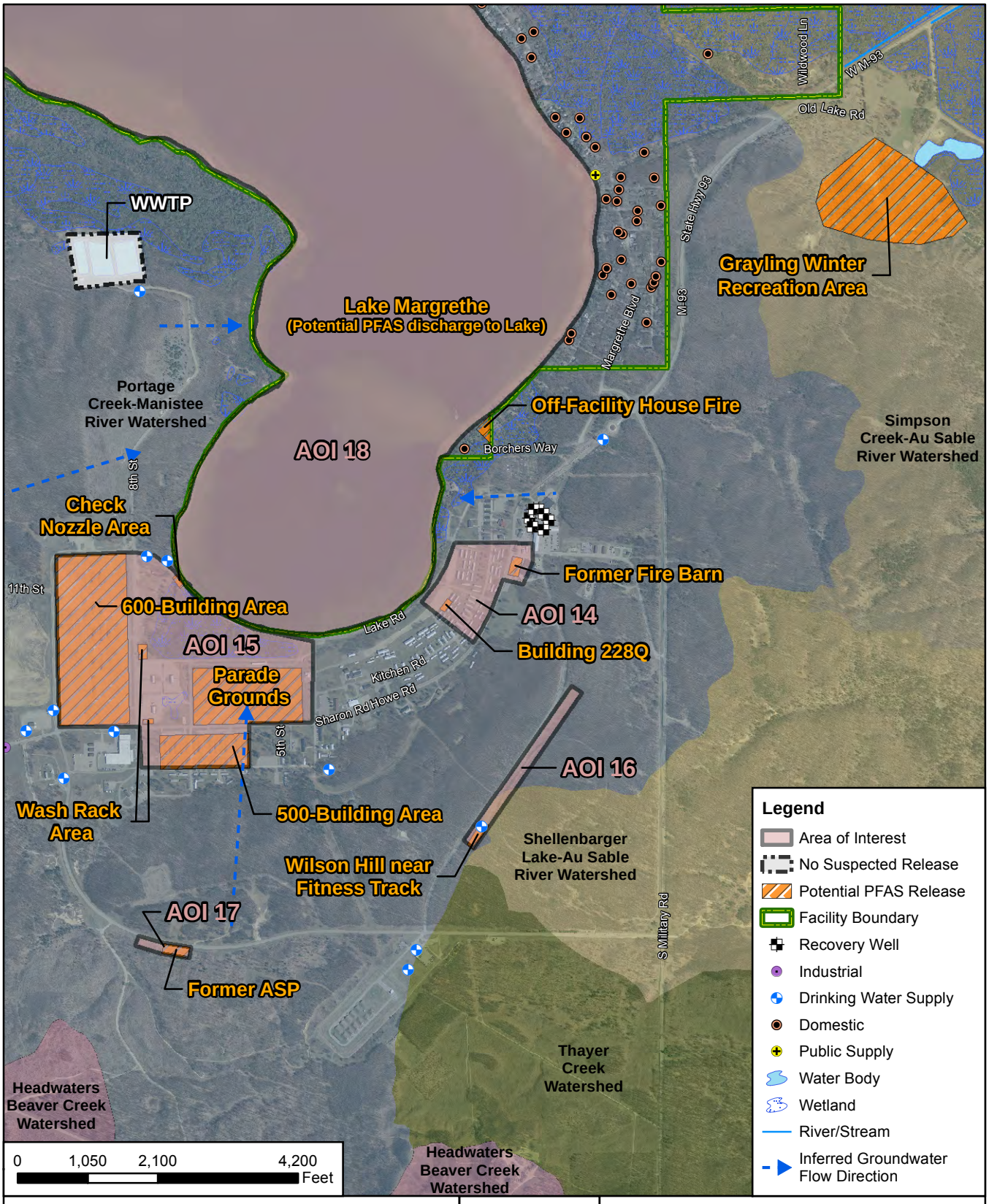
Figure 6-10
Conceptual Site Model
AOI 13 Range 15 Area



CLIENT	ARNG			
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SCALE	1:25,200	CHK BY	JL	8/6/2018
Base Map: Michigan Statewide Orthoimagery Program 2017		PM	RG	8/6/2018

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Cantonment Areas of Interest

AECOM
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Figure 6-11

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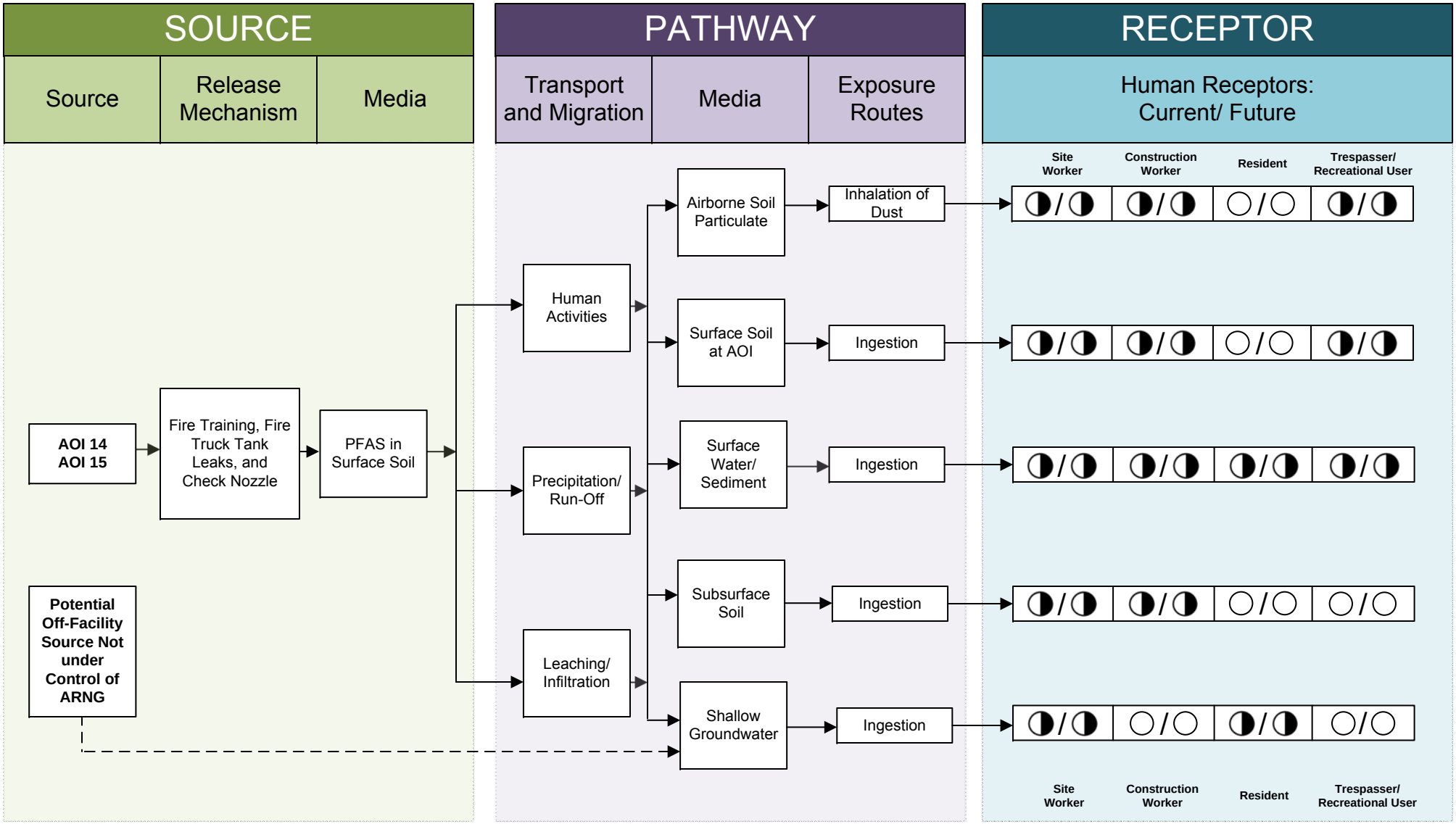

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Figure 6-12
Conceptual Site Model
AOI 14 & AOI 15 East & West Cantonment

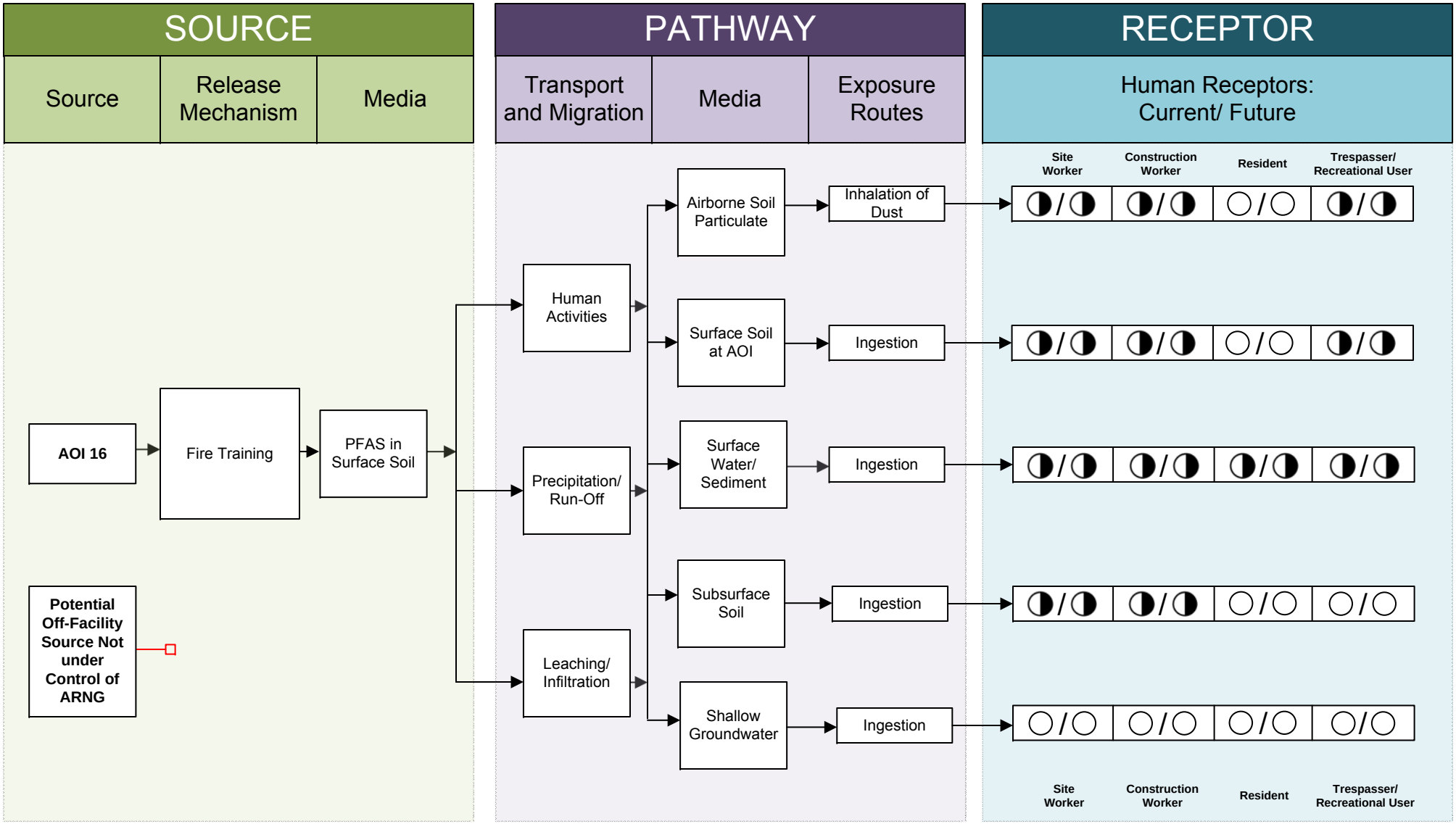

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Figure 6-13
Conceptual Site Model
AOI 16 Wilson Hill

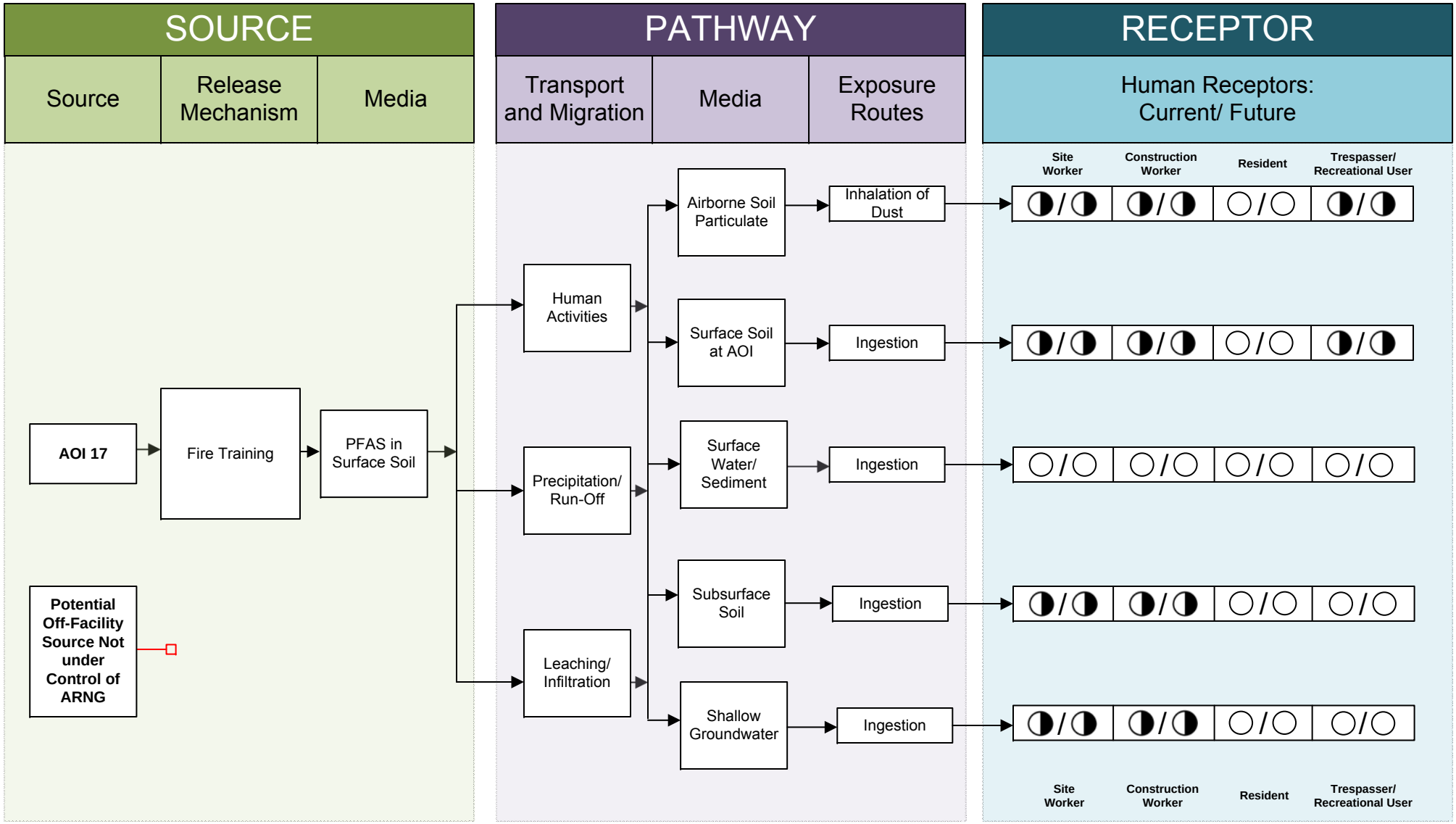

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Figure 6-14
Conceptual Site Model
AOI 17 Former Ammunition Storage Plant

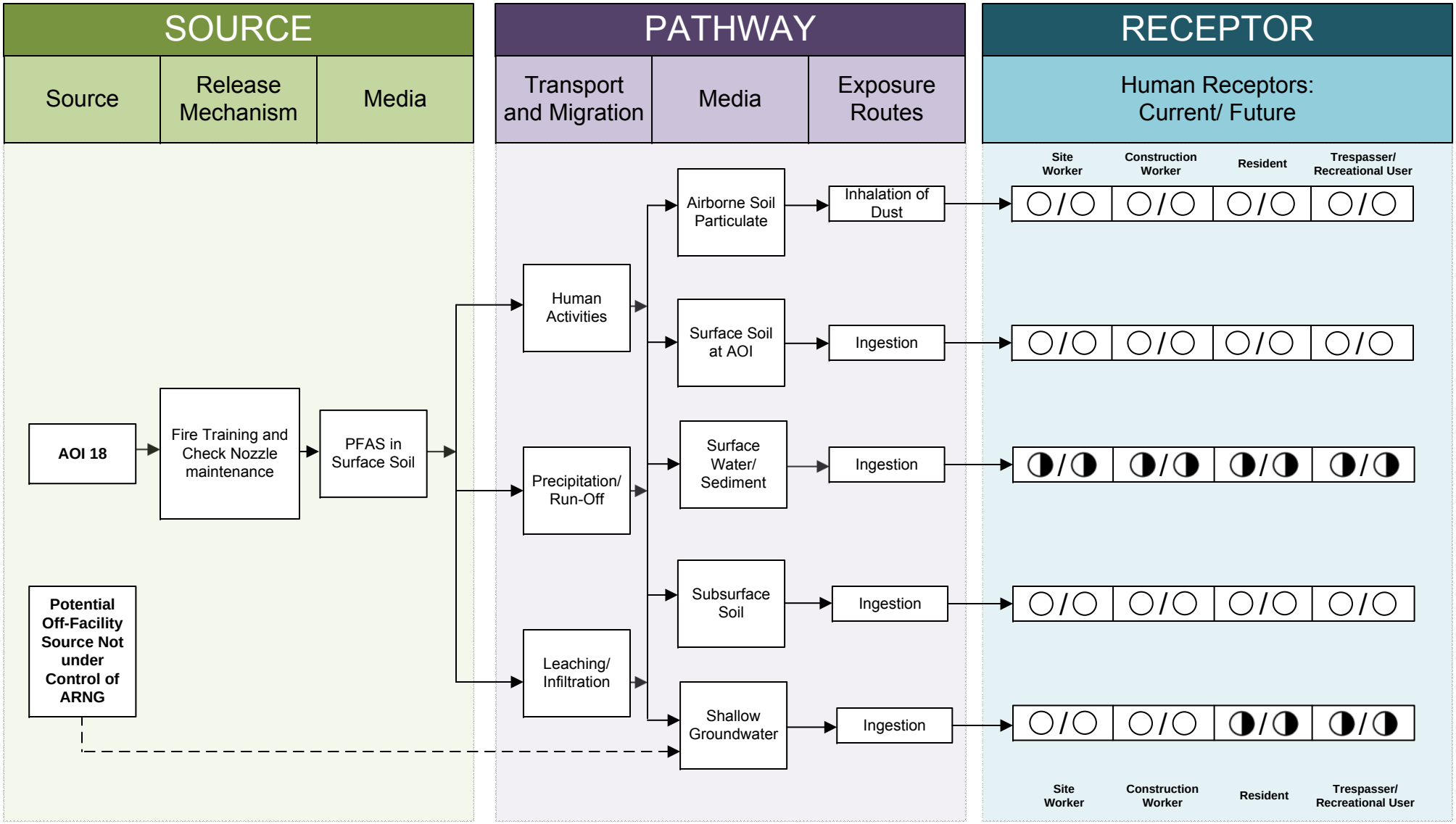
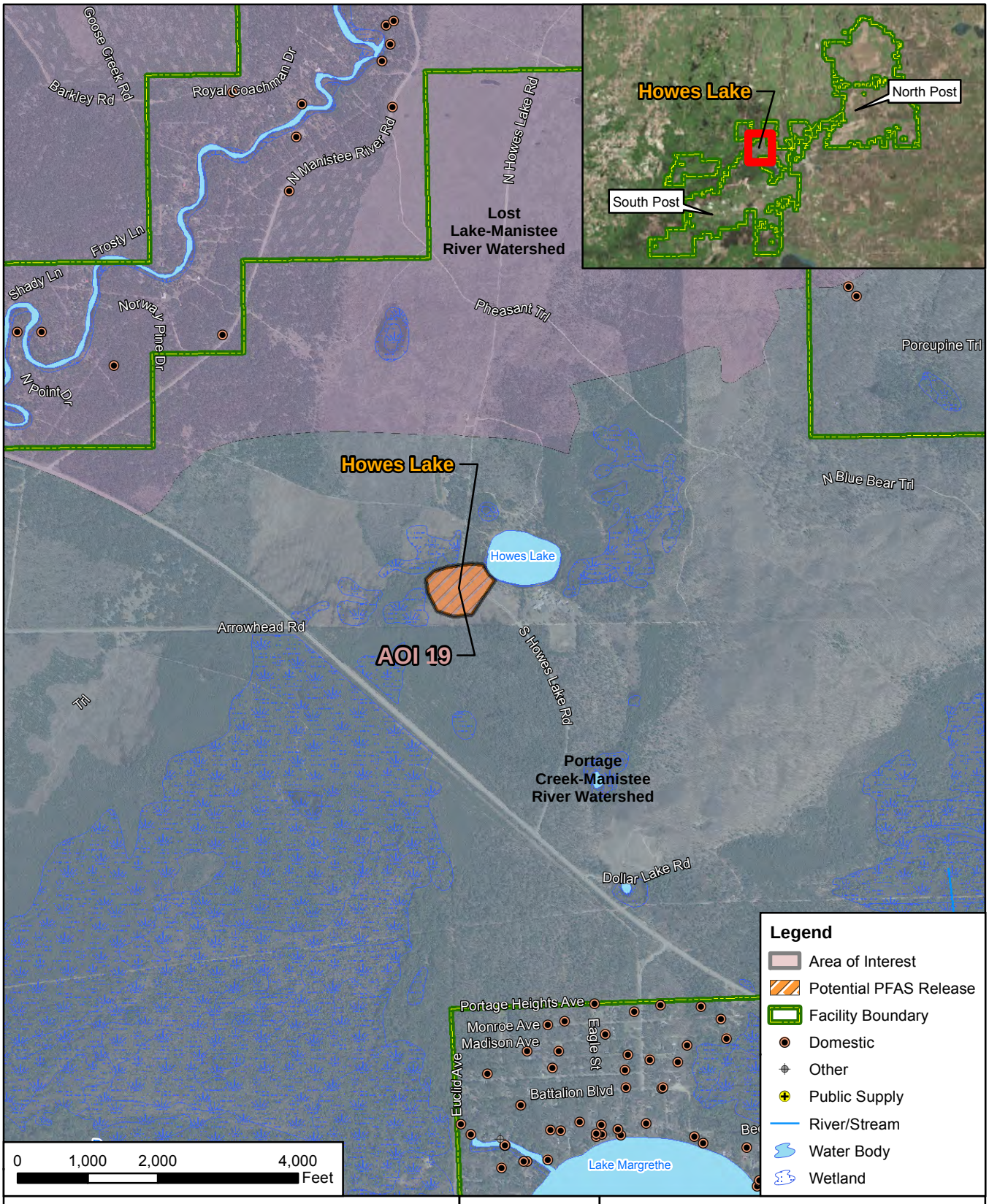


Figure 6-15
Conceptual Site Model
AOI 18 Lake Margrethe



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SCALE	1:24,000	CHK BY	JL	7/31/2018
Base Map: Michigan Statewide Orthoimagery Program 2017		PM	RG	7/31/2018

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Howes Lake Area of Interest

AECOM
12420 Milestone Center Drive
Germantown, MD 20876

Figure 6-16

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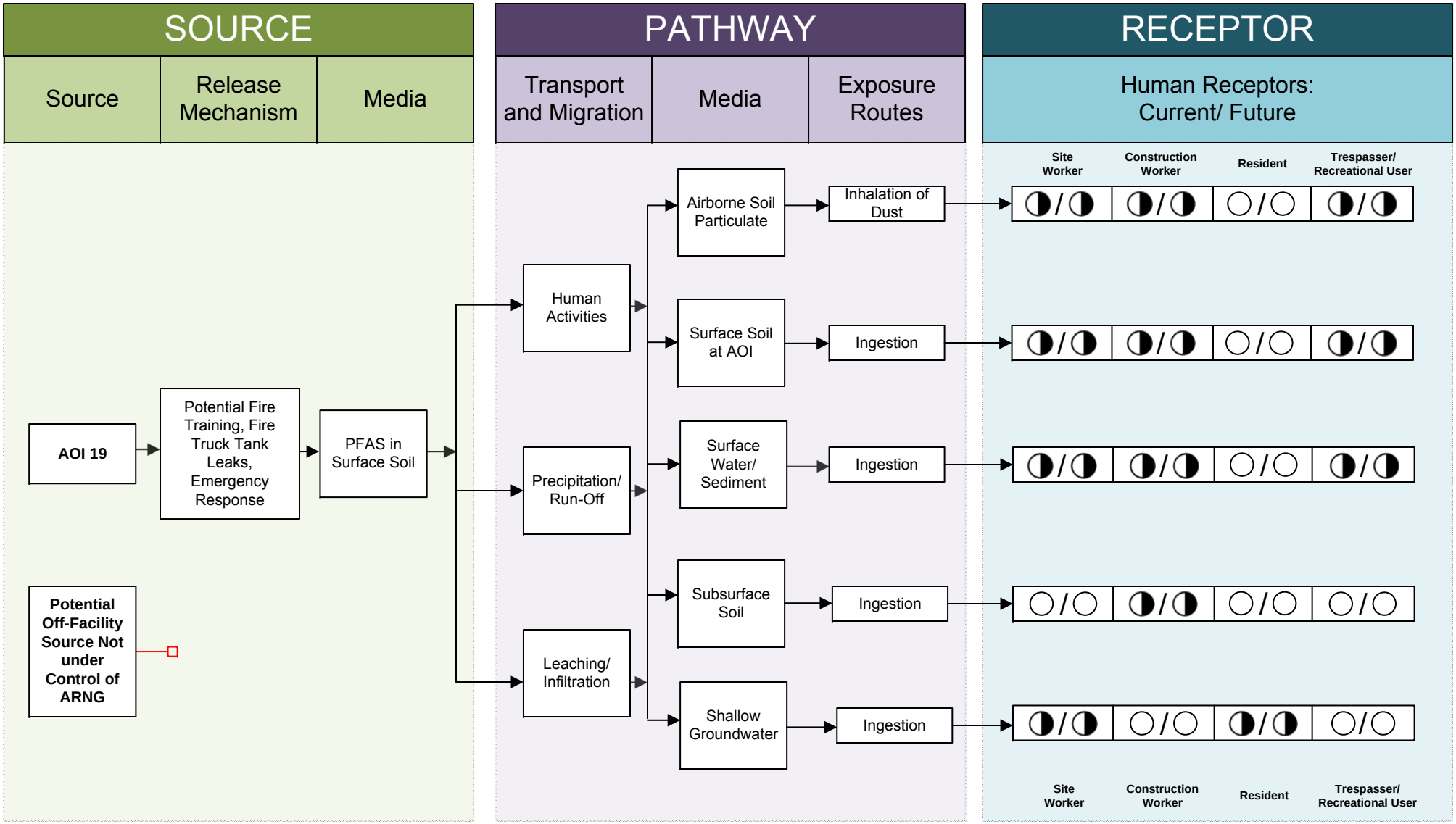

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Figure 6-17
Conceptual Site Model
AOI 19 Howes Lake

7. Conclusions

This report presents a summary of available information gathered during the PA on the use and storage of AFFF and other PFAS-related activities at Camp Grayling. The PA findings are based on the information presented in **Appendix A** and **Appendix B**.

7.1 Findings

Nineteen AOIs related to potential PFAS releases were identified at Camp Grayling during the PA. **Figures 7-1**, **7-2**, **7-3**, **7-4**, and **7-5** present a summary of PA findings.

Area of Interest	Name	Used by	Release Dates
AOI 1 – AOI 5	Grayling Army Airfield (GAAF)	Michigan ARNG (MIARNG) and City of Grayling Fire Department	Frequently during the 1970s and early 1980s
AOI 6	Range 40 Complex	MIARNG	Occasionally during the 1970s and early 1980s
AOI 7	North Forward Operating Base	MIARNG	Approximately twice per year during the 1970s and early 1980s
AOI 8	Range 30 Complex	MIARNG	Occasionally during the 1970s and early 1980s
AOI 9	Lewiston Grade Road	MIARNG	Regularly during summer training in the 1970s and early 1980s
AOI 10	Range 8 – Multipurpose Machine Gun Range	MIARNG	As needed during the 1970s and early 1980s
AOI 11	Small Arms Ranges	MIARNG	As needed during the 1970s and early 1980s
AOI 12	Light Demolition Ranges	MIARNG	As needed during the 1970s and early 1980s
AOI 13	Range 15 Area	MIARNG	As needed during the 1970s and early 1980s
AOI 14	East Cantonment	MIARNG	Frequently during the 1970s and early 1980s
AOI 15	West Cantonment	MIARNG	Frequently during the 1970s and early 1980s
AOI 16	Wilson Hill	MIARNG	Occasionally during training in the 1970s and early 1980s
AOI 17	Former Ammunition Storage Plant	MIARNG	Early 1980s

Area of Interest	Name	Used by	Release Dates
AOI 18	Lake Margrethe	MIARNG	Regularly during the1970s and early 1980s
AOI 19	Howes Lake	MIARNG	Unknown

Three potential off-facility sources of PFAS were considered in the local area surrounding Camp Grayling. These include:

- An automotive dealership to the east of GAAF – may conduct waterproofing activities which may involve PFAS-containing chemicals
- The City of Grayling Fire Department to the south of GAAF – stored a small amount of AFFF for City use and support of Camp Grayling, no reported spills or releases
- Grayling Winter Recreation Area located to the east of the cantonment – ski and snowboard wax is a known source of PFAS
- Off-Facility House Fire – a private residence located adjacent to the main gate of the Camp Grayling cantonment burned down and may have been extinguished with AFFF

Based on the potential AFFF releases documented at Camp Grayling during the PA, there is potential for exposure to PFAS contamination in soil, groundwater, surface water, and sediment for the following potential receptors: site workers (e.g., Camp Grayling military and non-military staff and visitors), onsite construction workers, trespassers, and recreational users. In addition, residents using groundwater for drinking water surrounding the facility may potentially be exposed to migrating PFAS contamination via the nearby groundwater pathway. For GAAF and Lake Margrethe, the groundwater ingestion pathway is complete for off-facility residents. Receptors are less likely to be exposed to potential PFAS contamination through direct contact with soil and inhalation via air; however, some PFAS chemicals are water soluble and can migrate readily from soil to groundwater or surface water via leaching and run-off. Therefore, there is a potential for PFAS contamination in soil to migrate to groundwater and surface water systems.

7.2 Uncertainty

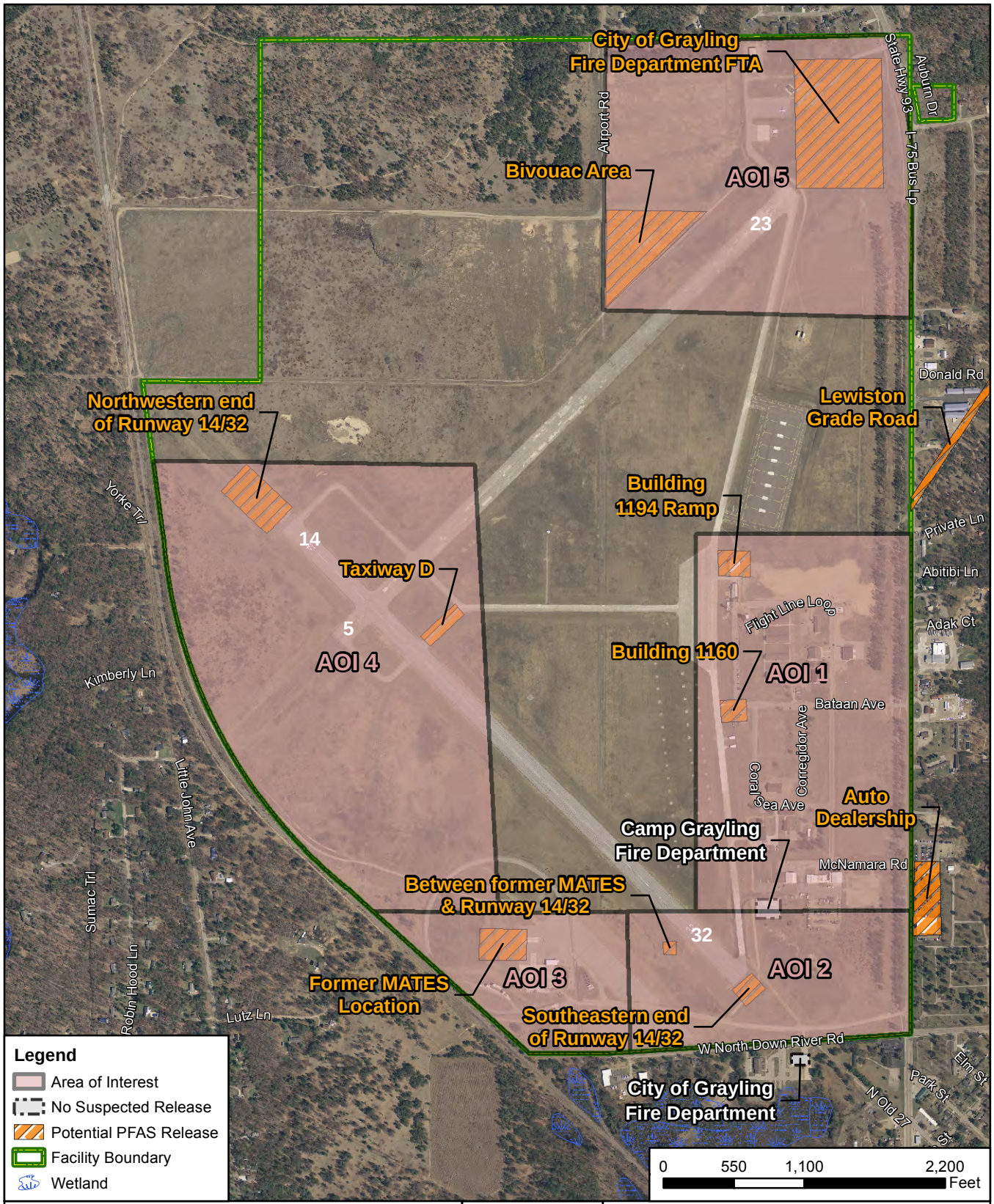
A number of information sources were investigated during this PA to determine the potential for PFAS-containing materials to have been present, used, or released at the facility. Historically, documentation of PFAS use was not required because PFAS were considered benign. Therefore, records were not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

The conclusions of this PA are predominantly based on the information provided during interviews with personnel who had direct knowledge of PFAS use at the facility. Sometimes the provided information was vague or conflicted with other sources. Gathered information has a degree of uncertainty due to the absence of written documentation, the limited number of personnel with direct knowledge due to staffing changes, the time passed since PFAS was first used (early 1970's), and a reliance on personal recollection. Inaccuracies may arise in potential PFAS release locations, dates of release, volume of releases, and the concentration of AFFF used. There is also a possibility the PA has missed a potential source of PFAS, as the science of how PFAS may enter the environment continually evolves.

In order to minimize the level of uncertainty, readily available data regarding the use and storage of PFAS were reviewed, retired and current personnel were interviewed, multiple persons were interviewed for the same potential source area, and potential source areas were visually inspected.

The following table summarizes the uncertainties associated with this PA:

Area of Interest	Source of Uncertainty
All AOIs	No information was available on the type, amount, and concentration of AFFF used at each AOI. Exact dates and frequency of potential releases were also not recalled. Camp Grayling interviewees did not recall the type or brand of firefighting foam historically used; it is not known if the generic use of the term “foam” by interviewees may have, in some instances, been in reference to AFFF or other non-PFAS containing firefighting foams or wetting agents.
AOI 1- AOI 5: GAAF	Exact locations of potential PFAS releases were not recalled during interviews.
AOI 5: Bivouac Area	Initial interviews identified a large, general area where the Bivouac area may have been within GAAF. The location where fire trucks were stationed on stand-by was later recalled by a former Camp Grayling firefighter within a smaller, adjacent area. No other interviewees recalled where the trucks were stationed.
AOI 5: City of Grayling Fire Department FTA	A former Camp Grayling firefighter recalled a City of Grayling Fire Department FTA at the northern end of runway 5/23; however, it was not known if AFFF was used during the training and no other interviewees recalled this location or potential release.
AOI 7 & 9: North FOB & Lewiston Grade Road	The exact location and extent of potential release was not recalled by interviewees.
AOI 8 & 9: Range 30 & 40 Complex AOI 10, 11,12, & 13: South Post Ranges	The exact locations where ERAs where within the range complexes was not recalled, nor was if AFFF “wet water” or water only was used.
AOI 14: Building 228Q	Building 228Q was identified as a potential release area based on a photograph provided by a former Camp Grayling firefighter. It is not known if AFFF was used.
AOI 16: Wilson Hill near Fitness Track	AOI 16 was identified as a FTA by interviewees and from photographs; however, exact locations of fire training activities were not recalled by interviewees.
AOI 19: Howes Lake	Interviewees did not recall if general training activities at Howes Lake included fire training or fire response with AFFF. Exact locations of training were also not known.



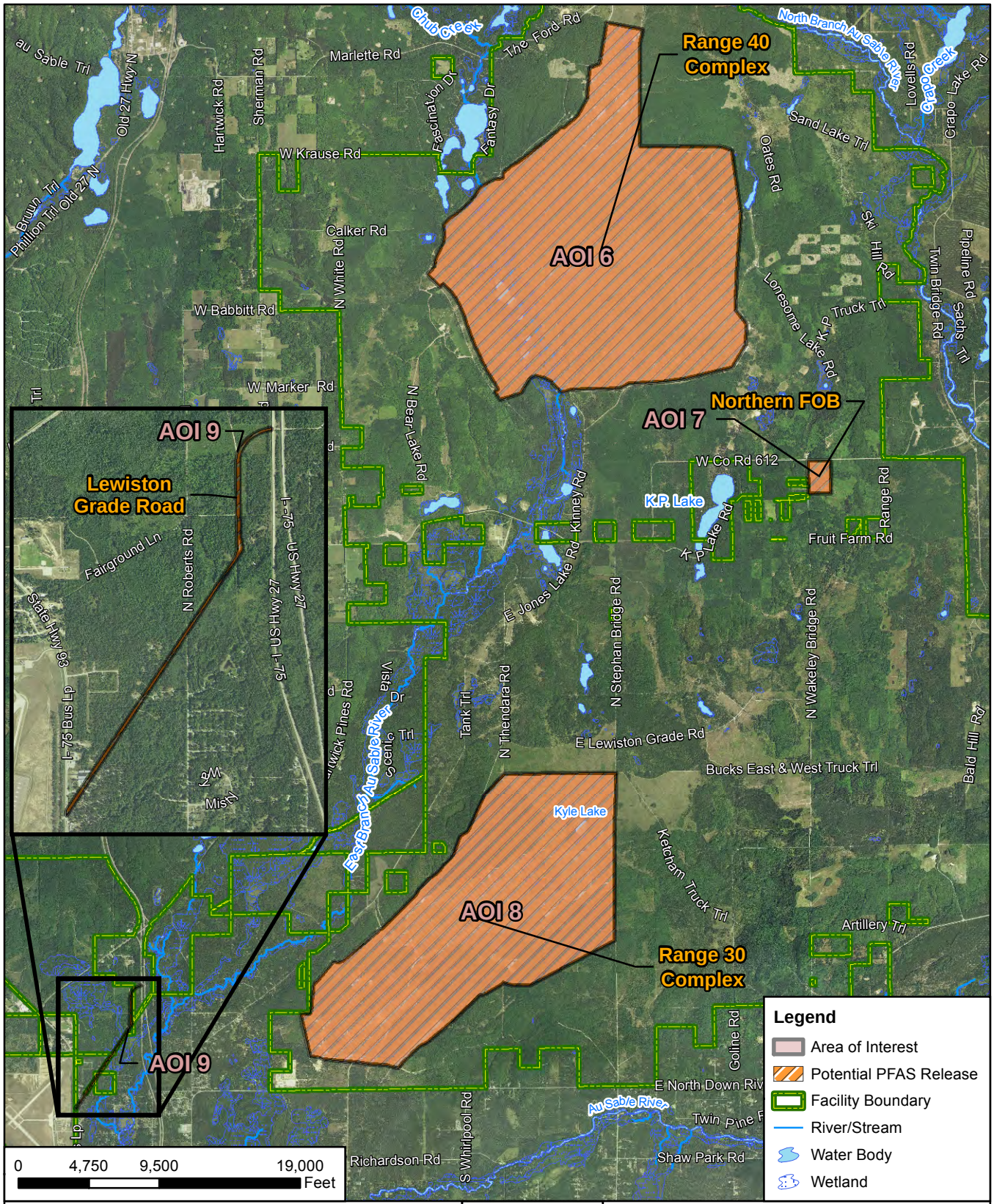
CLIENT	ARNG			
NOTES	Preliminary Assessment for PFAS at Camp Grayling, MI			
REVISED	7/31/2018	GIS BY	MS	7/31/2018
SCALE	1:13,200	CHK BY	JL	7/31/2018
Base Map: Michigan Statewide Orthoimagery Program 2017		PM	RG	7/31/2018

Grayling Army Airfield
Summary of Findings

AECOM
12420 Milestone Center Drive
Germantown, MD 20876

Figure 7-1

Q:\Projects\ENV\GEARS\GEO\ARNG PFAS\900-CAD-GIS\920-GIS or Graphics\MXD\MI\Grayling\PA_Figures\Fig_7-1_Grayling_Army_Airfield_Summary.mxd



CLIENT	ARNG			
NOTES	Preliminary Assessment for PFAS at Camp Grayling, MI			
REVISED	7/31/2018	GIS BY	MS	7/31/2018
SCALE	1:114,000	CHK BY	JL	7/31/2018
Base Map: National Agricultural Imagery Program, 2016		PM	RG	7/31/2018

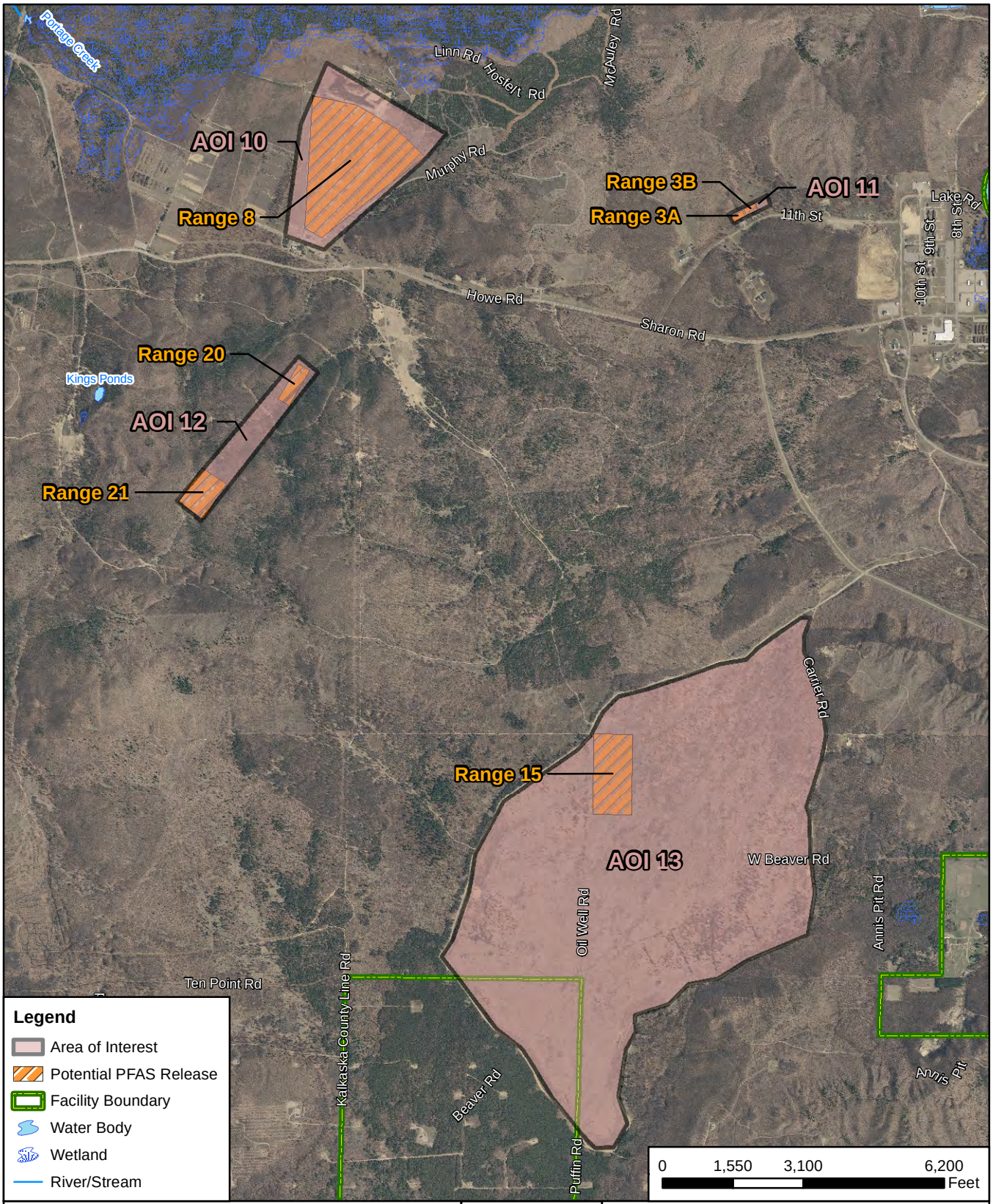
N

North Post Summary of Findings

AECOM
12420 Milestone Center Drive
Germantown, MD 20876

Figure 7-2

Q:\Projects\ENV\GEARS\GEO\ARNG PFAS\900-CAD-GIS\920-GIS or Graphics\MXD\MI\Grayling\PA_Figures\Fig_7-2_Grayling_North_Post_Summary.mxd



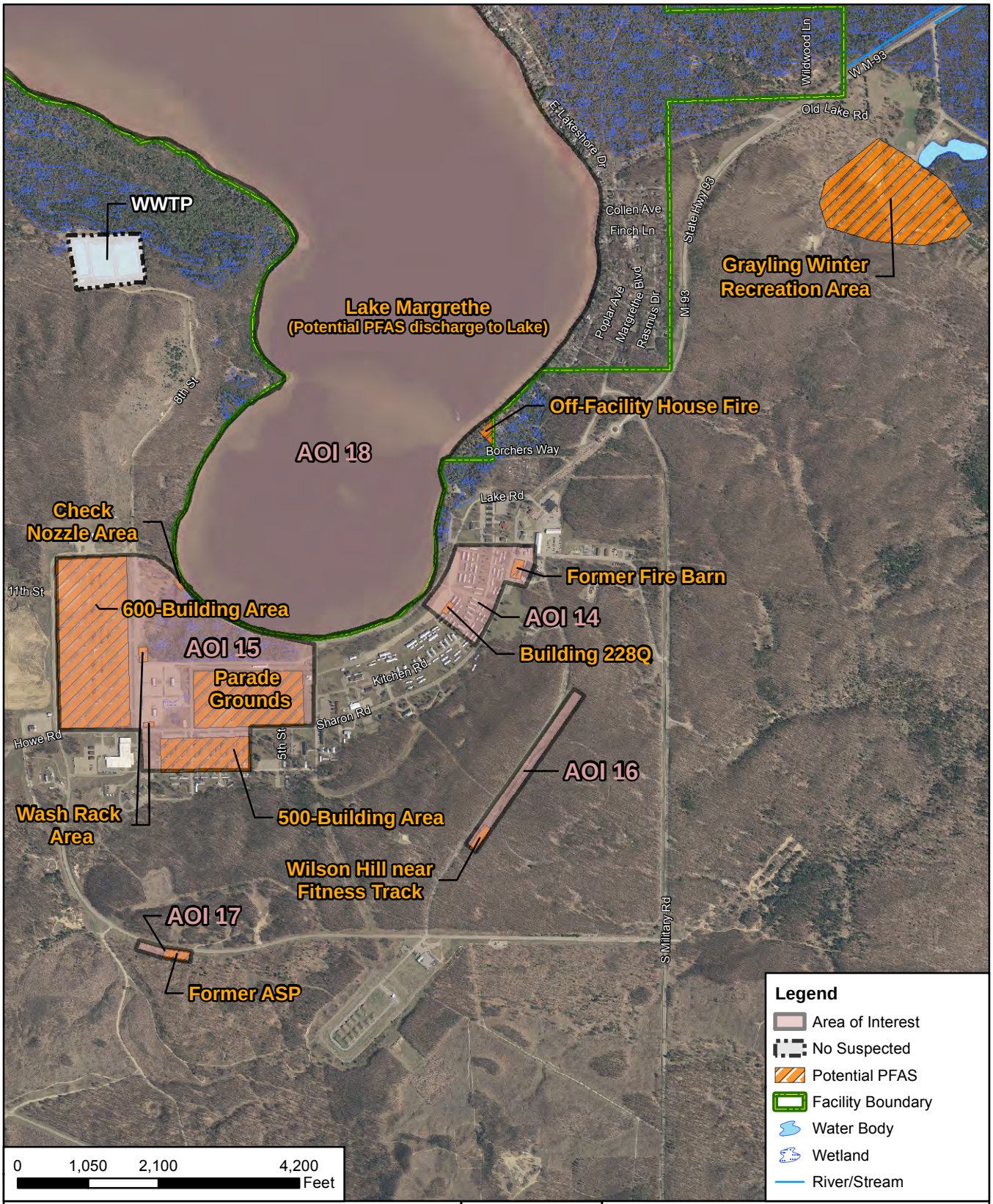
CLIENT	ARNG			
NOTES	Preliminary Assessment for PFAS at Camp Grayling, MI			
REVISED	8/7/2018	GIS BY	MS	8/7/2018
SCALE	1:37,200	CHK BY	JL	8/7/2018
Base Map: Michigan Statewide Orthoimagery Program 2017		PM	RG	8/7/2018

South Post Summary of Findings

AECOM
12420 Milestone Center Drive
Germantown, MD 20876

Figure 7-3

Q:\Projects\ENV\GEARS\GEO\ARNG PFAS\900-CAD-GIS\920-GIS or Graphics\MXD\MI\Grayling\PA_Figures\Fig_7-3_Grayling_South_Post_Summary.mxd



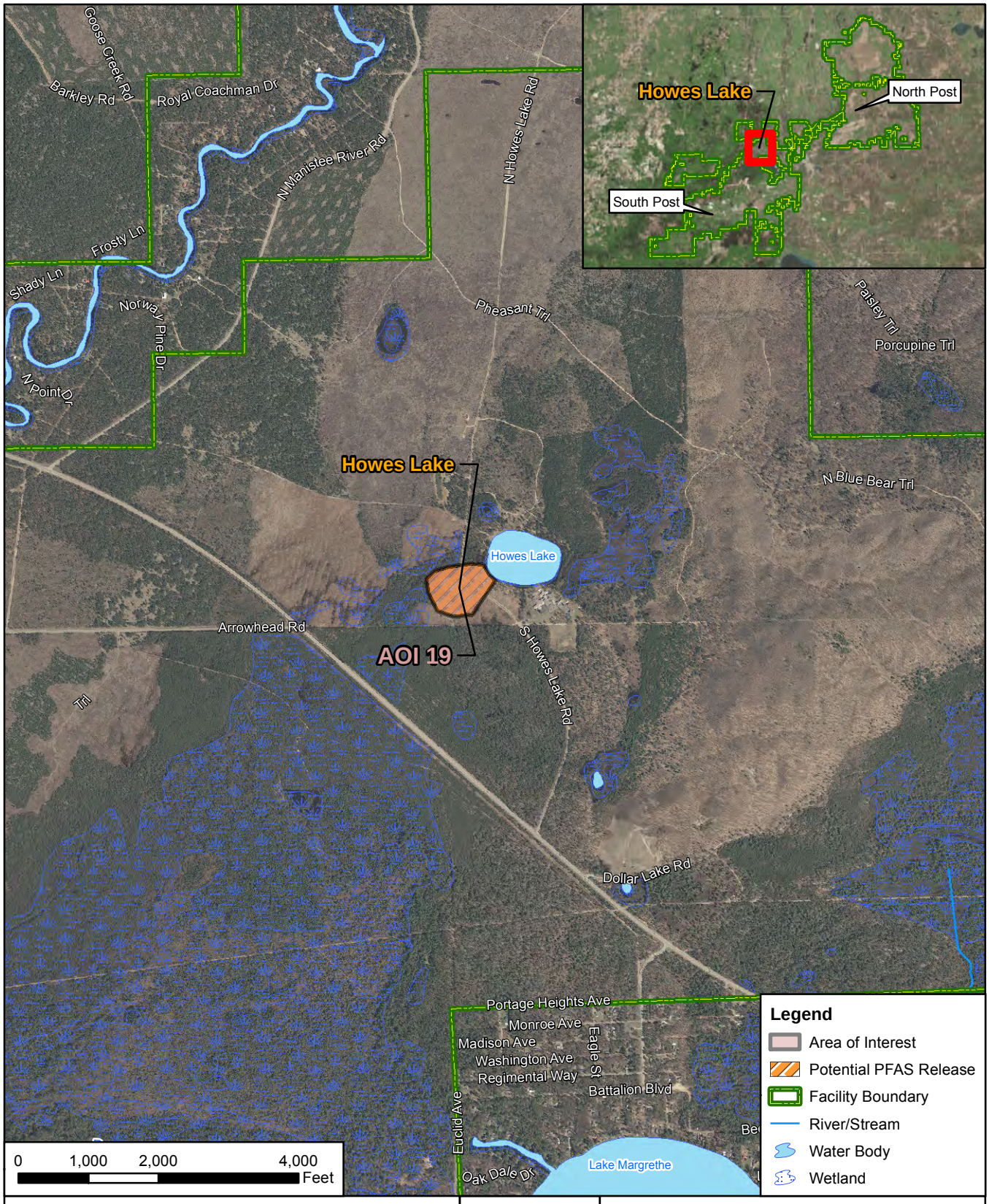
CLIENT	ARNG			
NOTES	Preliminary Assessment for PFAS at Camp Grayling, MI			
REVISED	8/6/2018	GIS BY	MS	8/6/2018
SCALE	1:25,200	CHK BY	JL	8/6/2018
Base Map: Michigan Statewide OrthoImagery Program 2017		PM	RG	8/6/2018

Cantonment Summary of Findings

AECOM
12420 Milestone Center Drive
Germantown, MD 20876

Figure 7-4

Q:\Projects\ENV\GEARS\GEO\ARNG PFAS\900-CAD-GIS\920-GIS or Graphics\MXD\MI\Grayling\PA_Figures\Fig_7-4_Grayling_Cantonment_Summary.mxd



CLIENT	ARNG			
NOTES	Preliminary Assessment for PFAS at Camp Grayling, MI			
REVISED	7/31/2018	GIS BY	MS	7/31/2018
SCALE	1:24,000	CHK BY	JL	7/31/2018
Base Map: Michigan Statewide Orthoimagery Program 2017		PM	RG	7/31/2018

N

Howes Lake Summary of Findings

AECOM
12420 Milestone Center Drive
Germantown, MD 20876

Figure 7-5

Q:\Projects\ENV\GEARS\GEO\ARNG PFAS\900-CAD-GIS\920-GIS or Graphics\MXD\MI\Grayling\PA_Figures\Fig_7-5_Grayling_Howes_Lake_Summary.mxd

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Appendix A
Data Resources

Data Resources will be provided separately on CD. Data Resources for Camp Grayling include:

Camp Grayling AFFF Release Documentation

- 2018 Interview List Correspondence and GIS Data Request
- 2018 AFFF Release Maps

Camp Grayling Firefighting Training Documentation

- Photographs provided by former Camp Grayling Firefighter Kim Halstead, annotated by Kimberly Bolan, Camp Grayling Environmental Quality Specialist

Previous Investigations Completed at Camp Grayling

- 2007 Integrated Natural Resources Management Plan
- 2013 Operational Range Assessment, Phase II Report
- 2017 PFCs Investigation – Camp Grayling Airfield
- 2017 PFOS and PFOA Sampling and Analysis Report, Maneuver Training Center (MTC)
- 2018 GIS Data Request

Camp Grayling Integrated Contingency Plans

- 2013 Integrated Contingency Plan, Camp Grayling Cantonment Area
- 2013 Integrated Contingency Plan, Grayling Army Airfield
- 2013 Integrated Contingency Plan, Camp Grayling MATES

Camp Grayling Installation Maps

- 1988 Installation Maps
- 2006 Installation Maps

State Regulatory Advisories

- 2018 Updated Fish Consumption Guidelines Related to PFAS in Crawford, Kent, and Oscoda Counties (Michigan Department of Health and Human Services)

Appendix B
Preliminary Assessment Documentation

Appendix B.1
Interview Records

PA Interview Questionnaire - Environmental Manager

Facility: Camp Grayling
Interviewer: J. Li + C. Mitchelle
Date/Time: 2/27/18

Interviewee: Kimberly Bolan **Title:** Env. Qual. Specialist - Compliance **Phone Number:** 989-344-6178 **Email:** kimberly.a.bolan.nfg@mail.mil	Can your name/role be used in the PA Report? (Y) or N Can you recommend anyone we can interview? Y or (N)

1. Roles or activities with the Facility/years working at the Facility.

   2002 - 2003 - part time special duty, full time to date since

2. Where can I find previous facility ownership information?

   - Part of Rasmush land Grant to use as military training facility
     - ↳ 60K acres
   - rest leased lands
   - history in EIS

3. What can you tell us about the history of PFAS including aqueous film forming foam (AFFF) at the Facility? Was it used for any of the following activities, circle all that apply and indicate years of active use, if known? Identify these locations on a facility map.

   Maintenance
   (Fire Training Areas)
   Firefighting (Active Fire)
   Crash no air craft crashes,
   Fire Suppression Systems (Hangers/Dining Facilities)
   Fire Protection at Fueling Stations
   Non-Technical/Recreational/ Pest Management
   Metals Plating Facility
   Waterproofing Uniforms (Laundry Facilities)
   Other

   - one car crash on 4-mile road AFFF used
   - old ASP "Cadillac Gate"
     - ammunition supply building demolished + AFFF used
   - Range 16 had "hit"
   - MATES: 2 wells with low level "hits"

4. Fill out CSM Information worksheet with the Environmental Manager.

5. Are any current buildings constructed with AFFF dispensing systems or fire suppression systems? What are the AFFF/suppression system test requirements? What is the frequency of testing the AFFF/suppression system? Do you have "As Built" drawings for the buildings?

   Not that aware of.

PA Interview Questionnaire - Environmental Manager

Facility: Camp Grayling
Interviewer: J. Lis C. Mitchell
Date/Time: 2/27/18

6. Are fire suppression systems currently charged with AFFF or have they been retrofitted for use of high expansion foam? If retrofitted, when was that done?

N/A

7. How is AFFF procured? Do you have an inventory/procurement system that tracks use?

Kim Halstead & Roger Green have information.

8. What type of AFFF has been/is being used (3%, 6%, Mil Spec Mil-F-24385, High Expansion)? Manufacturer (3M, Dupont, Ansul, National Foam, Angus, Chemguard, Buckeye, Fire Service Plus)?

unknown - likely Ansul

9. Where is the AFFF stored? How is it stored (tanks, 55-gallon drums, 5-gallon buckets)? What size are the storage tanks? Is the AFFF stored as a mixed solution (3% or 6%) or concentrated material?

5-gallon Buckets at FD, maybe Building 360 (DPW)

10. How many FTAs are/were on this facility and where are they? Locate on a map. How many FTAs are active and inactive? For inactive FTAs, when was the last time that fire training using AFFF was conducted at them?

- Building 600 area
- Airfield
- ASP once (Former ASP)
- Wash Racks

PA Interview Questionnaire - Environmental Manager

Facility: Camp Grayling
Interviewer: J.L. + C. Mitchell
Date/Time: 8/27/18

11. When a release of AFFF occurs during a fire training exercise, now and in the past, how is the AFFF cleaned and disposed of? Were retention ponds built to store discharged AFFF? Was the AFFF trickled to the sanitary sewer or left in the pond to infiltrate?

- Did not dump any

12. Can you recall specific times when city, county, and/or state personnel came on-post for training? If so, please state which state/county agency or military entity? Do you have any records, including photographs to share with us?

NO

13. Did military routinely or occasionally fire train off-post? List the units that you can recall used/trained at various areas.

- one Emergency response to car crash
- Indiana guard came out aerating nozzles + trained

14. Did individual units come with their own safety personnel, did they also bring their own AFFF? Was training with AFFF part of these exercises? How were emergencies handled under these circumstances?

- unknown

15. Are there specific emergency response incident reports (i.e., aircraft or vehicle crash sites and fires)? If so, may we please copy these reports? Who (entity) was the responder?

- Grayling FD responded to car crash on 4-mile road once

PA Interview Questionnaire - Environmental Manager

Facility: Camp Grayling
Interviewer: J.L. & C. Mitchell
Date/Time: 4/27/18

16. Do you have records of fuel spill logs? Was it common practice to wash away fuel spills with AFFF? Is/was AFFF used as a precaution in response to fuel releases or emergency runway landings to prevent fires?

- AFFF never used to wash away spills

17. Was AFFF used for forest fires or fire management on-post/off-post? If so, please describe what happened and who was involved?

Ask Duane Brooks

18. Are there mutual aid/use agreements between county, city, and local fire department? Please list, even if informal. If formalized, may we have a copy of the agreement?

- Grayling fire department. (City)

19. Can you provide any other locations where AFFF has been stored, released, or used (i.e. hangars, buildings, fire stations, firefighting equipment testing and maintenance areas, emergency response sites, storm water/surface water, waste treatment plants, and AFFF ponds)?

- FD - maybe Building 36 - old DPW building

20. Are you aware of any other creative uses of AFFF? If so, how was AFFF used? What entities were involved?

No, but used as "wet water" - ask Kim Halstead for details

PA Interview Questionnaire - Environmental Manager

Facility: Camp Grayling
Interviewer: J.L. + C. Mitchell
Date/Time: 2/27/18

21. Are there past studies you are aware of with environmental information on plants/animals/ groundwater/soil types, etc., such as Integrated Cultural Resources Management Plans or Integrated Natural Resources Management Plans?

- TCE investigation south airfield
- INRMP - will provide
- Integrated Contingency Plans for airfield, Cantonment, MATES
  ↳ will send

22. What other records might be helpful to us (environmental compliance, investigation records, admin record) and where can we find them?

23. Do you have or did you have a chrome plating shop on base? What were/are the years of operation of that chrome plating shop?

NO

24. Do you know whether the shop has/had a foam blanket mist suppression system or used a fume hood for emissions control? If foam blanket mist suppression was used, where was the foam stored, mixed, applied, etc.?

NA

25. How is off-spec AFFF disposed (used for training, turned in, or given to a local Fire Station)? If applicable, do you know the name of the vendor that removes off-spec AFFF? Do you have copies of the manifest or B/L?

Never disposed of.

PA Interview Questionnaire - Environmental Manager

Facility: Camp Grayling
Interviewer: J.Li + C.Mitchell
Date/Time: 4/27/18

26. Do you recommend anyone else we can interview? If so, do you have contact information for them?
No

- WWTP - sludge never removed
  - Effluent discharged air irrigation (spray)
  - Located west side of Lake Margrethe
    ↳ irrigation to west of lagoons.

PA Interview Questionnaire – Fire Station

Facility: Camp Grayling, MI
Interviewer: J.L. + C.M.
Date/Time: 2/27/18 @ 1300

Interviewee: See #1 Below for list **Title:** " **Phone Number:** " **Email:**	Can your name/role be used in the PA Report? (Y) or N Can you recommend anyone we can interview? Y or N

1. Roles or activities with the Facility/years working at the Facility.

Russel Strophal Jr - 37 yrs Grayling FD, Chief, 4 yrs AF³ training (#989-390-2123)
Kim Halstead - 1977 - 2001 Camp Grayling FD (#989-745-6106)
Roger Green - Fire fighter, 1975 (June 12th) till 1983 (#989-389-7410?)
Duane Brooks - 35 yrs former Grayling FD Chief, DNR supervisor (35 yrs). (#989-348-9814)

2. What can you tell us about the history of AFFF at the Facility? Was it used for any of the following activities, circle all that apply and indicate years of active use, if known? Identify these locations on a facility map.

• Brush fires

Maintenance (e.g., ramp washing)
(Fire Training Areas)
(Firefighting (Active Fire))
Crash - Car on 4-mile
Fire Suppression Systems (Hangers/Dining Facilities)
Fire Protection at Fueling Stations
Non-Technical/Recreational/ Pest Management

3. Are any current buildings constructed with AFFF dispensing systems or fire suppression systems? What are the AFFF/suppression system test requirements? What is the frequency of testing at the AFFF/suppression systems?

no.

4. Are fire suppression systems currently charged with AFFF or have they been retrofitted for use of high expansion foam?

NO.

5. How is AFFF procured? Do you have an inventory/procurement system that tracks use?

Ordered through GSA Catalyst

PA Interview Questionnaire – Fire Station

Facility: Camp Grayling, MI
Interviewer: JL & CM
Date/Time: 2/27/18 @ 1300

6. What type of AFFF has been/is being used (3%, 6%, Mil Spec Mil-F-24385, High Expansion)? Manufacturer (3M, Dupont, Ansul, National Foam, Angus, Chemguard, Buckeye, Fire Service Plus)?

XH RS

3M
Ansul

Army would purchase order through GSA catalogue
5-gallon Buckets.

7. Is AFFF formulated on base? If so, where is the solution mixed, contained, transferred, etc.?

no.

8. Where is the AFFF stored? How is it stored (tanks, 55-gallon drums, 5-gallon buckets)? What size are the storage tanks? Is the AFFF stored as a mixed solution (3% or 6%) or concentrated material?

- stored at Grayling Fire Department and
- Fire Barn.

9. How is the AFFF transferred to emergency response vehicles, suppression systems, flightline extinguishers? Is/was there a specified area on the facility where vehicles are filled with AFFF and does this area have secondary containment in case of spills? How and where are vehicles storing AFFF cleaned/decontaminated?

Dumped into truck w/ 5-gallon buckets.

10. Provide a list of vehicles that carried AFFF, now and in the past, and where are/were they located?

- Firetrucks.

11. Any vehicles have a history of leaking AFFF? Do you/did you test the vehicles spray patterns to make sure equipment is working properly? How often are/were these spray tests performed and can you provide the locations of these tests, now and in the past?

- Yes. Trucks leaked ~80gal/day. Parked at airfield off ramp - see map
- Nozzle Checks into/at Lake Margrethe.

RG - wash tanks out into Lake Margrethe.

KH - North airfield Bivouac Staging: 2 Summers, 2 weeks each ~'82-'83

once steve green started; they stopped using wet water - ~~1980~~ 1986 - 1994.

PA Interview Questionnaire – Fire Station

Facility: Camp Grayling, MI
Interviewer: JL & CM
Date/Time: 8/27/18 @ 1300

12. How many FTAs are/were on this facility and where are they? Locate on a map. How many FTAs are active and inactive? For inactive FTAs, when was the last time that fire training using AFFF was conducted at them?

- NO active FTAs w/ AFFF, Past FTAs indicated on ~~map~~ map
- AFFF training ~1970's - 1980's, KH: Didn't have foam nozzles so made "wet water" & used (mix AFFF & water in tanker trucks) for training & Response
- Locations of FTA's shown on map.

13. What types of fuels/flammables were used at the FTAs?

mixture of gas/water would mix w/ JP8 house for fire training activities
or gas / diesel fuel mixture

14. What was the frequency of AFFF use at each location? When a release of AFFF occurs during a fire training exercise, now and in the past, how is/was the AFFF cleaned and disposed of? Were retention ponds built to store discharged AFFF? Was the AFFF trickled to the sanitary sewer or left in the pond to infiltrate?

KH: 2 training weekends / month - starting using wet water in ~78
PS: has only trained on the airfield a few times
84-86. would ~~d~~ train a few years apart.

15. Are there mutual aid/use agreements between county, city, local fire department? Please list, even if informal. If formalized, may we have a copy of the agreement? Can you recall specific times when city, county, state personnel came on-post for training? If so, please state which state/county agency, military entity? Do you have any records, including photographs to share with us?

Dan Shrock on fire department + chief camp grayling
DNR at Camp Grayling would bring campers.
Camp Grayling had an agreement w/ DNR
↳ DNR would have to "officially" give the go ahead.

16. Did individual units come on-post with their own safety personnel, did they also bring their own AFFF? Was training with AFFF part of these exercises? How were emergencies handled under these circumstances?

Indiana Guard - brought right nozzles for foam
Ohio Guard.

PA Interview Questionnaire – Fire Station

Facility: Camp Grayling, MI
Interviewer: JL & CM
Date/Time: 2/27/18 @ 1300

17. Did military routinely or occasionally fire train off-post? List units that you can recall used/trained at various areas.

- No

18. Are there specific emergency response incident reports (i.e., aircraft or vehicle crash sites and fires)? If so, may we please copy these reports? Who (entity) was the responder?

RS - no, only the car crash on 4mile Drive.

19. Do you have records of fuel spill logs? Was it common practice to wash away fuel spills with AFFF? Is/was AFFF used as a precaution in response to fuel releases or emergency runway landings to prevent fires?

Common practice to use the "wet water" on fuel spills.
~~mostly~~
Run reports are available

20. Was AFFF used for forest fires or fire management on-post/off-post? If so, please describe what happened and who was involved?

yes. on operational Ranges.
Range 40, 30, Known Distance, Range 13

21. Can you provide any other locations where AFFF has been stored, released, or used (i.e. hangars, buildings, fire stations, firefighting equipment testing and maintenance areas, emergency response sites, storm water/surface water, waste water treatment plants, and AFFF ponds)?

Non-military car dealership - used scotchguard to detail cars for many years.

Tank trail; used for dust control. Airport Lewiston grade btwn 27(?) + 75 (Roberts Road (?))
↑ Kim + Chief.

used as dust control - North Fob. (1-2x per year)

PA Interview Questionnaire – Fire Station

Facility: Camp Grayling, MI
Interviewer: JL + CM
Date/Time: 2/27/18 @ 1300

22. Are you aware of any other creative uses of AFFF? If so, how was AFFF used? What entities were involved?

Dust control - see 21.

23. How is off-spec AFFF disposed (used for training, turned in, or given to a local Fire Station)? If applicable, do you know the name of the vendor that removes off-spec AFFF? Do you have copies of the manifest or B/L?

- used for training; not thrown away.
- would use other entities older foam + replenish w/ new foam.

24. Do you recommend anyone else we can interview? If so, do you have contact information for them?

Joe ~~Merritt~~ Meredith → lives in Traverse city; Airfield Commander (potentially)
→ helped w/ coordination of training
→ Joe's ex-wife works at officers club; contact her to see if Joe is available.

PA Interview Questionnaire – Fire Station

Facility: Camp Grayling
Interviewer: J. Li + C. Mitchelle
Date/Time: 2/27/18 @ ~1500

Interviewee: Paul Smith **Title:** Retired Fire Fighter **Phone Number:** 989-390-5577 **Email:** ddgoat639@hotmail.com	Can your name/role be used in the PA Report? (Y) or N Can you recommend anyone we can interview? Y or N _____

1. Roles or activities with the Facility/years working at the Facility.

Fire Fighter under Dan Schrock
Retired 1998
'78/'79 started 1st 1435-1440th units

2. What can you tell us about the history of AFFF at the Facility? Was it used for any of the following activities, circle all that apply and indicate years of active use, if known? Identify these locations on a facility map.

Maintenance (e.g., ramp washing)
Fire Training Areas – @ airfield @ Camp + Wildfires
Firefighting (Active Fire) – wildfires
Crash – Behind 39th Building = Helicopter Crash simulation
Fire Suppression Systems (Hangers/Dining Facilities)
Fire Protection at Fueling Stations
Non-Technical/Recreational/ Pest Management Demonstrations @ Parade Grounds + Ross Commons Firemans memorial

3. Are any current buildings constructed with AFFF dispensing systems or fire suppression systems? What are the AFFF/suppression system test requirements? What is the frequency of testing at the AFFF/suppression systems?

NO

4. Are fire suppression systems currently charged with AFFF or have they been retrofitted for use of high expansion foam?

N/A

5. How is AFFF procured? Do you have an inventory/procurement system that tracks use?

- Unknown

PA Interview Questionnaire – Fire Station

Facility: Camp Grayling
Interviewer: J. Li + C. Mitchell
Date/Time: 8/27/18 @ ~1500

6. What type of AFFF has been/is being used (3%, 6%, Mil Spec Mil-F-24385, High Expansion)? Manufacturer (3M, Dupont, Ansul, National Foam, Angus, Chemguard, Buckeye, Fire Service Plus)?

Not sure

7. Is AFFF formulated on base? If so, where is the solution mixed, contained, transferred, etc.?

No

8. Where is the AFFF stored? How is it stored (tanks, 55-gallon drums, 5-gallon buckets)? What size are the storage tanks? Is the AFFF stored as a mixed solution (3% or 6%) or concentrated material?

Buckets stored at Building 360, 560, FD station building 39, and fire station at the airfield.

9. How is the AFFF transferred to emergency response vehicles, suppression systems, flightline extinguishers? Is/was there a specified area on the facility where vehicles are filled with AFFF and does this area have secondary containment in case of spills? How and where are vehicles storing AFFF cleaned/decontaminated?

- Filled tankers as needed

10. Provide a list of vehicles that carried AFFF, now and in the past, and where are/were they located?

- All of the 530's (tankers) used AFF. Each 5,000 gal tanks.

11. Any vehicles have a history of leaking AFFF? Do you/did you test the vehicles spray patterns to make sure equipment is working properly? How often are/were these spray tests performed and can you provide the locations of these tests, now and in the past?

—

PA Interview Questionnaire – Fire Station

Facility: Camp Grayling
Interviewer: J. Li & C. Mitchelle
Date/Time: 8/27/18 @1500

12. How many FTAs are/were on this facility and where are they? Locate on a map. How many FTAs are active and inactive? For inactive FTAs, when was the last time that fire training using AFFF was conducted at them?

- Old MATES, Many different areas, Cannot direct via phone
- Intense training, 2 weekends every month
- The 39th & 40th units trained during Summer Camp at the airfield.

13. What types of fuels/flammables were used at the FTAs?

- JP8
- Buildings, out in Cantonment, layout store. of air craft & response drills

14. What was the frequency of AFFF use at each location? When a release of AFFF occurs during a fire training exercise, now and in the past, how is/was the AFFF cleaned and disposed of? Were retention ponds built to store discharged AFFF? Was the AFFF trickled to the sanitary sewer or left in the pond to infiltrate?

- See above frequency
- Training release areas not cleaned → foam soaked into ground.

15. Are there mutual aid/use agreements between county, city, local fire department? Please list, even if informal. If formalized, may we have a copy of the agreement? Can you recall specific times when city, county, state personnel came on-post for training? If so, please state which state/county agency, military entity? Do you have any records, including photographs to share with us?

- Camp Grayling FD supported Grayling City FD as needed.
- 26 fires responded to in one weekend - unknown date
- May 1990' fire burned 1,000's of acres ~~south~~ East of town

16. Did individual units come on-post with their own safety personnel, did they also bring their own AFFF? Was training with AFFF part of these exercises? How were emergencies handled under these circumstances?

- IN, OH, MI guard units
- Speculate IN brought (+OH) AF3 of them
- Trains went by book
- 1439th & 1440th members also Volunteer FD members
- Joint training of all entities.

PA Interview Questionnaire – Fire Station

Facility: Camp Grayling
Interviewer: J.C. & C. Mitchell
Date/Time: 8/27/18 @ ~1500

17. Did military routinely or occasionally fire train off-post? List units that you can recall used/trained at various areas.

ND

18. Are there specific emergency response incident reports (i.e., aircraft or vehicle crash sites and fires)? If so, may we please copy these reports? Who (entity) was the responder?

- Check w/ State Fire Marshal office in Lansing for records since Camp Grayling FD was State certified.

19. Do you have records of fuel spill logs? Was it common practice to wash away fuel spills with AFFF? Is/was AFFF used as a precaution in response to fuel releases or emergency runway landings to prevent fires?

Was told of refueling issues w/ a helicopter at the airport along the flight line.

20. Was AFFF used for forest fires or fire management on-post/off-post? If so, please describe what happened and who was involved?

—

21. Can you provide any other locations where AFFF has been stored, released, or used (i.e. hangars, buildings, fire stations, firefighting equipment testing and maintenance areas, emergency response sites, storm water/surface water, waste water treatment plants, and AFFF ponds)?

No

PA Interview Questionnaire – Fire Station

Facility: Camp Grayling
Interviewer: J.L. & C.M. Tetrault
Date/Time: 2/27/18 @ ~1520

22. Are you aware of any other creative uses of AFFF? If so, how was AFFF used? What entities were involved?

- Used during demonstration shows, specifically during the Firemens Memorial at Ross Commons.

23. How is off-spec AFFF disposed (used for training, turned in, or given to a local Fire Station)? If applicable, do you know the name of the vendor that removes off-spec AFFF? Do you have copies of the manifest or B/L?

- Not dumped
- Rotated stock

24. Do you recommend anyone else we can interview? If so, do you have contact information for them?

- Steve Green
- Mike Corlew (commander of 1440th)
- Dan Ellis
- Garry [redacted] Jines
- Louis Dudas

PA Interview Questionnaire – Fire Station

Facility: Camp Grayling
Interviewer: Jill + C. Mitchell
Date/Time: 2/28/18 @ 1000

Interviewee: Steve Green **Title:** Former Fire Chief/Captain **Phone Number:** 989-344-6191 **Email:**	Can your name/role be used in the PA Report? (Y) or N Can you recommend anyone we can interview? Y or (N)

1. Roles or activities with the Facility/years working at the Facility.

Fire Chief / Captain 1986 - 2002 12 - 13 yrs
Camp Grayling FD off & on

2. What can you tell us about the history of AFFF at the Facility? Was it used for any of the following activities, circle all that apply and indicate years of active use, if known? Identify these locations on a facility map.

- Didn't use much AFF due to availability
- Emergency response to Ranges 40, 13, 8 (machine gun), 3, and 20/21

Maintenance (e.g., ramp washing)
(Fire Training Areas) Spring & Summer
Firefighting (Active Fire)
Crash
Fire Suppression Systems (Hangers/Dining Facilities)
Fire Protection at Fueling Stations
Non-Technical/Recreational/ Pest Management

3. Are any current buildings constructed with AFFF dispensing systems or fire suppression systems? What are the AFFF/suppression system test requirements? What is the frequency of testing at the AFFF/suppression systems?

NO

4. Are fire suppression systems currently charged with AFFF or have they been retrofitted for use of high expansion foam?

N/A

5. How is AFFF procured? Do you have an inventory/procurement system that tracks use?

ordered via catalog - approx. 40 - 5gal buckets/year

PA Interview Questionnaire – Fire Station

Facility: Camp Grayling, MI
Interviewer: RS CM
Date/Time: 8/28/18 @ 1000

6. What type of AFFF has been/is being used (3%, 6%, Mil Spec Mil-F-24385, High Expansion)? Manufacturer (3M, Dupont, Ansul, National Foam, Angus, Chemguard, Buckeye, Fire Service Plus)?

unknown, blue buckets w/ white lettering

7. Is AFFF formulated on base? If so, where is the solution mixed, contained, transferred, etc.?

NO

8. Where is the AFFF stored? How is it stored (tanks, 55-gallon drums, 5-gallon buckets)? What size are the storage tanks? Is the AFFF stored as a mixed solution (3% or 6%) or concentrated material?

- 5 gal buckets
- Ceased storage in fire truck tanks during tenure

9. How is the AFFF transferred to emergency response vehicles, suppression systems, flightline extinguishers? Is/was there a specified area on the facility where vehicles are filled with AFFF and does this area have secondary containment in case of spills? How and where are vehicles storing AFFF cleaned/decontaminated?

NA

10. Provide a list of vehicles that carried AFFF, now and in the past, and where are/were they located?

2 - 5 ton tanker trucks, got foam trucks

11. Any vehicles have a history of leaking AFFF? Do you/did you test the vehicles spray patterns to make sure equipment is working properly? How often are/were these spray tests performed and can you provide the locations of these tests, now and in the past?

- stoped using tanker trucks w/ AFFF due to mixed use of water trucks and leaking wear on the tanks during his tenure

PA Interview Questionnaire – Fire Station

Facility: Camp Grayling, MI
Interviewer: JL & CM
Date/Time: 2/28/18 @ 1000

12. How many FTAs are/were on this facility and where are they? Locate on a map. How many FTAs are active and inactive? For inactive FTAs, when was the last time that fire training using AFFF was conducted at them?

- Building 600 area - formerly "tent city"
- Expired foam used for training

13. What types of fuels/flammables were used at the FTAs?

Unk. Demonstrations done on concrete pads

14. What was the frequency of AFFF use at each location? When a release of AFFF occurs during a fire training exercise, now and in the past, how is/was the AFFF cleaned and disposed of? Were retention ponds built to store discharged AFFF? Was the AFFF trickled to the sanitary sewer or left in the pond to infiltrate?

NA

15. Are there mutual aid/use agreements between county, city, local fire department? Please list, even if informal. If formalized, may we have a copy of the agreement? Can you recall specific times when city, county, state personnel came on-post for training? If so, please state which state/county agency, military entity? Do you have any records, including photographs to share with us?

unknown

16. Did individual units come on-post with their own safety personnel, did they also bring their own AFFF? Was training with AFFF part of these exercises? How were emergencies handled under these circumstances?

NA

PA Interview Questionnaire – Fire Station

Facility: Camp Grayling, MI
Interviewer: JL + CM
Date/Time: 2/28/18 @ 1000

17. Did military routinely or occasionally fire train off-post? List units that you can recall used/trained at various areas.

NO

18. Are there specific emergency response incident reports (i.e., aircraft or vehicle crash sites and fires)? If so, may we please copy these reports? Who (entity) was the responder?

MPRC southand (Range 30), North FOB

19. Do you have records of fuel spill logs? Was it common practice to wash away fuel spills with AFFF? Is/was AFFF used as a precaution in response to fuel releases or emergency runway landings to prevent fires?

No

20. Was AFFF used for forest fires or fire management on-post/off-post? If so, please describe what happened and who was involved?

Emergency Response to Small Arms Ranges, MPRC southend, North FOB

21. Can you provide any other locations where AFFF has been stored, released, or used (i.e. hangars, buildings, fire stations, firefighting equipment testing and maintenance areas, emergency response sites, storm water/surface water, waste water treatment plants, and AFFF ponds)?

PA Interview Questionnaire – Fire Station

Facility: Camp Grayling, MI
Interviewer: JL + CM
Date/Time: 8/28/18 @ 1000

22. Are you aware of any other creative uses of AFFF? If so, how was AFFF used? What entities were involved?

Not used for dust control during tenure

23. How is off-spec AFFF disposed (used for training, turned in, or given to a local Fire Station)? If applicable, do you know the name of the vendor that removes off-spec AFFF? Do you have copies of the manifest or B/L?

Expired AFFF used for training.

24. Do you recommend anyone else we can interview? If so, do you have contact information for them?

No.

PA Interview Questionnaire - Other

Facility: Grayling
Interviewer: C Mitchell / B. Packer
Date/Time: 06/05/18

Follow-up Interview - Kim Halstead, Camp Grayling Firefighter
cell#: 989-889-0448

Enquired regarding the location of the former tank trail and if AFFF was used.
- Only used AFFF along Lewiston grade road.
- Tank trail previously went through Airfield but it has since been changed.
- Sprayed foam / not water on Lewiston grade Rd due to dust complaints by home owners.

Location of Bivouac Area.
- Stated the location of Bivouac Area was more east than originally told during original interview. Mr. Halstead stated they could see the runway from ~~there~~ the bivouac area + circled an area NW of runway 5/23.

Northern End of Runway 5/23
- Mr Halstead stated the City of Grayling Fire Department did fire training in this area.
- Performed "a few" times during the late 1970's to early 1980s (not a regular training event.
- This area is now associated w/ the municipal airport.

DRAFT - Michigan Department of Natural Resources Input to the Army National Guard Grayling Preliminary Assessment

The Michigan Department of Natural Resources (MDNR) responds to wildfires in the areas surrounding Camp Grayling and will assist, when requested, on the base. In many cases, MDNR will assist with controlled burns to reduce wildfire potential and intensity. MDNR uses a Class A Foam manufactured by Phos-Chek/ICL Performance products. Class A foam is a is a biodegradable mixture of foaming and wetting agents and does not contain AFFF. Additionally, the DNR has historically used a wetting agent, commonly called "wetwater" which is very similar in chemical composition to Class A Foam but does not have the foaming abilities. MDNR used a wetting agent labelled 5100-103b that was approved by U.S.D.A. Forest Service and can be found referenced in federal wildland firefighting manuals and guidance. Preliminary research of DNR records dating back to the 1970s provides no evidence that any firefighting agents used contained AFFF and currently the DNR does not use or procure any products with AFFF for fighting wildland fires. In response to USANG inquiries related to firefighting and Camp Grayling, the generic use of the term "foam" may lead to a misunderstanding of the actual agent used as well as lead to uncertainty in the areas where AFFF contamination may be present. Future work around Camp Grayling should seek to better define this uncertainty while proactively testing to protect public health. However, simply assuming that wherever the DNR responded to a wildland fire resulted in an AFFF release would be incorrect.

June 26, 2018

Submitted by T.J. Newcomb, Ph.D.
MDNR Senior Water Policy Advisory
newcombt@michigan.gov
(517)284-5832

PA Interview Questionnaire - Other

Facility: Camp Grayling, MI
Interviewer: J. Li
Date/Time: 07/03/2018 @ 0900

Interviewee: Susan Thiel **Title:** Unit Manager, Grayling Forest Management Unit; Michigan DNR **Phone Number:** 989-348-6371, x7440 **Email:** ThielS1@michigan.gov	Can your name/role be used in the PA Report? **Y** or N Can you recommend anyone we can interview? Y or N _____

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

- Approximately 33 years total with Michigan DNR
- Over 25 years with the Grayling Unit
- Approximately 22 years as Unit Manager

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

Has DNR had any past or present AFFF or Class B foam use?

- Not aware of any use of AFFF type foam used. Class A foam that was used did not contain the chemicals of concern with AFFF. DNR did not have foam capability at first. Foam not used in the 1970's, DNR got the foaming capability in the mid-late 1980's.
- Foam use was not common or regular. It was only used in extreme drought conditions and tracked.

What manufacturer or Brand of Foam was used?

- Unknown manufacturer or concentration, containers were yellow or clear/white in color. Likely tracked by state.

Was "wet water" used and how was it made?

- Use of wet water was before her time. Understood that it was essentially a mixture of water and "heavy soap"

Any mutual aid use agreements with Camp Grayling Fire Department?

- Yes, likely on file with DNR.
- Typically fires on Camp Grayling were first responded to by Camp Grayling Fire Department units; if the fire extended beyond the Camp's fences then DNR would provide support. DNR support included creating fire breaks that would be wetted down with either water or Forest Service approved foam (non-AFFF).
- DNR responded to the "Meridian Fire" and a fire that originated at Range 9 on Camp Grayling that resulted from a controlled burn that became out of control.

Was any joint training conducted with Camp Grayling units?

- Yes, training classes were typically the basics and classroom based with practical training for pump use and fire shelter creation. Not aware of any intentional fires being put out with foam during training activities.

Follow-up email with additional information from interviewee provided on next page

PA Interview Questionnaire - Other

Facility: Camp Grayling, MI
Interviewer: J. Li
Date/Time: 07/03/2018 @ 0900

From:	Thiel, Susan (DNR) <ThielS1@michigan.gov>
Sent:	Tuesday, July 03, 2018 11:00 AM
To:	Li, Jennifer J (Germantown)
Cc:	Edgerly, Jonathan (DMVA)
Subject:	Additional fire information
Attachments:	Michigan NG Mutual Aid Agreement 2-21-17.pdf

Jennifer:
The start date of Range 9 and Meridian fires was May 18, 2010. Please note we also assisted with a fire a couple years later in the same area called the Range 8 fire. Some folks get those two confused. Per the fire report for Range 9 fire, we used 4 gallons of Fire Trol 1 Class A foam over the several day suppression period. Another point I neglected to mention is we cannot switch types of foam in our engines or it may gum up the inductors (not sure if that is truly correct terminology). So staff need to stick with same type of foam we use regularly to keep equipment running. Historically we did not have foam capabilities until mid to late 80's. We did not use foam regularly after that as it was expensive and so we did not make it common practice. I can't remember using foam when I worked on the large Stephan Bridge fire as an engine operator in 1990. We also cannot use foam if we draft from a natural water body (lake, stream, pond). So if we use a local water source for suppression in the field, we don't use foam. With that said, our use of class A foam has been increasing in the past few years due to reduction in staff. My staff have been using it more regularly over the past ten years as compared to the 1990s when I worked on the fire line. The use of foam is recorded on our fire reports and can be tracked. Every stat fire we run on has a fire report which outlines equipment use and costs. If foam is used, it is listed as a line item cost on our fire reports. I am not aware of us ever buying or using any Class B foam. I doubt we would even use it if given to us as we would not want to risk running it through our equipment. We should be able to track down the type of foam we have purchased via our historical purchasing records and the type of foam used is also on fire reports.

I checked with my Assistant Mike Janisse who puts on the training that CG staff have attended and I asked if he ever has used foam for hands on activities in the training. He said no, foam has not been used during trainings for the past several years he was involved with.

Attached is a copy of the current mutual aid agreement we are working under. If you have any questions, feel free to contact me. Susan

Susan J. Thiel, Unit Manager
Grayling Forest Mangement Unit, MDNR
1955 N. Hartwick Pines Road
Grayling, MI 49738
(989) 348-6371 x 7440
FAX: (989) 348-8825
Thiels1@michigan.gov

PA Interview Questionnaire - Other

Facility: Camp Grayling, MI
Interviewer: J. Li
Date/Time: 07/03/2018 @ 1100

Interviewee: Jim Fisher **Title:** Fire Section Manager, Forest Resources Division; Michigan DNR **Phone Number:** 517-284-5866 **Email:** FisherJ@michigan.gov	Can your name/role be used in the PA Report? **Y** or N Can you recommend anyone we can interview? Y or N _____

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

- Approximately 32 years total with Michigan DNR
- Current role as supervisor for past 2.5 years
- Started in 1985-1986 as fire fighter in Roscommon, MI and worked way up since

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

Has DNR had any past or present AFFF or Class B foam use?

- Not aware of any use of AFFF or Class B foams ever by DNR. Only used Class A foams and wetting agents approved by the Forest Service (currently listed on forest service website).
- They switched from using "wet water" to Class A foams in the late 1980's or 1990 when DNR got in-line injection pumps for foam use.

What manufacturer or Brand of Foam was used?

- Phos-chek and Fire Trol 103B

Was "wet water" used and how was it made? Was it ever made with foam concentrate?

- The term "wet water" is a general term used and not a brand type. Quart sized bottles of a liquid or dish washing detergent was used to mix batches of "wet water." Cannot speak to the use of foam concentrate to make it, his experience was using the above methods, primarily dish soap to break surface tension of the water.

Any mutual aid use agreements with Camp Grayling Fire Department?

- Not sure if it is a MOU agreement, but an annual agreement exists for joint use, support, communication, and training. Agreement in place since at least early 1990's.

Aware of instances where Camp Grayling Units responded to fires off Camp Grayling property?

- Camp Grayling typically did not go off of their facility. May have been a couple of instances but cannot remember any specific details or dates.

Was joint training conducted with Camp Grayling units?

- Yes, classroom based mostly. Also hands on truck operation, tactics, and communication. Prescribed burns treated as training; typically units involved in the training provided their own equipment. Joint training instances of prescribed burns usually on Camp Grayling and its ranges.

Appendix B.2
Visual Site Inspection Checklists

Visual Site Inspection Checklist

Names(s) of people performing VSI: JL, CM (AECOM), R. MacLeod (MIARNG), M. Leeper (AZNG), LTC Johnson, LTC Cowley (ARNG)

Recorded by: JLi (AECOM)

ARNG Contact: R. do MacLeod (MIARNG), M. Leeper (AZNG)

Date and Time: 2/28/18 @ 1000

Method of visit (walking, driving, adjacent): walking + driving

Source/Release Information

Site Name / Area Name / Unique ID: Camp Grayling Army Airfield

Site / Area Acreage:

Historic Site Use (Brief Description): Airfield - military + municipal

Current Site Use (Brief Description): same

Physical barriers or access restrictions: fence + locked gates

1. Was PFAS used (or spilled) at the site/area? (Y) / N

1a. If yes, document how PFAS was used and usage time (e.g., fire fighting training 2001 to 2014):

FTA's + fire tankers truck leaks ~ 1970's-1980's - exact timeframes unknown.

2. Has usage been documented? Y (N)

2a. If yes, keep a record (place electronic files on a disk):

N/A

3. What types of businesses are located near the site? **Industrial / (Commercial) / Plating / Waterproofing / (Residential)**

3a. Indicate what businesses are located near the site

lodging, car dealership, auto repair shops

4. Is this site located at an airport/flightline? (Y) / N

4a. If yes, provide a description of the airport/flightline tenants:

Army airfield, municipal use @ northern end of airfield, 2 flight lines.

Visual Survey Inspection Log

Other Significant Site Features:

1. Does the facility have a fire suppression system? Y / (N)

1a. If yes, indicate which type of AFFF has been used:

N/A

1b. If yes, describe maintenance schedule/leaks:

N/A

1c. If yes, how often is the AFFF replaced:

N/A

1d. If yes, does the facility have floor drains and where do they lead? Can we obtain an as built drawing?

N/A

Transport / Pathway Information

Migration Potential:

1. Does site/area drainage flow off installation? (Y) / N

1a. If so, note observation and location:

Little overland flow due to sandy soil, likely GW divide within airfield to west + east flow directions

2. Is there channelized flow within the site/area? Y / (N)

2a. If so, please note observation and location:

N/A

3. Are monitoring or drinking water wells located near the site? (Y) / N

3a. If so, please note the location:

Boundary VAP sampl. locations surrounding airfield boundary
DW wells in adjacent communities.

4. Are surface water intakes located near the site? Y / (N)

4a. If so, please note the location:

N/A

5. Can wind dispersion information be obtained? Y / (N)

5a. If so, please note and observe the location.

N/A

6. Does an adjacent non-ARNG PFAS source exist? (Y) / N maybe

6a. If so, please note the source and location.

- auto dealership to east suggested by interviewees as potentially due to waterproofing detailing to cars

6b. Will off-site reconnaissance be conducted? Y / (N)

Visual Survey Inspection Log

Significant Topographical Features:

1. Has the infrastructure changed at the site/area? Y / (N)

1a. If so, please describe change (ex. Structures no longer exist):

N/A

2. Is the site/area vegetated? (Y) / N

2a. If not vegetated, briefly describe the site/area composition:

Vegetated except for runways and northern municipal area

3. Does the site or area exhibit evidence of erosion? Y / (N)

3a. If yes, describe the location and extent of the erosion:

N/A

4. Does the site/area exhibit any areas of ponding or standing water? Y / (N)

4a. If yes, describe the location and extent of the ponding:

N/A

Receptor Information

1. Is access to the site restricted? (Y) / N

1a. If so, please note to what extent:

fenced boundary w/ locked gates

2. Who can access the site? **(Site Workers) / Construction Workers / Trespassers / Residential / Recreational Users / Ecological**

2a. Circle all that apply, note any not covered above:

3. Are residential areas located near the site? (Y) / N

3a. If so, please note the location/distance:

abutting airfield on all sides

4. Are any schools/day care centers located near the site? Y / (N)

4a. If so, please note the location/distance/type:

N/A

5. Are any wetlands located near the site? (Y) / N

5a. If so, please note the location/distance/type:

Riparian wetlands associated w/ Au Sable River + tributaries

Visual Survey Inspection Log

Additional Notes

Photographic Log

Photo ID/Name	Date & Location	Photograph Description

Visual Site Inspection Checklist

Names(s) of people performing VSI: JL + CM (AECOM), R. MacLeod (MIARNG), Kim Bolan (Camp Grayling)

Recorded by: JL (AECOM)

ARNG Contact: Rob MacLeod (MIARNG), M. Cooper (ARNG)

Date and Time: 6/28/18 @ 1400

Method of visit (walking, driving, adjacent): Driving + walking

Source/Release Information

Site Name / Area Name / Unique ID: Camp Grayling South Post Ranges.

Site / Area Acreage: various

Historic Site Use (Brief Description): Range 8 - multipurpose machine gun, Ranges 3 - small arms, Ranges 20-21 - Demo HE, Range 13/17 - grenade/mortar

Current Site Use (Brief Description): same

Physical barriers or access restrictions: all ~~fenced~~ fenced w/ locked gates

1. Was PFAS used (or spilled) at the site/area? (Y) / N

1a. If yes, document how PFAS was used and usage time (e.g., fire fighting training 2001 to 2014):

Emergency wildfire response in 1970's - 1980's

2. Has usage been documented? Y / (N)

2a. If yes, keep a record (place electronic files on a disk):

3. What types of businesses are located near the site? **Industrial / Commercial / Plating / Waterproofing / Residential**

3a. Indicate what businesses are located near the site

none

4. Is this site located at an airport/flightline? Y / (N)

4a. If yes, provide a description of the airport/flightline tenants:

Visual Survey Inspection Log

Other Significant Site Features:

1. Does the facility have a fire suppression system? Y (N)

1a. If yes, indicate which type of AFFF has been used:

N/A

1b. If yes, describe maintenance schedule/leaks:

N/A

1c. If yes, how often is the AFFF replaced:

N/A

1d. If yes, does the facility have floor drains and where do they lead? Can we obtain an as built drawing?

N/A

Transport / Pathway Information

Migration Potential:

1. Does site/area drainage flow off installation? Y / (N)

1a. If so, note observation and location:

no overland flows, GW infiltration ~~to~~ + potential GW migration to nearby SW bodies - see map

2. Is there channelized flow within the site/area? Y / (N)

2a. If so, please note observation and location:

3. Are monitoring or drinking water wells located near the site? (Y) / N

3a. If so, please note the location:

2013 ORA wells may still be present around Range 13 Complex + Range 20/21

4. Are surface water intakes located near the site? Y / (N)

4a. If so, please note the location:

5. Can wind dispersion information be obtained? Y / (N)

5a. If so, please note and observe the location.

6. Does an adjacent non-ARNG PFAS source exist? Y / (N)

6a. If so, please note the source and location.

6b. Will off-site reconnaissance be conducted? Y / N N/A

Visual Survey Inspection Log

Significant Topographical Features:

1. Has the infrastructure changed at the site/area? Y / (N)

1a. If so, please describe change (ex. Structures no longer exist):

2. Is the site/area vegetated? (Y) / N

2a. If not vegetated, briefly describe the site/area composition:

except for heavy use training lands & Demo areas.

3. Does the site or area exhibit evidence of erosion? Y / (N)

3a. If yes, describe the location and extent of the erosion:

4. Does the site/area exhibit any areas of ponding or standing water? Y / (N)

4a. If yes, describe the location and extent of the ponding:

Receptor Information

1. Is access to the site restricted? (Y) / N

1a. If so, please note to what extent:

all ranges fenced w/ controlled gates. South post access controlled by manned gate.

2. Who can access the site? (Site Workers) / Construction Workers / Trespassers / Residential / Recreational Users / Ecological

2a. Circle all that apply, note any not covered above:

access by guardsmen

3. Are residential areas located near the site? Y / (N)

3a. If so, please note the location/distance:

4. Are any schools/day care centers located near the site? Y / (N)

4a. If so, please note the location/distance/type:

5. Are any wetlands located near the site? (Y) / N

5a. If so, please note the location/distance/type:

North end of Range 8

Visual Survey Inspection Log

Additional Notes

Photographic Log

Photo ID/Name	Date & Location	Photograph Description

Visual Site Inspection Checklist

Names(s) of people performing VSI: JL & CM (AECOM)

Recorded by: JL

ARNG Contact: Rob Medeiros (MIARNG) + M. Lupek (ARNG)

Date and Time: 3/1/18 @ 1500

Method of visit (walking, driving, adjacent): Driving

Source/Release Information

Site Name / Area Name / Unique ID: Camp Grayling Cantonment

Site / Area Acreage: unknown at Pre

Historic Site Use (Brief Description): Training Installation Cantonment

Current Site Use (Brief Description): Same

Physical barriers or access restrictions: fenced and controlled gate access

1. Was PFAS used (or spilled) at the site/area? **Y / N**

1a. If yes, document how PFAS was used and usage time (e.g., fire fighting training 2001 to 2014):

Fire Training ~1970's - 1980's, old Fire Barn, 600 + 500 building areas, Wash Racks, Parade Ground, Former AFSP, Wilson Hill, 2285D

2. Has usage been documented? **Y / N**

2a. If yes, keep a record (place electronic files on a disk):

3. What types of businesses are located near the site? **Industrial / Commercial / Plating / Waterproofing / Residential**

3a. Indicate what businesses are located near the site

Grayling Winter Recreation - Hanson Hills located off post to east of Cantonment

4. Is this site located at an airport/flightline? **Y / N**

4a. If yes, provide a description of the airport/flightline tenants:

Visual Survey Inspection Log

Other Significant Site Features:

1. Does the facility have a fire suppression system? Y / (N)

1a. If yes, indicate which type of AFFF has been used:

N/A

1b. If yes, describe maintenance schedule/leaks:

N/A

1c. If yes, how often is the AFFF replaced:

N/A

1d. If yes, does the facility have floor drains and where do they lead? Can we obtain an as built drawing?

N/A

Transport / Pathway Information

Migration Potential:

1. Does site/area drainage flow off installation? (Y) / N

1a. If so, note observation and location:

Storm Sewers drain to Lake Marguethe

2. Is there channelized flow within the site/area? Y / (N)

2a. If so, please note observation and location:

3. Are monitoring or drinking water wells located near the site? (Y) / N

3a. If so, please note the location:

DW wells Wthin Containment & NE community on Lake Marguethe.

4. Are surface water intakes located near the site? Y / (N)

4a. If so, please note the location:

5. Can wind dispersion information be obtained? Y / (N)

5a. If so, please note and observe the location.

6. Does an adjacent non-ARNG PFAS source exist? (Y) / N

6a. If so, please note the source and location.

Greyly Winter Recreation - Hanson Hills: Ski + Snowboard Facility

6b. Will off-site reconnaissance be conducted? Y / (N)

Visual Survey Inspection Log

Significant Topographical Features:

1. Has the infrastructure changed at the site/area? Y / N

1a. If so, please describe change (ex. Structures no longer exist):

Building 6000 Area - New housing being built

2. Is the site/area vegetated? Y / N

2a. If not vegetated, briefly describe the site/area composition:

Exception at parking areas near 2280 & wash racks

3. Does the site or area exhibit evidence of erosion? Y / N

3a. If yes, describe the location and extent of the erosion:

4. Does the site/area exhibit any areas of ponding or standing water? Y / N

4a. If yes, describe the location and extent of the ponding:

Receptor Information

1. Is access to the site restricted? Y / N

1a. If so, please note to what extent:

Contonment fenced w/ controlled gate access

2. Who can access the site? **Site Workers / Construction Workers / Trespassers / Residential / Recreational Users / Ecological**

Approved

2a. Circle all that apply, note any not covered above:

3. Are residential areas located near the site? Y / N

3a. If so, please note the location/distance:

Immediately adjacent to Contonment to NE along Lake Margrethe Shore.

4. Are any schools/day care centers located near the site? Y / N

4a. If so, please note the location/distance/type:

5. Are any wetlands located near the site? Y / N

5a. If so, please note the location/distance/type:

Between Parade Grounds & Lake Margrethe - dammed stock Pond.

Visual Survey Inspection Log

Additional Notes

Photographic Log

Photo ID/Name	Date & Location	Photograph Description

Appendix B.3
Conceptual Site Model Information

Preliminary Assessment – Conceptual Site Model Information

Site Name: Camp Grayling – Grayling Army Airfield

Why has this location been identified as a site?

Interviews indicated former AFFF used for training and incidental leaking from fire trucks

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

No – Car dealership detailing activities likely de minimis

Training Events

Have any training events with AFFF occurred at this site? – *Yes, mostly at end of runways*

If so, how often? – *unknown frequency, however, intense training 2x per month reported.*

How much material was used? Is it documented? – *Unknown, not documented*

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

Surface Water:

Surface water flow direction? *East Branch Au Sable flows to south towards Au Sable River which flows to the east/southeast*

Average rainfall? *33.61 inches rain annually – 105.1 inches snow*

Any flooding during rainy season? *No, localized ponding during snow melt due to permafrost*

Direct or indirect pathway to ditches? *none*

Direct or indirect pathway to larger bodies of water? *Infiltration to groundwater, shallow groundwater flows towards nearest surface water features (i.e., Au Sable and its tributaries)*

Does surface water pond any place on site? *No*

Any impoundment areas or retention ponds? *No*

Any NPDES location points near the site? *No*

How does surface water drain on and around the flight line? *Storm water drains off of runways and infiltrates into sandy soil surrounding.*

Preliminary Assessment – Conceptual Site Model Information

Groundwater:

Groundwater flow direction? *Shallow groundwater flows towards nearest surface water body*

Depth to groundwater? *Average depth to groundwater is approximately 45 feet bgs in City of Grayling.*

Uses (agricultural, drinking water, irrigation)? *Drinking Water*

Any groundwater treatment systems? *Air sparging system south of airfield for TCE plume*

Any groundwater monitoring well locations near the site? *VAP locations surrounding boundary*

Is groundwater used for drinking water? *Yes off post*

Are there drinking water supply wells on installation? *Not at airfield*

Do they serve off-post populations? *No, separate nearby public supply wells in City of Grayling*

Are there off-post drinking water wells downgradient? *Yes*

Waste Water Treatment Plant:

Has the installation ever had a WWTP, past or present? *Yes in South Post*

If so, do we understand the process and which water is/was treated at the plant? *Yes, effluent spray irrigated to west of WWTP at South Post.*

Do we understand the fate of sludge waste? *Never removed*

Is surface water from potential contaminated sites treated? *No current PFAS treatment, TCE contamination at southern end of air field has a groundwater air sparging system*

Equipment Rinse Water

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

Not known.

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

Yes, nozzles were tested and tanks cleaned into/next to Lake Margrethe in South Post.

3. Other?

Preliminary Assessment – Conceptual Site Model Information

Identify Potential Receptors:

Site Worker

Construction Worker

Recreational User

Residential

Child

Ecological

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

Residential households located immediately off-post on all sides of airfield. City of Grayling located immediately south east of the airfield.

Documentation

Ask for Engineering drawings (if applicable). *None available*

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

Au Sable River dam removed in recent history, exact date unknown. Minor changes to river path.

Preliminary Assessment – Conceptual Site Model Information

Site Name: Camp Grayling – North Post

Why has this location been identified as a site?

Interviews indicated former AFFF used for emergency response and controlled burns along fence lines

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

No – Car dealership detailing activities likely de minimis

Training Events

Have any training events with AFFF occurred at this site? – *No only emergency response or tanker staging*

If so, how often? – *unknown frequency, however, very active fire seasons reported.*

How much material was used? Is it documented? – *Unknown, not documented*

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

Surface Water:

Surface water flow direction? *North Branch and East Branch Au Sable flow to south towards Au Sable River which flows to the east/southeast*

Average rainfall? *33.61 inches rain annually – 105.1 inches snow*

Any flooding during rainy season? *No, localized ponding during snow melt due to permafrost*

Direct or indirect pathway to ditches? *none*

Direct or indirect pathway to larger bodies of water? *Infiltration to groundwater, shallow groundwater flows towards nearest surface water features (i.e., Au Sable and its tributaries)*

Does surface water pond any place on site? *Range 40 Complex: Barnes and Timber lakes; Range 30 Complex: Kyle Lake; North FOB: KP Lake*

Any impoundment areas or retention ponds? *No*

Any NPDES location points near the site? *No*

How does surface water drain on and around the flight line? *Storm water drains off of runways and infiltrates into sandy soil surrounding.*

Preliminary Assessment – Conceptual Site Model Information

Groundwater:

Groundwater flow direction? *Shallow groundwater flows towards nearest surface water body*

Depth to groundwater? *0-200 feet bgs, local average around 45 feet in City of Grayling.*

Uses (agricultural, drinking water, irrigation)? *Drinking Water*

Any groundwater treatment systems? *Only at airfield*

Any groundwater monitoring well locations near the site? *Yes around Range 40 Complex*

Is groundwater used for drinking water? *Yes*

Are there drinking water supply wells on installation? *Yes at current MATES*

Do they serve off-post populations? *No, separate nearby public supply wells in City of Grayling*

Are there off-post drinking water wells downgradient? *Yes*

Waste Water Treatment Plant:

Has the installation ever had a WWTP, past or present? *Yes in South Post*

If so, do we understand the process and which water is/was treated at the plant? *Yes, effluent spray irrigated to west of WWTP at South Post.*

Do we understand the fate of sludge waste? *Never removed*

Is surface water from potential contaminated sites treated? *No current PFAS treatment, TCE contamination at southern end of air field has a groundwater air sparging system*

Equipment Rinse Water

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

Not known.

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

Yes, nozzles were tested and tanks cleaned into/next to Lake Margrethe in South Post.

3. Other?

Preliminary Assessment – Conceptual Site Model Information

Identify Potential Receptors:

Site Worker

Construction Worker

Recreational User

Residential

Child

Ecological

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

Residential households sporadically located throughout uncontrolled North Post areas. City of Grayling located immediately south of the North Post.

Documentation

Ask for Engineering drawings (if applicable). *None available*

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

Au Sable River dam removed in recent history, exact date unknown. Minor changes to river path.

Preliminary Assessment – Conceptual Site Model Information

Site Name: Camp Grayling – South Post

Why has this location been identified as a site?

Interviews indicated former AFFF used for emergency response at ranges, training within the cantonment, and maintenance related discharges.

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

Yes – Grayling Winter Recreation Area/Hanson Hills ski and snowboarding area located east of the cantonment.

Training Events

Have any training events with AFFF occurred at this site? – *Yes, mostly west cantonment, other minor areas in southern areas along South Access Road.*

If so, how often? – *unknown frequency, however, heavy training schedules 2x monthly.*

How much material was used? Is it documented? – *Unknown, not documented*

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

Surface Water:

Surface water flow direction? *Lake Margrethe drains to Portage Creek which flows west towards the Manistee River; Beaver Creek f lows to east towards Au Sable*

Average rainfall? *33.61 inches rain annually – 105.1 inches snow*

Any flooding during rainy season? *No, localized ponding during snow melt due to permafrost*

Direct or indirect pathway to ditches? *none*

Direct or indirect pathway to larger bodies of water? *Infiltration to groundwater, shallow groundwater flows towards nearest surface water features (i.e., Lake Margrethe or Portage Creek)*

Does surface water pond any place on site? *Kings Ponds near Ranges 20 & 21; Cantonment: Stock pond between Parade Grounds and Lake Margrethe*

Any impoundment areas or retention ponds? *No*

Any NPDES location points near the site? *No*

How does surface water drain on and around the flight line? *N/A*

Preliminary Assessment – Conceptual Site Model Information

Groundwater:

Groundwater flow direction? *Shallow groundwater flows towards nearest surface water body*

Depth to groundwater? *9-35 feet bgs within cantonment, up to 164 feet bgs in southern hills.*

Uses (agricultural, drinking water, irrigation)? *Drinking Water*

Any groundwater treatment systems? *Only at airfield*

Any groundwater monitoring well locations near the site? *Yes around Range 13 complex, around WWTP*

Is groundwater used for drinking water? *Yes*

Are there drinking water supply wells on installation? *Yes various locations*

Do they serve off-post populations? *No, separate nearby public supply wells in City of Grayling*

Are there off-post drinking water wells downgradient? *Yes*

Waste Water Treatment Plant:

Has the installation ever had a WWTP, past or present? *Yes in South Post*

If so, do we understand the process and which water is/was treated at the plant? *Yes, effluent spray irrigated to west of WWTP at South Post.*

Do we understand the fate of sludge waste? *Never removed*

Is surface water from potential contaminated sites treated? *No current PFAS treatment, TCE contamination at southern end of air field has a groundwater air sparging system*

Equipment Rinse Water

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

Not known.

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

Yes, nozzles were tested and tanks cleaned into/next to Lake Margrethe.

3. Other?

Preliminary Assessment – Conceptual Site Model Information

Identify Potential Receptors:

Site Worker

Construction Worker

Recreational User

Residential

Child

Ecological

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

Residential households located immediately to north of east side of cantonment along Lake Margrethe shore. Households located sporadically along east side of South Post.

Documentation

Ask for Engineering drawings (if applicable). *None available*

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

None in South Post.

Appendix C
Photographic Log

APPENDIX C – Photographic Log

Army National Guard, Preliminary Assessment for PFAS	Camp Grayling	Grayling, Michigan

Photograph No. 1

Description:

Area of interest (AOI) 1: Grayling Army Airfield (GAAF); Standing on southern access road facing north towards the firefighting training area and Runway 32. Snow in foreground.

Photograph No. 2

Description:

AOI1: GAAF; Standing on northern side of Building 1194 facing southeast towards AOI1. Snow piles on right side of photograph. Leaking fire trucks were routinely parked near Building 1194.

APPENDIX C – Photographic Log

Army National Guard, Preliminary Assessment for PFAS	Camp Grayling	Grayling, Michigan

Photograph No. 3

Description:

Camp Grayling Fire Department (at GAAF): Class A firefighting foam concentrate stored in the Camp Grayling Fire Department building.

Photograph No. 4

Description:

Camp Grayling Fire Department (at GAAF): Class A firefighting foam concentrate stored in the Camp Grayling Fire Department building.

APPENDIX C – Photographic Log

Army National Guard, Preliminary Assessment for PFAS	Camp Grayling	Grayling, Michigan

Photograph No. 5

Description:

AOI2: GAAF; standing within AOI2 on west side of the southern portion of Runway 32, facing vehicle maintenance Building 1100 (former MATES; AOI3).

Photograph No. 6

Description:

AOI4: GAAF; Standing at intersection of Runway 32 and 23, looking northeast. Former fire training area

APPENDIX C – Photographic Log

Army National Guard, Preliminary Assessment for PFAS	Camp Grayling	Grayling, Michigan

Photograph No. 7

Description:

AOI11: South Post, Small Arms Range 3A Complex. Standing on southern end of range facing northwest. Snow seen on range floor.

Photograph No. 8

Description:

AOI10: Range 8 – Multipurpose Machine Gun Range. Standing at firing line looking north-northeast.

APPENDIX C – Photographic Log

Army National Guard, Preliminary Assessment for PFAS	Camp Grayling	Grayling, Michigan

Photograph No. 9

Description:

AOI12: Range 20 – light demolitions range. Range 21 not accessible due to icy roads. Standing on northeast end facing southwest towards range floor.

Photograph No. 10

Description:

AOI13: Range 15. Standing on northwest end facing southeast towards range. Fence seen in foreground.

APPENDIX C – Photographic Log

Army National Guard, Preliminary Assessment for PFAS	Camp Grayling	Grayling, Michigan

Photograph No. 11

Description:

AOI14: Building 39 – Former Fire Barn. Standing on Howe Road facing east.

Photograph No. 12

Description:

AOI15: Building 600 area. Standing on east side of 8th Street facing northwest towards Building 600 area.

APPENDIX C – Photographic Log

Army National Guard, Preliminary Assessment for PFAS	Camp Grayling	Grayling, Michigan

Photograph No. 13

Description:

AOI15: Parade Grounds circa 2018. Standing on Howe Road facing north towards Lake Margrethe (seen in background).

Photograph No. 14

Description:

AOI15: Parade Grounds circa 1970s – 1980s. Photograph provided by Kim Halstead. Camp Grayling fire parked on Parade Grounds. Blue AFFF bucket seen in back of truck.

APPENDIX C – Photographic Log

Army National Guard, Preliminary Assessment for PFAS	Camp Grayling	Grayling, Michigan

Photograph No. 15

Description:

AOI15: Wash Rack on corner of Howe Road and 8th Street. Standing on east side facing west. Snow present in wash rack and background.

Photograph No. 16

Description:

AOI15: Larger Wash Rack on corner of Parade Road and 8th Street. Standing on southern side of Wash Rack facing north. Wash Rack surrounded by large concrete pad.

APPENDIX C – Photographic Log

Army National Guard, Preliminary Assessment for PFAS	Camp Grayling	Grayling, Michigan

Photograph No. 17

Description:

AOI14: Building 228Q (circa 2018), standing on west side of buildings facing east. Unpaved parking area in foreground.

Photograph No. 18

Description:

AOI14: Building 228Q (1970s - 1980s). Photograph provided by Kim Halstead.

APPENDIX C – Photographic Log

Army National Guard, Preliminary Assessment for PFAS	Camp Grayling	Grayling, Michigan

Photograph No. 19

Description:

AOI15: Check nozzle area (2018). Standing on Soldier Drive facing southeast toward a frozen, snow covered Lake Margrethe.

Photograph No. 20

Description:

AOI15: Check nozzle area (1970s - 1980s). Photograph provided by Kim Halstead. Camp Grayling Firefighters performing check nozzle maintenance on fire truck next to Lake Margrethe.

APPENDIX C – Photographic Log

Army National Guard, Preliminary Assessment for PFAS	Camp Grayling	Grayling, Michigan

The following photographs were provided by former Camp Grayling firefighter Kim Halstead and annotated by Camp Grayling Environmental Quality Specialist Kimberly Bolan.

Photograph No. 21

Description:

AOI16

APPENDIX C – Photographic Log

Army National Guard, Preliminary Assessment for PFAS	Camp Grayling	Grayling, Michigan

Photograph No. 22

Description:

AOI15

APPENDIX C – Photographic Log

Army National Guard, Preliminary Assessment for PFAS	Camp Grayling	Grayling, Michigan

Photograph No. 23

Description:

Single time emergency response to car accident.

APPENDIX C – Photographic Log

Army National Guard, Preliminary Assessment for PFAS	Camp Grayling	Grayling, Michigan

Photograph No. 24

Description:

AOI17

1981 or 1982 after Buildings were Demolished at the OLd ASP on south access Rd by the Old Quonset Hut at the Range Gate. Burning Brush Piles. Used AFFF to Put out Brush fires.

Photograph No. 25

Description:

AOI18

Pre-Burn on Range 30 Complex in the Early 1980s. AFFF was Put into the water tank on the Fire truck and mixed with water to form wet water to Fight wild Land Fires

← AFFF = Blue Containers on Back of fire truck.

APPENDIX C – Photographic Log

Army National Guard, Preliminary Assessment for PFAS	Camp Grayling	Grayling, Michigan

Photograph No. 26

Description:

AOI1

APPENDIX C – Photographic Log

Army National Guard, Preliminary Assessment for PFAS	Camp Grayling	Grayling, Michigan

Photograph No. 27

Description:

AOI4

APPENDIX C – Photographic Log

Army National Guard, Preliminary Assessment for PFAS	Camp Grayling	Grayling, Michigan

Photograph No. 28

Description:

AOI4

APPENDIX C – Photographic Log

Army National Guard, Preliminary Assessment for PFAS	Camp Grayling	Grayling, Michigan

Photograph No. 29

Description:

AOI4

APPENDIX C – Photographic Log

Army National Guard, Preliminary Assessment for PFAS	Camp Grayling	Grayling, Michigan

Photograph No. 30

Description:

AOI4