FINAL PRELIMINARY ASSESSMENT AND SITE INSPECTION OF PER- AND POLYFLUOROALKYL SUBSTANCES

Milan Army Ammunition Plant, Tennessee

Prepared For:
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Preliminary Assessment and Site Inspection of Per- and Polyfluoroalkyl Substances

Milan Army Ammunition Plant, Tennessee

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EXECUTIVE SUMMARY

The United States Army (Army) is performing preliminary assessments (PAs) and site inspections (SIs) on the current or potential historical use of per- and polyfluoroalkyl substances (PFAS) with a focus on perfluorooctane sulfonate (PFOS), perfluorooctanoic acid (PFOA), and perfluorobutanesulfonic acid (PFBS), at Army installations (installations) nationwide. The PA identifies areas of potential interest (AOPIs) where PFAS-containing materials were used, stored, and/or disposed, or areas where known or suspected releases to the environment occurred. The SI includes multi-media sampling at AOPIs to determine whether or not a release has occurred. The SI may conclude further investigation is warranted, a removal action is required to address immediate threats, or no further action is required. This Milan Army Ammunition Plant (MLAAP) PA/SI was completed in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) and The National Oil and Hazardous Substances Pollution Contingency Plan, and Army/Department of Defense (DoD) policy and guidance.

MLAAP is located in portions of Gibson and Carroll counties in western Tennessee immediately east of Milan, Tennessee. MLAAP is an active U.S. Army installation with the mission to load, assemble, package, store, and ship ammunition.

The MLAAP PA identified 12 AOPIs. Eleven of these AOPIs were selected for investigation during the SI phase. One of the AOPIs (Operable Unit 3 Groundwater Treatment Plant [OU3 GWTP]) was not sampled because groundwater samples from another AOPI (O-Line Ponds/O-Line Lagoons), where the water was treated and discharged by the OU3 GWTP originates, were non-detect for PFOS, PFOA, and PFBS. SI sampling results from the 11 AOPIs were compared to risk-based screening levels calculated by the Office of the Secretary of Defense (OSD) for PFOS, PFOA, and PFBS. PFOS, PFOA, and/or PFBS were detected in soil and/or groundwater at three AOPIs; however, none of the AOPIs had PFOS, PFOA, and/or PFBS present at concentrations greater than the risk-based screening levels. The MLAAP PA/SI did not identify the need for further study in a CERCLA remedial investigation. **Table ES-1** below summarizes the PA/SI sampling results and provides recommendations for further study in a remedial investigation or no action at this time at each AOPI.

Table ES-1. Summary of AOPIs Identified during the PA, PFOS, PFOA, and PFBS Sampling at MLAAP, and Recommendations

AOPI Name	PFOS, PFOA, and/or PFBS Detected Greater than OSD Risk Screening Levels? (Yes/No/ND/NS)		Recommendation
	GW	SO	
Active Fire Station	No	No	No action at this time
Area K Fire Systems Testing	ND	ND	No action at this time
Line Z Flare Composition Facility	ND	ND	No action at this time
O-Line Ponds/ O-Line Lagoons	ND	ND	No action at this time
Operable Unit 3 (OU3) Groundwater Treatment Plant (GWTP)	NS/ND*	NS/ND*	No action at this time
Open Burning Ground	ND	ND	No action at this time
Active Industrial Landfill	ND	NS	No action at this time
Ammunition Destruction Area	ND	NS	No action at this time
Line E	ND	ND	No action at this time
Active WWTP	NS	ND	No action at this time
Spray Fields	ND	No	No action at this time
Line K Former Metal Plating Facility	ND	No	No action at this time

Notes:
* - Samples were not collected within the OU3 GWTP AOPI during this SI. The surrogate soil and groundwater samples collected from the O-Line Ponds/O-Line Lagoons AOPI (the origin of water discharged by the OU3 GWTP) address the presence/absence of PFOS, PFOA, and PFBS at both AOPIs.
GW – groundwater
ND – non-detect
NS – not sampled
SO – soil

1 INTRODUCTION

The United States (U.S.) Army (Army) is performing preliminary assessments (PAs) and site inspections (SIs) on the current or potential historical use of per- and polyfluoroalkyl substances (PFAS) with a focus on perfluorooctane sulfonate (PFOS), perfluorooctanoic acid (PFOA), and perfluorobutanesulfonic acid (PFBS), at Army installations (installations) nationwide. The Army is the lead agency under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) and Executive Order 12580 and is conducting the PA/SI consistent with its authority under CERCLA, 42 United States Code §§ 9600, et seq. (as amended), and the Defense Environmental Restoration Program, 10 United States Code §§ 2701, et seq. The PFAS PA/SI included two distinct efforts. The PA identified locations that are areas of potential interest (AOPIs) at Milan Army Ammunition Plant (MLAAP), Tennessee based on the use, storage, and/or disposal of PFAS-containing materials, in accordance with the 2018 Army Guidance for Addressing Releases of Per-and Polyfluoroalkyl Substances (Army 2018). The SI included multi-media sampling at AOPIs to determine whether or not a release has occurred, and the PFOS, PFOA, and PFBS results were compared to the Office of the Secretary of Defense (OSD) PFOS, PFOA, and PFBS risk screening levels to determine whether further investigation is warranted. This report provides the PA/SI for MLAAP and was completed in accordance with CERCLA and The National Oil and Hazardous Substances Pollution Contingency Plan.

1.1 Project Background

PFAS are a class of compounds that have been used in a wide range of industrial applications and commercial products due to their unique surface tension/leveling properties. Due to industry and regulatory concerns about the potential health effects and adverse environmental impacts, there has been a reduction in the manufacture and use of PFAS worldwide. In the U.S., significant reductions in the production, importation, and use of PFOS and PFOA (two individual compounds in the PFAS class) occurred between 2001 and 2015 (Interstate Technology Regulatory Council 2017). PFBS replaced PFOS in some applications and is currently used and manufactured in the U.S.

In 2016, the United States Environmental Protection Agency (USEPA) established a lifetime health advisory of 70 nanograms per liter (ng/L) in drinking water for PFOS or PFOA and for the sum of PFOS and PFOA when both are present (USEPA 2016a). On 15 October 2019, the OSD provided guidance on the investigation of PFOS, PFOA, and PFBS at Department of Defense (DoD) restoration sites (OSD 2019). The DoD guidance provides risk screening levels for PFOS, PFOA, and PFBS in groundwater (tap water) and soil, calculated using the USEPA's Regional Screening Level (RSL) calculator for residential and industrial/commercial worker receptor scenarios. Following the issuance of the 2019 OSD memo, on 08 April 2021, USEPA published an updated toxicity assessment for PFBS (USEPA 2021). Based on the updated toxicity assessment for PFBS, the OSD issued a memorandum on 15 September 2021 to include updated PFBS risk screening levels (OSD 2021). The September 2021 Memorandum: Investigating Per- and Polyfluoroalkyl Substances within the Department of Defense Cleanup Program is provided for reference as **Appendix A**. The OSD risk screening levels for tap water (also used to evaluate groundwater) are 40 ng/L for PFOS and PFOA, and 600 ng/L for PFBS. The PFOS and PFOA soil screening levels for the residential and industrial/commercial scenarios are 0.13 milligrams per kilogram (mg/kg) (residential) and 1.6 mg/kg (industrial/commercial). The soil screening levels for PFBS are 1.9

mg/kg (residential) and 25 mg/kg (industrial/commercial). These screening criteria are discussed further in **Section 6.5**.

1.2 PA/SI Objectives

This PA/SI was conducted consecutively because the results of the PA yielded AOPIs that necessitated continuing onto the SI phase in accordance with CERCLA. Consequently, this report provides the combined objectives of both PA and SI reports.

1.2.1 PA Objectives

During the PA, investigators collect readily available information and conduct site reconnaissance. This PA will evaluate and document areas where PFAS-containing materials were used, stored, and/or disposed, so the Army can distinguish between sites that pose little or no threat to human health and the environment and sites that require further investigation.

1.2.2 SI Objectives

An SI is conducted when the PA determines an AOPI exists based on probable use, storage, and/or disposal of PFAS-containing materials. The SI includes multi-media sampling at AOPIs to determine whether or not a release has occurred. The SI may conclude further investigation is warranted, a removal action is required to address immediate threats, or no further action is required.

Installation-specific data quality objectives (DQOs) and the sampling design and rationale are summarized in **Sections 6.1** and **6.2**.

1.3 PA/SI Process Description

For MLAAP, PA/SI development followed a similar process as described in **Sections 1.3.1** through **1.3.5** below. **Section 3** provides a summary of the PA activities completed, and **Section 6** provides a summary of the SI activities completed for MLAAP. The PA and SI processes are documented in the PA/SI Quality Control Checklist included as **Appendix B**.

1.3.1 Pre-Site Visit

First, an installation kickoff teleconference was held between applicable points of contact (POCs) from United States Army Environmental Command (USAEC), United States Army Corps of Engineers (USACE), MLAAP, and Arcadis U.S., Inc. (Arcadis). The kickoff call occurred on 31 January 2019, 5 weeks before the site visit, to discuss the goals and scope of the PA, project scheduling, installation access, timeline for the site visit, access to installation-specific databases, and to request available records.

Records review was conducted before the site visit to obtain electronically available documents from the installation and external sources for review. The purpose of the records research was to identify any area

on the installation that may have been a location where PFAS-containing materials were used, stored, and/or disposed, as well as gather information on the physical setting and site history at MLAAP.

A read-ahead package was prepared and submitted to the appropriate POCs two weeks before the site visit. The read-ahead package contained the following information:

- The Army Materiel Command (AMC) operation order
- The Army PA Operations Security requirements package, which includes the antiterrorism/operations security review cover sheet (**Appendix C**)
- The PFAS PA kickoff call minutes
- An information paper on the PA portion of the Army's PFAS PA/SI
- Contact information for key POCs
- A list of the data sources requested and reviewed
- A list of preliminary locations identified during the kick-off call and pre-site visit records review to be evaluated for use, storage, and/or disposal of PFAS-containing materials, where additional information on those areas will be collected through personnel interviews, additional document review, and site reconnaissance.
- A list of roles for the installation POC to consider when recommending potential interviewees.

1.3.2 Preliminary Assessment Site Visit

The site visit was conducted from 11 to 12 March 2019. An in-brief meeting was held to provide installation staff with the objectives of the site visit and team introductions. **Section 3** includes information regarding personnel interviewed.

Personnel interviews were conducted with individuals having significant historical knowledge at MLAAP. The interviews focused on confirming information discussed in historical documents, collecting information that may have not been in historical documents, and corroborating other interviewees' information.

Site reconnaissance included visual surveys that assessed the points of potential use, storage, and/or disposal of PFAS-containing materials, as well as potential secondary impacts, and the migration potential from each AOPI (e.g., stormwater drains, building drains and sumps, cracks in the floor/pavement). Physical attributes of the preliminary locations were documented, including local slope and ground and floor conditions (i.e., paved, unpaved, visual staining), surface water bodies and surface flow, potential receptors, and the distance to the installation boundary. Access to existing groundwater monitoring wells, if present, were also noted during the site reconnaissance in case the monitoring wells could be proposed for future SI sampling. Photo documentation of the preliminary locations was collected, and access limitations or advantages related to potential future sampling activities were noted.

An exit briefing was offered to installation personnel at the conclusion of the site visit to raise any items identified during the site visit, discuss any follow-up items, and review the schedule for submitting deliverables. The exit briefing was conducted on 12 March 2019 with the installation to discuss preliminary findings of the PA site visit.

1.3.3 Post-Site Visit

Information collected before, during, and after the site visit was reviewed and corroborated by cross-referencing records and reviewing interview details and observations noted during site visit reconnaissance. A site visit trip report was completed and provided to the installation POC, applicable USAEC POCs, and USACE regional POCs following the site visit. The information collected during the pre-site visit and site visit activities was compiled to develop the installation-specific PA portion of the PA/SI report (**Section 3**). Site data obtained during the PA were used to develop preliminary conceptual site models (CSMs) for each AOPI, which serve as the basis for developing the SI scope of work presented in an installation-specific Quality Assurance Project Plan (QAPP) Addendum.

1.3.4 Site Inspection Planning and Field Work

The SI process was initiated at the installation to evaluate PFOS, PFOA, and PFBS presence or absence at each AOPI and determine whether further investigation is warranted. First, an SI kickoff teleconference was held between the Army PA team and MLAAP.

The objectives of the SI kickoff teleconference were to:

- discuss the AOPIs selected for sampling and the proposed sampling plan for each AOPI
- gauge regulatory involvement requirements or preferences
- identify overlapping unexploded ordinance or cultural resource areas
- discuss the plan for investigation-derived waste (IDW) handling and disposal
- identify specific installation access requirements and potential schedule conflicts
- discuss general SI deliverable and field work schedule information and logistics

Following development of the SI sampling technical approach, an SI scoping teleconference was held to obtain concurrence on the SI sampling plan from USAEC, USACE, and the installation. Additional discussion topics included:

- confirm overlapping unexploded ordnance or cultural resource areas
- discuss the unexploded ordnance escort plan
- confirm specific installation access requirements and potential schedule conflicts
- confirm the plan for IDW handling and disposal
- provide an updated SI deliverable and field work schedule

A Programmatic Uniform Federal Policy-Quality Assurance Project Plan (PQAPP) was developed and finalized in October 2019 for the USAEC PFAS PA/SI (Arcadis 2019). The PQAPP details general planning processes for collecting data and describes the implementation of quality assurance (QA) and quality control (QC) activities for the SI portion for Army installations nationwide. Additionally, an

installation-specific QAPP Addendum was developed to define the DQOs, present the sampling design and rationale, and provide qualifications for project personnel. The SI field work was completed in accordance with the PQAPP (Arcadis 2019) and the approved installation-specific QAPP Addendum. A Site Safety and Health Plan (SSHP) was also developed as an attachment to the QAPP Addendum to identify specific health and safety hazards that may be encountered at the installation during sampling. The SSHP was designed to supplement the Accident Prevention Plan (Arcadis 2018), which was developed for Army installations nationwide. The QAPP Addendum and SSHP were submitted to the installation and finalized before commencement of field work.

The DQOs, sampling design and rationale, and field methods employed for the SI are summarized from the QAPP Addendum developed for MLAAP (Arcadis 2020) in **Sections 6.1** through **6.3**.

After finalization of the QAPP Addendum and SSHP, field planning and coordination with the installation and subcontractors was completed. Once the schedule was determined, field teams mobilized to the installation to complete the scope of work defined in the QAPP Addendum.

1.3.5 Data Analysis, Validation, and Reporting

Environmental samples collected during the SI were submitted to a laboratory which is DoD Environmental Laboratory Accreditation Program (ELAP)-accredited for PFOS, PFOA, and PFBS analysis by liquid chromatography with tandem mass spectrometry and compliant with the DoD Quality Systems Manual (QSM) 5.1.1 (DoD 2018). Laboratory analytical results were then validated and verified by a project chemist to assess the usability of the data collected. Validated analytical results were summarized in the context of OSD risk screening levels (defined in **Section 6.5**).

2 INSTALLATION OVERVIEW

The following subsections provide general information about MLAAP, including the location and layout, the installation mission(s) over time, a brief site history, current and projected land use, climate, topography, geology, hydrogeology, surface water hydrology, potable wells within a 5-mile radius of the installation, and applicable ecological receptors.

2.1 Site Location

MLAAP is located in portions of Gibson and Carroll counties in western Tennessee, immediately west of Milan, Tennessee, 26.5 miles north of Jackson, Tennessee, and approximately 50 miles east of the Mississippi River (**Figure 2-1**). The facility spans 22,357 acres. MLAAP is bordered on the northeast and east by land owned by the Tennessee National Guard, on the west and northwest by land owned by the City of Milan and the University of Tennessee, and on the north and south by private farmland (Tetrahedron, Inc. 2017). The site layout is shown on **Figure 2-2.**

2.2 Mission and Brief Site History

MLAAP opened in 1942 and was an active U.S. Army installation with the mission to load, assemble, package, store, and ship ammunition. Currently, MLAAP is under the U.S. Army Headquarters Joint Munitions Command. Production facilities at MLAAP historically included 10 ammunition load, assemble, and package (LAP) lines, one washout/rework line, one central x-ray facility, one test area, two shop maintenance areas, 16 permitted hazardous waste storage areas, a demolition and burning grounds area, and an administrative area. The LAP lines, x-ray facility, test area, and washout/rework line are inactive and being transferred to closed status. One shop area is open, and the installation has one active industrial wastewater treatment plant (WWTP) (Tetrahedron, Inc. 2017).

2.3 Current and Projected Land Use

Multiple uses of land within the boundary of MLAAP often overlap. Land uses include munitions productions areas, munitions storage areas, ammunition destruction areas, test area, cantonment area, landfills, domestic wastewater irrigation spray fields, and buffer zones which are managed as agricultural and grazing out-leases and managed forest areas.

There are various tenants at MLAAP, such as Appalachian Rail Service, Esterline, Greenway Nursery, ORICA, Kilgore Flares, and JABEZCO (Kennedy 2014).

2.4 Climate

The Milan, Tennessee area climate is defined as humid subtropical with mild winters and hot, humid summers. Annual rainfall is approximately 54 inches with an average minimum of 3 inches in August and a maximum 5.6 inches in December; there is typically no dry season. Relative humidity averages 60 to 70 percent (%). Monthly mean temperature ranges from 40 degrees Fahrenheit in the winter to 77 degrees Fahrenheit in the summer. Winds are mostly from the south and average 6 to 10 miles per hour (Arcadis 2020).

2.5 Topography

The topography of MLAAP and the surrounding area is gently rolling to level terrain with a westward regional slope (**Figure 2-3**). Ground elevation varies from approximately 590 feet above mean sea level in the southern portion of the installation to 320 feet above mean sea level at its northern boundary (Arcadis 2013).

2.6 Geology

MLAAP is located on the eastern flank of the Mississippi Embayment in the Gulf Coastal Plain Physiographic Province. The Mississippi Embayment is structurally a down-warped, down-faulted trough, the axis of which approximates the course of the Mississippi River (Moore 1965). The trough contains sediments and sedimentary rocks, ranging in age from Cretaceous to recent. These sediments consist of sand, gravel, lignite, clay, chalk, and limestone units that vary in thickness. The geology of MLAAP is composed of the Middle Claiborne Group and the Upper Wilcox Group underlain by the Porters Creek Clay (Parks and Carmichael 1990). The stratigraphy at MLAAP has been separated into two units, a surficial unit that is primarily composed of clay and silty clay and an underlying thick body of sand (Arcadis 2013).

The surficial unit is primarily composed of tan to reddish-brown clay and silty clay of medium to high plasticity with some layers of very fine to fine sand and silty sand. These surficial deposits (clay and silty clay) can extend to a depth of 50 to 65 feet below ground surface (bgs) and may exist below the water table at discrete locations. The deeper thick body of sand includes lenses or beds of silt and clay at various depths. Locally, the silt and clay lenses are not laterally extensive. The sand ranges from very fine to very coarse. Stringers of white clay have been observed at various depths. Boring logs from previous investigations have noted that the thick body of sand (i.e., Memphis Sand of the Tertiary Age Claiborne Group) coarsens with depth (Arcadis 2013). The Memphis Sand unit primarily consists of a thick body of very fine to very coarse sand that includes subordinate lenses or beds of clay and silt at various horizons. The Memphis Sand unit generally ranges from 0 to approximately 900 feet in thickness.

2.7 Hydrogeology

The major aquifer beneath the MLAAP study area is the Memphis Aquifer, which is composed of the Memphis Sand unit. Where saturated, the Memphis Sand unit makes up the Memphis Aquifer, and regionally, the Memphis Aquifer is included in the Lower Claiborne-Upper Wilcox Aquifer and Middle Claiborne Aquifer. On a regional scale, groundwater within the Memphis Aquifer generally flows west toward the eventual discharge point at the Mississippi River, approximately 50 miles west of MLAAP. The aquifer system that includes the Memphis Sand formation is the most prolific source of groundwater in Tennessee and serves as the primary source of drinking water for western Tennessee (Parks and Carmichael 1990).

Beneath the MLAAP area, the Memphis Aquifer is approximately 200 to 300 feet thick and is generally unconfined. Semi-confining conditions may also exist at depth due to the presence of discontinuous clay layers (lenses) throughout the formation (Parks and Carmichael 1990). As measured in monitoring wells distributed across MLAAP, depth to groundwater ranges from approximately 97 feet bgs to less than 1

foot bgs near the Rutherford Fork of the Obion River (RFOR; Arcadis 2013). Depth to groundwater may be greater in areas where no previous investigations have been conducted.

Vertical well clusters at MLAAP generally show a downward vertical hydraulic gradient, indicating recharge conditions. However, well clusters located near the RFOR show an upward vertical hydraulic gradient, indicating discharge conditions.

The RFOR, located along the northern boundary of the site, acts as the predominant groundwater discharge boundary for the Memphis Aquifer in the vicinity of the installation. Groundwater beneath the site generally flows to the north-northwest toward the RFOR and other regional discharge features (e.g., Mississippi River).

Results of aquifer tests performed on wells screened within the Memphis Aquifer at MLAAP indicate a range in hydraulic conductivity values of approximately 1.1 to 167 feet per day, with the lower range of hydraulic conductivity values likely representative of areas where clay layers are more prevalent within the formation. Using the range in hydraulic conductivity values estimated from aquifer tests performed at MLAAP (1 to 167 feet per day), an assumed hydraulic gradient of 0.0015 feet per foot, and an “effective” porosity of 20%, the average interstitial groundwater velocity at the site is estimated to range from approximately 3 to 467 feet per year (Arcadis 2013).

The installation restoration strategy is to separate the installation into Operable Units (OUs) and/or major study areas. These areas are defined as follows:

- OU1: The groundwater plume emanating from O-Line
- OU2: The O-Line ponds soils, sediments, and surface water
- OU3: The remaining sources and groundwater contamination within the O-Line ponds basin that is not included as part of OU1 and OU2 units.
- OU4: All aspects of groundwater contamination arising from residues due to past discharges emanating from lines A, F, G, V, X, and Z, as well as several ditches and Wolf Creek.

2.8 Surface Water Hydrology

There are numerous perennial and ephemeral surface water features within MLAAP, including streams, creeks, and drainage ditches. Due to the significant depth to the water table across most of MLAAP the majority of the surface water creeks and drainage channels across and adjacent to MLAAP are considered to be “losing streams”.

Many of the streams and drainages within the facility drain northward to the RFOR. The southernmost portion of MLAAP drains south to the Middle Fork of the Forked Deer River. Wolf River and its associated tributaries, Dry Creek, East Fork of Wolf Creek, and West Fork of Wolf Creek drain the southern and central sections of the post and flow northward to the RFOR. The northeastern portion of MLAAP drains to Halls Branch, Johns Creek, and then to the RFOR. The MLAAP installation has several well-developed, ephemeral drainage pathways shown as ditches on **Figure 2-2**. These ditches join the RFOR along the northern boundary, and Wolf Creek and Johns Creek along the western and eastern boundaries, respectively. There is also a wetland area (i.e., groundwater discharge area) north of Area N

and south of the RFOR. The Obion River and Forked Deer River ultimately empty into the Mississippi River, which is approximately 50 miles west of MLAAP.

The RFOR to the north of MLAAP represents the major downgradient discharge boundary for groundwater (i.e., it is considered a gaining stream), and therefore, the potential exists for contamination in groundwater to discharge to the RFOR. Wolf Creek, located to the west of MLAAP, is not a significant groundwater discharge point and does not represent a hydraulic boundary to groundwater flowing from MLAAP. The majority of the streams and drainage channels in the upland area of MLAAP are losing streams; however, these same streams and drainage channels are gaining (receive groundwater) where the incised channels are in contact with the shallow water table at the northern boundary of MLAAP close to the RFOR (Arcadis 2013). The rivers, streams, and water bodies, along with the general surface water directions of flow are shown on **Figure 2-2**.

2.9 Relevant Utility Infrastructure

The following subsections provide general information regarding the installation's stormwater and wastewater management systems, as well as information on how the utility infrastructures may influence the fate and transport of PFAS constituents at MLAAP.

2.9.1 Stormwater Management System Description

Stormwater is managed via the MLAAP Spill Prevention, Control, and Countermeasures Program to prevent contaminants from entering surface drainages and groundwater and to accomplish protection of surface water from contamination. National Pollution Discharge Elimination System (NPDES) stormwater drainages flow in a northerly direction off the installation and eventually enter the RFOR.

MLAAP has a Stormwater Pollution Prevention Plan in accordance with requirements specified in the facility's NPDES Permit. The NPDES permit currently contains five stormwater outfalls, which are monitored on an annual basis. MLAAP's Stormwater Pollution Prevention Plan combines its Spill Prevention, Control, and Countermeasures/Installation Spill Continency Programs with erosion control at construction areas to accomplish the goals of the stormwater pollution prevention effort (Kennedy 2014).

2.9.2 Sewer System Description

MLAAP has four industrial WWTPs, two are active and two are in standby mode. The industrial WWTPs discharge into MLAAP's sanitary sewer system. These pretreated discharges, along with MLAAP's other domestic and non-process wastewater flows, receive further treatment at the Active WWTP and are then land-applied to the Plant's Slow Rate Land Application (spray field) so that the treated wastewater does not create a surface drainage channel (i.e., outfall). The spray field system is operated in accordance with the terms and conditions of an NPDES Permit.

A major sanitary sewer rehabilitation project to reduce the amount of extraneous flow to the sewer was completed in 2003. Regular testing and repair of the system is conducted to reduce inflow and infiltration (Kennedy 2014).

2.10 Potable Water Supply and Drinking Water Receptors

Drinking water wells on the installation (**Figure 2-2**) are screened in sands of the Clairborne and Wilcox groups up to 100 feet bgs. Generally, there is no hydrologic boundary, except for the RFOR, located along the northern boundary of the site. Construction details for on-post drinking water supply wells are provided in **Table 2-1**. The MLAAP public water system is designated as Community System #1, public water system (PWS) identifier #0000798. The system consists of three drinking water supply wells (C-5, S-99, and T-99). The combined capacity of the active wells is 3,000 gallons per minute, or 4,320,000 gallons per day. Water is treated at the wellheads. The water distribution system consists of approximately 42 miles of water mains, approximately 600 valves and 255 fire hydrants. Water storage consists of five elevated water storage towers. MLAAP drinking water customers are the industrial facilities which are tenants at MLAAP, including Moore Supply, and the Orchard House at the former Line G. MLAAP supplies potable water to a limited portion of the Tennessee Army National Guard Training Center near headquarters building T-116. Some tenants, including United Ammunition Container, Esterline, and the Tennessee Army National Guard Training Center at Lavenia are not on the MLAAP water supply.

Off-installation drinking water is also sourced from groundwater. The Milan Water Department extraction wells are located approximately 1 mile from the westernmost boundary of the installation. An Environmental Data Resources, Inc. (EDR) report includes search results from a variety of environmental, state, city, and other publicly available databases for a referenced property. An EDR report was generated for MLAAP, which along with state and county GIS provided by the installation identified several off-post public and private wells within 5 miles of the installation boundary (**Figure 2-4**). The EDR report providing well search results is provided as **Appendix E**.

2.11 Ecological Receptors

The PA team collected information regarding ecological receptors that was available in the installation documents reviewed during the PA process. The following information is provided for future reference should the Army decide to evaluate exposure pathways relevant to the ecological receptors.

MLAAP does not have any federally endangered, threatened, or candidate species. State species with listings of endangered, threatened, or deemed in need of management occurring within the MLAAP boundary are the following (Kennedy 2014):

- Plants: compass plant and willowleaf aster
- Mammals: southeastern shrew, southeastern myotis bat, meadow jumping mouse, and eastern woodrat
- Birds: sharp-shinned hawk, great egret, northern harrier, loggerhead shrike, barn owl, and yellow-bellied sap sucker
- Amphibians: barking treefrog

2.12 Previous PFAS Investigations

Previous (i.e., pre-PA) PFAS investigations relative to MLAAP, including both those conducted and not conducted by the Army, are summarized to provide full context of available PFAS data for MLAAP. However, only data collected by the Army will be used to make recommendations for further investigation.

In response to the third Unregulated Contaminant Monitoring Rule, samples were collected in 2013 from the PWS Jackson Water System, which is located near the southern boundary of the installation. The PWS identifier for the Jackson Water System is TN0000299. Samples were also collected in 2015 from the PWS Lexington Water System, which is located southeast of the installation. The PWS identifier for the Lexington Water System is TN0000402. Samples were collected at the entry points of the distribution systems and were analyzed for various parameters, including PFOS and PFOA. PFOS and PFOA were not detected in these samples during these sampling events; the practical quantitation limit was 40 and 20 ng/L, or parts per trillion, respectively (USEPA 2016b).

Water samples were collected for PFOS and PFOA analysis in 2016 from the Milan Water Department (PWS identifier TN0000458) and the Milan Arsenal #1 water system (PWS identifier TN0000798). Results from these sampling events can be found in **Table 2-2**. Samples were collected from TN0000798 sample ports in wellhouse S-99 and C-5, as well as the TN0000458 tap in Building Y-103. PFOS and PFOA were not detected above the minimum reportable level (40 ng/L and 20 ng/L, respectively: Tetrahedron, Inc. 2018). Well T-99 was not sampled during this event because the well was offline for maintenance. The laboratory which analyzed samples under these previous sampling events met the USEPA's UCMR3 Laboratory Approval Program application and Proficiency Testing criteria for USEPA Method 537 Version 1.1.

3 SUMMARY OF PA ACTIVITIES

To document areas where any potential current and/or historical PFAS-containing materials were used, stored, and/or disposed at MLAAP, data was collected from three principal sources of information:

1. Records review
2. Personnel interviews
3. Site reconnaissance

These sources of data, along with their relative application to this PA, are discussed below. The specific findings of records review, personnel interviews, and site reconnaissance relevant to PFAS-containing materials at MLAAP are described in **Section 4**.

3.1 Records Review

The records reviewed for this PA included, but were not limited to, various Installation Restoration Program (IRP) administrative record documents, compliance documents, MLAAP fire department documents, MLAAP directorate of public works documents, and GIS files. Internet searches were also conducted to identify other publicly available relevant information. A list of the specific documents reviewed for MLAAP is provided in **Appendix F**.

3.2 Personnel Interviews

Interviews were conducted during the site visit. If a previously identified interviewee was not available during the site visit, attempts were made to complete the interview via telephone before or following the site visit or by contacting an alternate interviewee identified by the installation POC.

The list of roles for the installation personnel interviewed during the PA process for MLAAP is presented below (affiliation is with MLAAP unless otherwise noted).

- Environmental Coordinator
- Engineer
- Natural Resource Manager
- American Ordnance, LLC (AO) Environmental Manager
- AO Environmental Compliance Coordinator
- AO Fire Captain
- AO Fire/Security Chief
- Retired AO Environmental Manager
- AO Maintenance Manager
- AO Burning Ground Manager

The compiled interview logs are provided in **Appendix G**.

3.3 Site Reconnaissance

Site reconnaissance and visual surveys were conducted at the preliminary locations identified at MLAAP during the records review process, the installation in-brief meeting, and/or during the installation personnel interviews. A photo log from the site reconnaissance is provided in **Appendix H**; photos were used to assist in verification of qualitative data collected in the field. The site reconnaissance logs are provided in **Appendix I**.

Access to existing groundwater monitoring wells, if present, were also noted during the site reconnaissance in case the monitoring wells could be proposed for SI sampling.

Preliminary locations of potential use, storage, and/or disposal of PFAS-containing materials were then evaluated in the PA (during records review, personnel interviews, and/or site reconnaissance) and were categorized as AOPIs or as areas not retained for further investigation at this time based on a combination of information collected.

A summary of the observations made, and data collected through records reviews (**Appendix F**), installation personnel interviews (**Appendix G**), and site reconnaissance logs (**Appendix I**) during the PA process for MLAAP is presented in **Section 4**. Further discussion regarding rationale for not retaining areas for further investigation is presented in **Section 5.1**, and further discussion regarding categorizing areas as AOPIs is presented in **Section 5.2**.

4 POTENTIAL PFAS USE, STORAGE AND/OR DISPOSAL AREAS

MLAAP was evaluated for all potential current and historical use, storage, and/or disposal of PFAS-containing materials. There are a variety of PFAS-containing materials used in relation to current and historical Army operations. However, the use, storage, and/or disposal of aqueous film-forming foam (AFFF) is the most prevalent potential source of PFAS chemicals at DoD facilities. This section is organized to summarize the AFFF-related uses first, and all remaining potential PFAS-containing materials in the subsequent section.

4.1 AFFF Use, Storage, and Disposal Areas

AFFF was developed in the mid-1960s in response to a need for firefighting foams better suited to extinguish Class B, fuel-based fires. AFFF formulations consist of water, an organic solvent, up to 5% hydrocarbon surfactants, and 1 to 3% PFAS (Interstate Technology Regulatory Council 2020). AFFF concentrate is designed to be diluted with water to become a 1, 3, or 6% foam. AFFF releases at DoD facilities may have occurred during firefighter training, emergency response actions, equipment testing, or accidental releases. The military still primarily uses AFFF for Class B fires; however, the current formulations of AFFF contain significantly lower amounts of PFOS, PFOA, and their precursors, and significant operational changes have been implemented to restrict uncontrolled releases and non-essential use of PFAS-containing foams. Army installations may still house AFFF, commonly stored in closed containers (e.g., 55-gallon drums, 5-gallon buckets), within designated storage buildings or at firehouses.

MLAAP Fire Department and Directorate of Public Works Environmental personnel were interviewed regarding AFFF use and storage. Additionally, information on AFFF storage was collected from historical reports and documents provided by the Army.

There is one active fire station on MLAAP. During site reconnaissance (**Appendix I**), AFFF was observed stored on shelves at the Active Fire Station (Building F-50) and in Building F-172, a shed with a concrete foundation and floor drain. Approximately eight 5-gallon containers of 3% to 6% Pioneer, three 5-gallon containers of Chemguard 3% C301MS, three 5-gallon containers of 3M Light Water, and one 5-gallon container of Chemguard 3% to 6% C361 Class B AFFF remained in storage at Buildings F-50 and F-172 as of the PA site visit. Two 5-gallon containers of Chemguard 3% C301MSF also remain in storage on the fire truck. In addition to the 17 containers of Class B AFFF noted above, there were two 5-gallon containers of Buckeye Class A foam and one unknown 5-gallon container of foam. There are no known spills or accidental releases of this AFFF in storage.

The MLAAP Fire Department provided safety data sheets (SDSs) for all materials found in storage at MLAAP. In total, twenty, 5-gallon containers of foam and twelve, 1-gallon containers of Water Wetter were observed on shelves located on concrete foundations with a drain that leads to the Active WWTP. Water Wetter does not contain PFOS, PFOA, or PFBS.

For emergency preparedness, installation/fire department personnel were trained to performed nozzle testing with AFFF to ensure optimal flow and use of the AFFF mixture. Nozzle testing involved spraying AFFF through fire equipment. Fire equipment training also included arc training to maximize the arc,

reach, and distance covered by AFFF in an emergency response. The review of historical documents and personnel interviews did not indicate nozzle testing or tank flushing involving AFFF discharge at the Active Fire Station (Building F-50). Current fire training activities at MLAAP include controlled burns of vegetation and fire training exercises with Water Wetter along the railroad tracks adjacent to the fire house; AFFF is not used for these activities.

However, during personnel interviews (**Appendix G**), the Area K fire systems training area was identified as a potential location for the use of AFFF foam. A first-hand witness reported AFFF foam being sprayed in the field adjacent to the Area K Building K-323 well house using water extracted from a nearby holding pond. This event occurred around the mid- to late-1980s.

4.2 Other PFAS Use, Storage, and/or Disposal Areas

Following document research, personnel interviews, and site reconnaissance at MLAAP, multiple wastewater treatment systems and landfills were also preliminarily identified as locations of potential use, storage, and/or disposal of PFAS-containing materials. Most of these did not have any suspected receipts of PFAS-containing waste. Additionally, the installation has historical metal plating operations, laundry facilities, x-ray facilities, a maintenance facility, and operations involving Teflon® use. Currently active facilities considered as potential PFAS sources include a pesticide storage/mixing area and car washes. A summary of information gathered in the PA for each of these preliminary locations is described below. Specific discussion regarding areas not retained for further investigation is presented in **Section 5.1** and specific discussion regarding areas retained as AOPIs is presented in **Section 5.2**.

Potential PFAS use associated with metal plating activities may be relevant to Army installations. During metal plating operations, a metal surface may be treated with a layer of electrochemically deposited metals in an acid bath. PFAS, specifically PFOS, have been used in metal plating operations as surface tension-reducing wetting agents to mitigate the release of aerosolized chemicals into a working environment. Hard chromium plating is one type of metal plating operation where PFAS-containing mist suppressants were commonly used. Historically, it was common for spent plating baths from metal plating operations to be disposed of in a lined or unlined pit or into a sanitary or storm sewer. Therefore, PFAS present in mist suppressants during the metal plating process could be released to the environment.

Zinc chromate electrolytic plating and cadmium electrolytic plating processes were performed at Building K-50 from the early-1940s to approximately 1975. Historical information regarding details of the operation and use of mist suppression is unavailable. Reports document that a settling pond slightly north of Building K-50 was used for plating waste collection, and cadmium has been detected in soil (Arcadis 2006). Wastewater was treated then discharged to a drainage ditch leading to a pond located in Line K. Sludge from plating processes was loaded onto rail cars to transport to an unknown location. The Line K facility is still in place but is not in use. The pond has been filled in and is dry.

During a telephonic interview with the IMCOM Pest Management Consultant, it was noted that products containing Sulfluramid (i.e., associated with insecticides) may have contained PFAS and were phased out in 1996. During the PA records review, the IMCOM Pest Management Consultant provided records of potentially PFAS-containing pesticides and insecticides used at and/or stored at Army installations and did not identify MLAAP as an installation having used or stored PFAS-containing pesticides/insecticides.

Additionally, the PA team reviewed available pesticide use inventory documentation provided by the installation and did not identify PFAS-containing pesticides use, storage, or disposal.

4.3 Readily Identifiable Off-Post PFAS Sources

An exhaustive search to identify all potential off-post PFAS sources (i.e., not related to operations at MLAAP) is not part of the PA/SI. However, potential off-post PFAS sources within a 5-mile radius of the installation are recorded if identified during the records search and site visit. No such off-post potential PFAS sources were identified near MLAAP.

5 SUMMARY AND DISCUSSION OF PA RESULTS

The preliminary locations evaluated for potential use, storage and/or disposal of PFAS-containing materials at MLAAP were further refined during the PA process and identified either as an area not retained for further investigation or as an AOPI. In accordance with the established process for the PA/SI, 12 have been identified as AOPIs. The process used for refining these areas is presented on **Figure 5-1**, below.

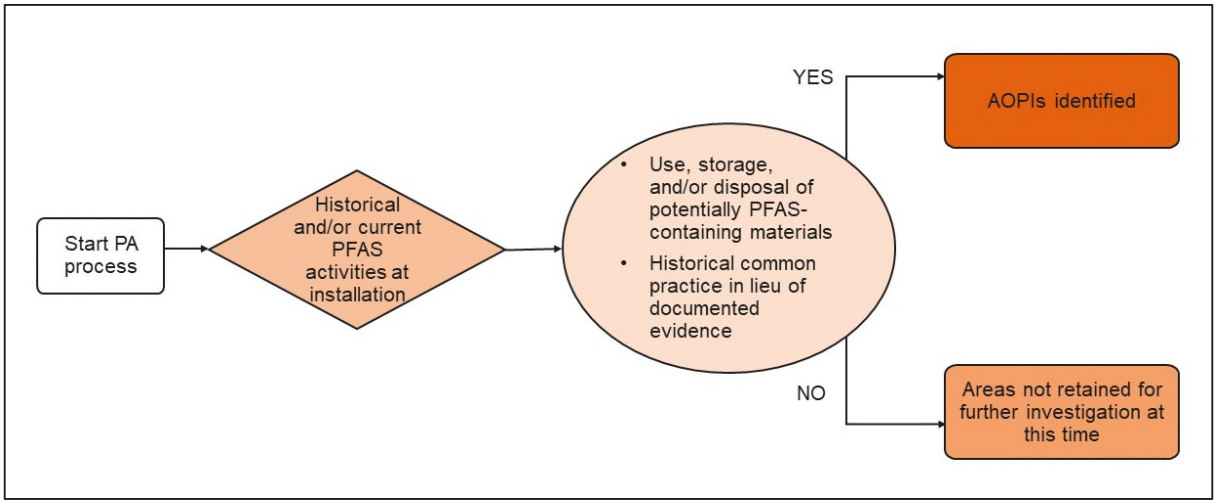

Figure 5-1: AOPI Decision Flowchart

The areas not retained for further investigation are presented in **Section 5.1**. The areas retained as AOPIs are presented in **Section 5.2**.

Data limitations for this PA/SI at MLAAP are presented in **Section 8**.

5.1 Areas Not Retained for Further Investigation

Through the evaluation of information obtained during records review, personnel interviews, and/or site reconnaissance, the areas described below were categorized as areas not retained for further investigation at this time.

A brief site history and rationale for areas not retained for further investigation are presented in **Table 5-1**, below.

Table 5-1. Installation Areas Not Retained for Further Investigation

Area Description	Dates of Operation	Relevant Site History	Rationale
Line J, Building J-4 Laundry Facility	1980s to Unknown	A fire-retardant material (Spartan X-12, which does not contain PFOS, PFOA, or PFBS) was mixed in a vat in the laundry facility to treat worker's clothes. Excess mixture and washout were poured down the drain, which went to the J-139 WWTP.	No evidence of PFOS, PFOA, or PFBS-containing materials used, stored, and/or disposed of at this location.
Line J, Building J-136 Herbicide/ Pesticide Storage and Mixing Areas	Unknown to present	Building J-136 contains a concrete slab with concrete bumper around a pesticide mixing area. SDSs for the pesticide (Termidor) and herbicide (Valor) show that neither contain PFOS, PFOA, or PFBS.	No evidence of PFOS, PFOA, or PFBS-containing materials used, stored, and/or disposed of at this location.
Line J, Building J-139 Former WWTP	Unknown to 2016	X-ray solvent wastewater was transported from Line J to Building J-139 after going through the silver reclamation process. Treated wastewater from Building J-139 discharged to the installation's active WWTP. Building J-139 was demolished in 2016.	No evidence of PFOS, PFOA, or PFBS-containing materials used, stored, and/or disposed of at this location.
Line V, Building V-21 Chemical Storage Room	Unknown to 2012	Line V contained a large x-ray operation. X-rays were developed on site using fixer/developer solvents and utilized proprietary items noted in the SDSs. Spill reported on 21 July 2009 - Approximately 50 gallons of diluted part C fixer was released in Building V-21. Some material seeped under the walls into other parts of the building and released to the WWTP via a drain in the floor. Material also seeped under the wall into the soil outside the building.	No evidence of PFOS, PFOA, or PFBS-containing materials used, stored, and/or disposed of at this location.
MOD WWTP	1941 to 1988	Small WWTP (served less than 500 people) in use prior to the Former Wolfe Creek Ordnance Plant (WCOP) WWTP; served all of Area I and Buildings D-44 and D-1 and, therefore, received wastewater from car wash facilities. No known PFOS, PFOA, or PFBS-containing chemicals were used at car washes. This WWTP was taken out of service in 1988 when a lift station and force main were installed for the Former WCOP WWTP. Discharged to a tributary of Wolf Creek.	No evidence of PFOS, PFOA, or PFBS-containing materials used, stored, and/or disposed of at this location.

Area Description	Dates of Operation	Relevant Site History	Rationale
Building A-50 Soil Bioremediation Facility	2000 to 2008	This facility was used for bioremediation of explosives-impacted soil via composting. Soil was contained in large vats within a covered warehouse with concrete pad. Wastewater from the warehouse was channeled to an above-ground storage tank outside on concrete pad then conveyed to the Active WWTP. Soil from many explosives-impacted remediation sites was mixed and treated at this facility. Soil excavated from the O-Line Ponds/O-Line Lagoons (247 tons) was treated here. The O-Line Ponds/O-Line Lagoons area may contain Teflon® from washout operations there. The treated soil from Building A-50 Soil Bioremediation Facility was then spread at the Active Industrial Landfill, the Ammunition Destruction Area, Open Burning Ground, Line E, Spray Fields, and other non-specified areas of the installation.	No evidence of PFOS, PFOA, or PFBS-containing materials at this facility. SI soil and groundwater samples from the O-Line Ponds/O-Line Lagoons AOPI (from which the soil treated at Building A-50 was excavated) were non-detect for PFOS, PFOA, or PFBS.
Line J, Building J-130 Maintenance Facility	Unknown to approximately 2006	Magnaflux was mixed in this building to test metal parts for cracks. Wastewater was washed down the drain. This drain water went to the Former WCOP WWTP.	No evidence of PFOS, PFOA, or PFBS-containing materials used, stored, and/or disposed of at this location.
Former WCOP WWTP	Unknown to 2002	Located east of the active WWTP close to OU3; used prior to 2002 and served approximately 7,000 people. Facility contained a primary clarifier, trickle filters, anaerobic digester, secondary clarifier, chlorine contact chamber, and concrete sludge drying beds. Wastewater from the J-130 Magnaflux mixing process discharged to this the WWTP. Solid waste was disposed of in the Closed Landfill and Active Industrial Landfill. Outfall was to a tributary of the RFOR.	No evidence of PFOS, PFOA, or PFBS-containing materials used, stored, and/or disposed of at this location.
Closed Sanitary Landfill	1980s to 1993	This landfill received solid waste from the Former WCOP WWTP. The solid waste contained sludge from the J-130 Magnaflux mixing process.	No evidence of PFOS, PFOA, or PFBS-containing materials used, stored, and/or disposed of at this location.

5.2 AOPIs

Overviews for each AOPI identified during the PA process are presented in this section. Seven of the AOPIs overlap with MLAAP IRP sites and/or Headquarters Army Environmental System sites (**Figure 5-2**). The AOPI, overlapping IRP site identifier, Headquarters Army Environmental System number, and

current site status are discussed within each AOPI subsection presented below. At the time of this PA/SI, one of these seven sites had previously been investigated or for the possible presence of PFOS, PFOA, and/or PFBS.

The AOPI locations are shown on **Figure 5-2**. Aerial photographs of each AOPI that also show the approximate extent of AFFF use (if applicable) are presented on **Figures 5-3** through **5-13** and include active monitoring wells in the vicinity of each AOPI.

5.2.1 Active Fire Station

The Active Fire Station (**Figure 5-3**) is identified as an AOPI following records research, personnel interviews, and site reconnaissance due to AFFF storage and use. According to site reconnaissance and personnel interviews, AFFF was stored in 5-gallon buckets in Active Fire Station (Building F-50) and Building F-172 (storage building adjacent to the fire station) at the time of the PA site visit (March 2019). Interviewees reported AFFF storage there began as early as 1987. There is no known disposal at the Active Fire Station. Information regarding historical operations associated at the Active Fire Station prior to the early 2000s was unavailable.

5.2.2 Area K Fire Systems Testing

The Area K Fire Systems Testing (**Figure 5-4**) is identified as an AOPI following records research, personnel interviews, and site reconnaissance due to AFFF use. At least one reported AFFF training exercise occurred around 1980, when a first-hand witness reported that the fire truck pulled onto a road north of the lagoon east of Building K-323 and used water pumped from the lagoon to spray AFFF onto the adjacent ground surface.

5.2.3 Line Z Flare Composition Facility (MAAP-012/47475.1020 and MAAP-012A/47475)

The Line Z Flare Composition Facility (**Figure 5-5**) is identified as an AOPI following records research, personnel interviews, and site reconnaissance due to operations involving Teflon® use. Line Z was a decoy flare composition facility used from 2004 to 2012. These flares contained approximately 40% Teflon® powder along with magnesium and fluorel (hexafluoropropylene). Teflon® manufacturers are known to use PFOA in the manufacturing process; therefore, Teflon® was considered to potentially contain PFOA. Further research indicated that PFOA is mostly burned off during the creation process and may only cause residual PFOA presence in liquid Teflon® products. The Teflon® used at this facility was a powder and likely did not contain high levels of PFOA, if any.

Quality testing occurred inside and directly outside of Building Z-205 according to installation personnel. In the outdoor yard surrounding Building Z-205, flares were ignited on the ground surface of a test pad, and flare composition including Teflon® was released. Runoff may have possibly flowed to the unnamed tributary, located to the east of the outdoor yard. The indoor testing facility was frequently washed out with water, which drained to a sump and then to the Active WWTP.

The facility also contains several buildings where Teflon® was stored, weighed, and mixed. Washout from these buildings drained to waste tanks. When the facility closed in 2012, all waste tanks were removed, and contents were disposed of off-site. There are no records of spills/releases from these tanks.

Two restoration sites account for previous studies and remediation at Line Z. Both of these IRP sites, MAAP-012/47475.1020 and MAAP-012A/47475.1021, are closed and did not address potential PFOS, PFOA, or PFBS impacts.

5.2.4 O-Line Ponds/O-Line Lagoons (MAAP-014/47475.1024 and MAAP-014A/47475.1001)

The O-Line Ponds/O-Line Lagoons (**Figure 5-6**) is identified as an AOPI following records research, personnel interviews, and site reconnaissance due to contact of wastewater with potentially Teflon®-containing process machinery. This former wastewater treatment area of unlined ponds received water from the O-Line washout facility from 1941 to 1984. It is likely that machinery in the washout operation contained Teflon® parts. Effluent from the last pond flowed through sawdust-filled tanks then discharged to the surrounding ditch. The sawdust and collected solids were burned at the Open Burning Ground (**Section 5.2.6**). In 1984, the facility was closed and capped.

Two restoration sites account for previous studies and remediation– MAAP-014/47475.1024 and MAAP-014A/47475.1001. In 1992, groundwater pump-and-treat systems were implemented. OU1 is the O-Line groundwater contamination below OU2 and is covered in this AOPI. Soil remediation for explosives occurred from 2005 to 2008. Contaminated soil was removed for bioremediation; some was left in place due to access issues. Site MAAP-014 is closed, but site MAAP-014A is an active IRP site in long-term management with groundwater monitoring. Neither IRP site addressed potential PFOS, PFOA, or PFBS impacts.

5.2.5 Operable Unit 3 Groundwater Treatment Plant (MAAP-034/47475.1036)

OU3 Groundwater Treatment Plant (GWTP) is identified as an AOPI following records research, personnel interviews, and site reconnaissance due to potential PFOS, PFOA, and/or PFBS impacts in association with Teflon® related waste in the O-Line Ponds/O-Line Lagoons.

Pump-and-treat systems to address explosives contamination for the OUs associated with the O-Line Ponds/O-Line Lagoons went into operation in 1994, including two GWTPs at OU1 and OU3. Since 2010, groundwater from OU1 and OU3 have been pumped and treated at the OU3 GWTP. Groundwater potentially containing PFOS, PFOA, and/or PFBS associated with the O-Line Ponds/O-Line Lagoons is extracted by a treatment system and piped to the OU3 GWTP, where it is treated for explosives using activated carbon. After treatment at OU3, water is discharged to a tributary of the RFOR north of the OU3 site.

One restoration site accounts for previous studies and remediation at OU3: MAAP-034/47475.1036. The IRP site is now closed and did not address potential PFOS, PFOA, or PFBS impacts.

5.2.6 Open Burning Ground (MAAP-017/47475.1017 and MAAP-017A/47475.1018)

The Open Burning Ground (**Figure 5-7**) is identified as an AOPI following records research, personnel interviews, and site reconnaissance due to burning of potential PFOA-containing waste (Teflon®-containing flares and O-Line Ponds/O-Line Lagoons waste as described in **Section 5.2.4**). From 2004 to 2014, a total of 253,352 pounds of flares containing Teflon® powder were burned at the Open Burning Ground in flash pans on concrete pads. Ash was swept into 35-gallon drums and disposed of at the

Active Industrial Landfill (**Section 5.2.7**). Additionally, parts containing Teflon®, such as gaskets and spacers, may have been burned on the ground surface prior to the construction of the concrete pads. The specific quantities of parts burned, burn locations, and dates the parts may have been burned are unknown. These concrete and earthen pads are located less than 0.5 mile downgradient away from unnamed tributaries. PFOA from these areas may have been carried via stormwater runoff to an unnamed tributary approximately 700 feet to the northeast.

From 1941 to 1984, solid waste from the O-Line Ponds/O-Line Lagoons washout facility effluent treatment system, which consisted of sawdust-filled tanks, was also burned at the Open Burning Ground. O-Line wastewater is suspected to have contained Teflon® due to contact with Teflon®-containing machinery. The soil from the O-Line Ponds/O-Line Lagoons was also treated at the Building A-50 Soil Bioremediation Facility and then spread at the Open Burning Ground area. The Building A-50 Soil Bioremediation Facility is not considered an AOPI because there is no evidence of PFOS, PFOA, or PFBS-containing materials at this facility. SI soil and groundwater samples from the O-Line Ponds/O-Line Lagoons AOPI (from which the soil treated at Building A-50 was excavated) were non-detect for PFOS, PFOA, or PFBS. Quantities and exact locations of the soil spread within the Open Burning Ground is unknown.

Two restoration sites account for previous studies and remediation at the Open Burning Ground: MAAP-017/47475.1017 and MAAP-017A/47475.1018. The IRP sites are now closed and did not address potential PFOS, PFOA, or PFBS impacts.

5.2.7 Active Industrial Landfill

The Active Industrial Landfill (**Figure 5-8**) is identified as an AOPI following records research, personnel interviews, and site reconnaissance due to disposal of potential PFOA-containing waste (Teflon®-containing flares). This landfill has been active since 1993. It received ash disposal from flares known to contain Teflon® that were burned at the Open Burning Ground from 2004 to 2014. The Active Industrial Landfill is lined and contains a leachate collection system. Areas that are filled have been capped. The Active Industrial Landfill is a currently active Resource Conservation and Recovery Act-permitted landfill.

5.2.8 Ammunition Destruction Area (MAAP-016/47475.1026)

The Ammunition Destruction Area (**Figure 5-9**) is identified as an AOPI following records research, personnel interviews, and site reconnaissance due to application of potential PFOA-containing soil originating at the O-Line Ponds/O-Line Lagoons being applied here. This soil was treated at the Building A-50 Soil Bioremediation Facility between 2001 and 2008. Quantities and exact locations of the soil spread within the Ammunition Destruction Area are unknown.

One restoration site accounts for previous studies and remediation at the Ammunition Destruction Area – MAAP-016/47475.1026. The IRP site is now closed and did not address potential PFOS, PFOA, or PFBS impacts.

5.2.9 Line E (MAAP-007/47475.1011 and MAAP-07A/47475.1012)

The Line E (**Figure 5-10**) is identified as an AOPI following records research, personnel interviews, and site reconnaissance due to potentially PFOA-containing soil originating at the O-Line Ponds/O-Line

Lagoons being used to build an earthen berm here. This soil was treated at the Building A-50 Soil Bioremediation Facility between 2001 and 2008.

Two restoration sites account for previous studies and remediation at Line E: MAAP-007/47475.1011 and MAAP-07A/47475.1012. MAAP-07A is now closed and did not address potential PFOS, PFOA, or PFBS impacts. MAAP-007 was combined with another IRP site (MAAP-003) and remains open.

5.2.10 Active WWTP

The Active WWTP (**Figure 5-11**) is identified as an AOPI following records research, personnel interviews, and site reconnaissance due to processing of potential PFOA-containing wastewater. The Active WWTP has been in use from 2002 to the present. Wastewater from all LAP lines, including the Line Z (**Section 5.2.3**) flare operation containing Teflon®, is discharged to the lined WWTP lagoon. During warmer months, treated water is pumped to the Spray Fields (**Section 5.2.11**). Secondary outfall from the lagoon is to an unnamed tributary of the RFOR.

5.2.11 Spray Fields

The Spray Fields (**Figure 5-12**) is identified as an AOPI following records research, personnel interviews, and site reconnaissance due to processing of potential PFOA-containing wastewater and bioapplication of potentially PFOA-containing soil. Wastewater from the Line Z Teflon® flare operation (**Section 5.2.3**) was treated at the Active WWTP and discharged as effluent to the Spray Fields from 2002 to 2012, when the Line Z operation was closed.

Potentially PFOA-containing soil originating at the O-Line Ponds/O-Line Lagoons was also applied here. This soil was treated at the Building A-50 Soil Bioremediation Facility between 2001 and 2008. Quantities and exact locations of the soil spread within the Spray Fields are unknown.

5.2.12 Line K Former Metal Plating Facility (MAAP-010/47475.1017)

The Line K Former Metal Plating Facility (**Figure 5-13**) is identified as an AOPI following records research, personnel interviews, and site reconnaissance due to potential use of a PFOS-, PFOA-, and/or PFBS-containing mist suppressant and disposal of associated waste. Zinc chromate electrolytic plating and cadmium electrolytic plating processes were used at Building K-50 from the early-1940s to approximately 1975. Details of the operation and use of mist suppression were not available. Reports document that a settling pond slightly north of Building K-50 was used for plating waste collection, and chromium has been detected in soil. Due to the timeframe, potentially PFOS-, PFOA-, and/or PFBS-containing mist suppressant use is possible.

One restoration site accounts for previous studies and remediation at Line K: MAAP-010/47475.1017. The IRP site is now closed and did not address potential PFOS, PFOA, or PFBS impacts.

6 SUMMARY OF SI ACTIVITIES

Based on the results of the PA at MLAAP, an SI for PFOS, PFOA, and PFBS was conducted in accordance with CERCLA. SI sampling was completed at MLAAP at 11 of the 12 AOPIs to evaluate presence or absence of PFOS, PFOA, and PFBS in comparison with the OSD risk screening levels. One AOPI (OU3 GWTP) was not sampled because groundwater samples from another AOPI (O-Line Ponds/O-Line Lagoons), where the water was treated and discharged by the OU3 GWTP originates, were non-detect for PFOS, PFOA, and PFBS. As such, an installation-specific QAPP Addendum (Arcadis 2020) was developed to supplement the general information provided in the PQAPP (Arcadis 2019) and to detail the site-specific proposed scopes of work for the SI. A preliminary CSM was prepared for each of the installation's AOPIs in accordance with the USACE Engineer Manual on Conceptual Site Models, EM 200-1-12 (USACE 2012). The preliminary CSMs identified potential human receptors and chemical exposure pathways based on current and/or reasonably anticipated future land uses. The preliminary CSMs identified soil, groundwater, surface water, and sediment pathways as potentially complete, which guided the SI sampling. The QAPP Addendum details the sampling design and rationale based on each AOPI's preliminary CSM. The SI scope of work was completed in May 2020 through the collection of field data and analytical samples

The SI field work was completed in accordance with the standard operating procedures (SOPs), technical guidance instructions (TGIs), sampling design, and QA/QC requirements as detailed in the QAPP Addendum (Arcadis 2020) and PQAPP (Arcadis 2019). The subsections below summarize the DQOs, sampling design and rationale, sampling activities and methods, and data analyses procedures for the SI phase at MLAAP. Non-conformances to the prescribed procedures in the PQAPP and QAPP Addendum are described in **Section 6.3.3**. Analytical results obtained through SI field activities are summarized in **Section 7**.

The groundwater originating from the O-Line Ponds/O-Line Lagoons AOPI is intercepted by a pump and treat system which routes it to the OU3 GWTP. Several groundwater wells were sampled as part of the SI strategy for the O-Line Ponds/O-Line Lagoons AOPI; therefore, the O-Line Ponds/O-Line Lagoons sampling results will establish absence/presence at both the O-Line Ponds/O-Line Lagoons and the OU3 GWTP.

6.1 Data Quality Objectives

As identified during the DQO process and outlined in the site-specific QAPP Addendum (Arcadis 2020), the objective of the SI is to identify whether there has been a release to the environment from any of the AOPIs identified in the PA and to determine if further investigation is warranted. This SI evaluated groundwater and soil for the presence or absence of PFOS, PFOA, or PFBS at each of the sampled AOPIs.

6.2 Sampling Design and Rationale

The rationale for sampling at each AOPI is illustrated on **Figure 6-1** below.

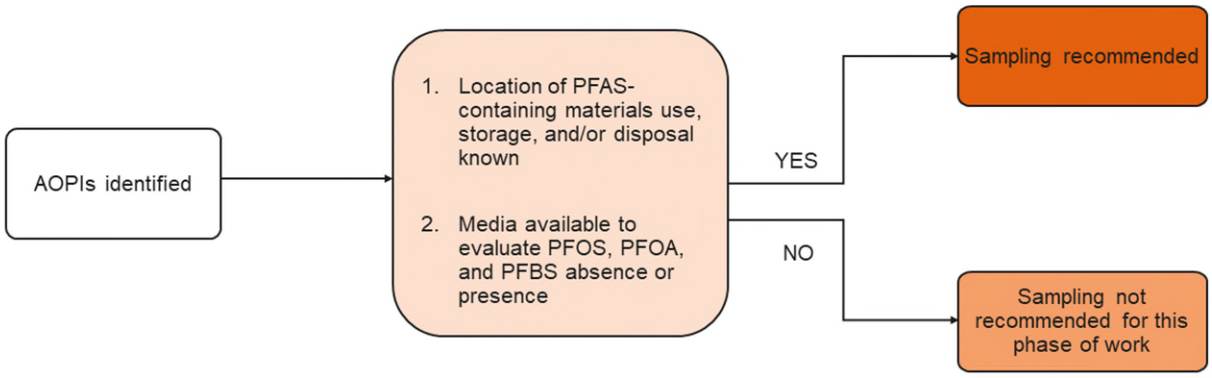

Figure 6-1: AOPI Sampling Decision Tree

The sampling design for SI sampling activities at MLAAP is detailed in Worksheet #17 of the QAPP Addendum (Arcadis 2020). Briefly, soil and groundwater samples were collected to evaluate PFOS, PFOA, and PFBS presence or absence at potential release areas, and to evaluate the potential for those areas to be sources of PFOS, PFOA, and/or PFBS to groundwater and surface water. One to four soil samples were collected from discrete locations at each of the following AOPIs: Active Fire Station, Area K Fire Systems Testing, Line Z Flare Composition Facility, O-Line Ponds/O-Line Lagoons, Open Burning Ground, Line E, Active WWTP, Spray Fields, and Line K Former Metal Plating Facility. Soil samples were collected from the top 2 feet of native soil from locations of suspected release or surface runoff from suspected release. Groundwater samples were collected to inform the interpretation of PFOS, PFOA, and PFBS presence and update the individual AOPI CSMs. Two groundwater samples were collected by advancing a borehole utilizing a conventional hollow stem auger (HSA) drilling rig at the following AOPIs: Active Fire Station and Area K Fire Systems Testing. Sixteen groundwater samples were collected from existing monitoring wells in the vicinity of eight AOPIs: Line Z Flare Composition Facility, O-Line Ponds/O-Line Lagoons, Open Burning Ground, Active Industrial Landfill, Ammunition Destruction Area, Line E, Spray Fields, and Line K Former Metal Plating Facility.

The sampling depths at existing monitoring wells were at approximately the center of the saturated screened interval. **Table 6-1** includes the monitoring well construction details for the wells sampled during the SI (when available).

Specific sampling rationale for each AOPI are presented in **Table 6-2** below.

Table 6-2. SI Sampling Rationale at MLAAP

AOPI Description	Sampling Approach
Active Fire Station	**Shallow soil sampling**: Soil samples were collected from two hand auger soil borings located directly adjacent to the fire station apron in areas of surface runoff from the potential nozzle testing area, and from two additional hand auger soil borings located near the storage building adjacent to the fire station. **Groundwater sampling:** One groundwater sample was collected from a soil boring advanced via HSA at a location directly northwest and downgradient of the AOPI.
Area K Fire Systems Testing	**Shallow soil sampling**: Soil samples were collected from two hand auger soil borings located in the area of AFFF release from the MLAAP fire department training activities; AFFF was sprayed adjacent to the lagoon. An additional soil boring was placed southeast of the release area. **Groundwater sampling:** One groundwater sample was collected from a soil boring advanced via HSA at a location downgradient of the AOPI, northwest of the AOPI boundary.
Line Z Flare Composition Facility	**Shallow soil sampling**: Soil samples were collected from three hand auger soil borings located in areas where Teflon®-containing wastewater may have flowed to soil: 1) northeast corner of the outdoor testing pad near Building Z-205; 2) the southwest end of the Building Z-205 testing facility, near the door where washout occurred; and 3) east of the testing facility in the direction of surface runoff. **Groundwater sampling:** Two existing monitoring wells located down- to side-gradient of the facility were sampled (MI408 and MI114).
O-Line Ponds/O-Line Lagoons	**Shallow soil sampling**: A soil sample was collected from one hand auger soil boring located at the discharge point for process water from the O-Line buildings area. **Groundwater sampling:** Four existing monitoring wells were sampled: 1) Well MI671 located in the lagoon source area, 2) Well MW16S located at the downgradient edge of the lagoon source area, 3) Well MI634 located at the downgradient edge of the reinjection well area, and 4) Well MI004 located at the downgradient of edge of the O-Line buildings area.
Open Burning Ground	**Shallow soil sampling**: Soil samples were collected from three hand auger soil borings located adjacent to concrete pads where Teflon® flares were burned, and one soil boring was located in the center of an earthen pad where Teflon® parts burning potentially occurred. **Groundwater sampling:** Three existing monitoring wells were sampled: 1) Well MI261 located downgradient from earthen pads, 2) Well MI250 located

AOPI Description	Sampling Approach
	downgradient from the concrete pads, and 3) Well MI258 located cross gradient of the earthen pads.
Active Industrial Landfill	**Groundwater sampling:** One existing monitoring well downgradient of the landfill was selected for sampling (ILF-3). Soil sampling was not performed at this AOPI since the Teflon® ash was placed into the landfill, which was then capped.
Ammunition Destruction Area	**Groundwater sampling:** Two existing monitoring wells (MI272 and MI268) located on the downgradient edges of the Ammunition Destruction Area were sampled. Soil sampling was not performed at this AOPI because exact locations of bioapplication are unknown.
Line E	**Shallow soil sampling**: A soil sample was collected from one hand auger soil boring at the midpoint of the soil berm constructed using soils potentially containing Teflon® originating from the O-Line Ponds/O-Line and treated at Building A-50 Bioremediation Facility. **Groundwater sampling:** One existing monitoring well (MI369) located downgradient of the soil berm was selected for sampling.
Active WWTP	**Shallow soil sampling**: A soil sample was collected from one hand auger soil boring at the outfall location southeast of the Active WWTP. Groundwater sampling was not performed at this AOPI since the lagoon associated with the WWTP is lined and contact with soil/groundwater at the WWTP is not suspected.
Spray Fields	**Shallow soil sampling**: Soil was collected from three hand auger soil borings located in areas potentially impacted by the spray activities. **Groundwater sampling:** Two monitoring wells were selected for sampling, one down- to side-gradient of the AOPI (MI026) and one within the spray area (MI399).
Line K Former Metal Plating Facility	**Shallow soil sampling**: Soil samples were collected from two hand auger soil borings. One sample was obtained at a dry point of the pond where metal plating waste was collected, and another from the ditch next to Building K-50 based on historical detections of chromium, which may indicate releases from the facility. **Groundwater sampling:** One existing monitoring well (MI023) cross-gradient of the AOPI was sampled.
OU3 GWTP	The groundwater originating from the O-Line Ponds/O-Line Lagoons AOPI is intercepted by a pump and treat system which routes it to the OU3 GWTP. Several groundwater wells were sampled as part of the SI strategy for the O-Line Ponds/O-Line Lagoons AOPI; therefore, the O-Line Ponds/O-Line Lagoons sampling results

AOPI Description	Sampling Approach
	will establish absence/presence at both the O-Line Ponds/O-Line Lagoons and the OU3 GWTP

6.3 Sampling Methods and Procedures

Environmental data were collected and analyzed in accordance with the PQAPP (Arcadis 2019), the SOPs and TGIs included as Appendix A to the PQAPP, the QA/QC requirements identified in Worksheet #20 of the PQAPP, the approved scope and sampling methods outlined in the site-specific QAPP Addendum (Arcadis 2020), and the safety procedures specified in the Accident Prevention Plan (Arcadis 2018) and SSHP (Arcadis 2020). The sampling methods described in the SOPs and TGIs establish equipment requirements, procedures for preparing equipment and containers before sampling, sampling procedures under various conditions, and procedures for storing samples to ensure that sample contamination does not occur during collection, and transport. In general, sampling techniques used in the SI were consistent with conventional sampling techniques used in the environmental industry, but special considerations were made regarding PFAS-containing materials and equipment and cross-contamination potential.

The sampling methods employed during the SI are detailed in the PQAPP (Arcadis 2019) and QAPP Addendum (Arcadis 2020). The subsections below provide a summary of the field methods and procedures utilized to complete the SI scope of work. Field notes and field forms (i.e., soil boring logs, groundwater purging logs, equipment calibration forms, tailgate health and safety forms, and sample collection logs) documenting the SI sampling activities are included in **Appendices J** and **K**, respectively.

6.3.1 Field Methods

Groundwater samples were collected via HSA drilling from discrete zones at first encountered groundwater. Boreholes were advanced using a top-down sampling method to minimize cross-contamination at depth. A bladder pump with PFAS-free disposable high-density polyethylene tubing was used to collect groundwater samples through prepacked screens. Groundwater samples from existing monitoring wells were collected via low-flow purging methods (i.e., bladder pump) from approximately the center of the saturated screened interval.

At locations where only soil samples were collected, a hand auger was used.

During drilling, soil descriptions were logged by a geologist for the entire boring depth and were documented on field forms. All samples were collected in accordance with the TGI for PFAS-Specific Drilling and Monitoring Well Installation (P-12 in Appendix A to the PQAPP [Arcadis 2019]). All soil samples were collected from the top 2 feet of soil considered to have been the location where PFAS-containing materials may have been released. Coordinates for each soil sampling location were recorded using a handheld global positioning system.

Decontamination procedures for non-dedicated equipment used during sampling are described in **Section 6.3.4**.

6.3.2 Quality Assurance/Quality Control

Worksheets #20 of the PQAPP and QAPP Addendum provide QA/QC requirements for field duplicates, matrix spike/matrix spike duplicates, equipment blanks (EBs), source blanks for water used in the initial decontamination step for drill tooling, and field blanks using laboratory-supplied water used in the final decontamination step.

QA/QC samples were collected at the frequencies specified in the QAPP Addendum (Arcadis 2020), typically at a rate of 1 per 20 parent samples. Field duplicates and matrix spike/matrix spike duplicate samples were collected for media sampled for PFOS, PFOA, and PFBS, and total organic carbon (TOC) only. EBs were collected for media sampled for PFOS, PFOA, and PFBS, at a frequency of one per piece of relevant equipment for each sampling event, as specified in the QAPP Addendum (Arcadis 2020). The decontaminated reusable equipment from which EBs were collected include screen-point samplers, drill casing and cutting shoes, hand augers, and water-level meters, as applicable to the sampled media. Source blanks were collected from the water used to wash drill tooling. Analytical results for blank samples are discussed in **Section 7.13**.

6.3.3 Field Change Reports

No instances of major scope modifications (i.e., those that may have had a significant impact on the project scope and/or data usability/quality, or required stop-work, and warranted discussion with USACE) were encountered during the MLAAP SI work.

In some cases, clarifications to the established scope of work were needed but do not necessarily constitute a non-conformance from the sampling plans described in the QAPP Addendum. Minor modifications from and clarifications for the procedures and scope of work detailed in the QAPP Addendum and PQAPP and that did not affect DQOs are documented in Field Change Reports included as **Appendix L** and are summarized below:

- Active Fire Station AOPI: The one required field duplicate, matrix spike, and matrix spike duplicate for groundwater were collected at boring MLAAP-FS-1-GW instead of at existing well sample MLAAP-MI408 as listed in the QAPP Addendum. The QA/QC frequency of 1 per 20 parent samples is still met.
- Active WWTP AOPI: The location of soil boring WWTP-1-SO was moved approximately 290 feet west-northwest of the originally planned position. This boring was planned to be positioned at the WWTP outfall location. The previously marked outfall location was incorrect, so the sample location was moved closer to the actual outfall location.
- Line Z Flare Composition Facility AOPI: Boring LINEZ-3-SO was moved approximately 33 feet to the southwest of the originally planned position. Based on on-site evaluation of the topography and surface runoff flow directions, the sample location was moved from the originally planned position to the main drainage pathway from the test pad.
- Open Burning Ground AOPI: Boring OBG-1-SO was moved approximately 45 feet to the northeast of the originally planned position, based on on-site evaluation of the topography and surface runoff flow directions. The location was adjusted to be within the main drainage pathway from the concrete burning pad.

6.3.4 Decontamination

Non-dedicated reusable sampling equipment (e.g., hand augers, drill cutting shoes and casing, drilling equipment, and water-level meters) that came into direct contact with sampled media was decontaminated before first use, between sampling locations/intervals, and before demobilization in accordance with P-09, TGI - Groundwater and Soil Sampling Equipment Decontamination (Arcadis 2019; Appendix A).

6.3.5 Investigation-Derived Waste

IDW, including soil cuttings from the boreholes drilled via HSA, purged groundwater, and equipment decontamination water were temporarily containerized in drums, segregated by medium, as required by the Tennessee Department of Environment and Conservation as well as the installation's preference. Samples of the IDW soil and liquid were sent to the lab for analysis. At the direction of the installation, liquid IDW (i.e., purge water and decontamination water) was discharged at the WWTP. Soil was spread on the ground at the point of collection. Consumable IDW includes personal protective equipment and other disposable materials (e.g., gloves, plastic sheeting, and high-density polyethylene and silicon tubing) that may contact sampled media. Consumable IDW were disposed of in the dumpsters at the WWTP facility northwest of Area K.

6.4 Data Analysis

The subsections below summarize the laboratory analytical methods and the methodology used to evaluate data collected during the SI through data verification and usability assessments (as completed by a project chemist, independent of the project team).

6.4.1 Laboratory Analytical Methods

Analytical samples collected during the SI were submitted to Pace South Carolina (formerly Shealy Environmental Services, Inc.), an ELAP-accredited laboratory for PFOS, PFOA, and PFBS analysis by liquid chromatography with tandem mass spectrometry. Laboratory analyses associated with the SI were completed in accordance with Worksheets #12.1 through #12.5 in the PQAPP (Arcadis 2019). PFOS, PFOA, and PFBS were analyzed for in groundwater and soil samples using an analytical method that is ELAP-accredited and compliant with QSM 5.1.1, Table B-15 (DoD 2018).

Additionally, the following general chemistry and physical characteristic analyses were completed for select soil samples in accordance with Worksheet #18 of the QAPP Addendum (Arcadis 2020) by the analytical method noted:

- TOC by Solid Waste Test Method 846 9060A
- Grain size analysis by American Society for Testing and Materials D422-63
- pH by Solid Waste Test Method 846 9045D.

These data are collected as they may be useful in future fate and transport studies.

The laboratory limit of detection (LOD) is defined as "the lowest concentration for reliable reporting of a non-detect of a specific analyte in a specific matrix with a specific method at 99 percent confidence" (DoD 2017). The lowest concentration of a substance that produces a quantitative result within specified limits of precision and bias is known as the limit of quantitation (LOQ; DoD 2017). Concentrations detected between the LOD and LOQ, therefore, are considered estimates and are qualified as such on laboratory analytical reports. Instrument-specific detection limits (e.g., the smallest analyte concentration that can be demonstrated to be different from zero or a blank concentration with 99 percent confidence; DoD 2017), as provided for each analyte by the laboratory, are reported along with the LODs and LOQs in the laboratory analytical reports included in the Data Usability Summary Report (DUSR) (**Appendix M**).

6.4.2 Data Validation

All analytical data generated during the SI, except grain size, were verified and validated in accordance with the data verification procedures described in Worksheets #34 through #36 of the PQAPP (Arcadis 2019). Each laboratory data package/sample delivery group underwent Stage 3 data validation in accordance with DoD QSM 5.1.1 (DoD 2018). Additionally, 10% of the data underwent Stage 4 data validation. Copies of the data validation reports for each sample delivery group are included as attachments to the DUSR in **Appendix M**.

6.4.3 Data Usability Assessment and Summary

A data usability assessment was completed for all analytical data associated with SI sampling at MLAAP. Documentation generated during the data usability assessments, which were compiled into a DUSR (**Appendix M**), was prepared in accordance with the USACE Engineer Manual 200-1-10 (USACE 2005), the Final DoD General Data Validation Guidelines (DoD 2019) and the Final DoD Data Validation Guidelines Module 3: Data Validation Procedure for Per-and Polyfluoroalkyl Substances Analysis by QSM Table B-15 (DoD 2020), that reviewed precision, accuracy, completeness, representativeness, comparability, and sensitivity. A statement of overall data usability is included in the DUSR (**Appendix M**).

Based on the final data usability assessment, the environmental data collected at MLAAP during the SI were found to be acceptable and usable for this SI evaluation with the qualifications documented in the DUSR and its associated data validation reports (**Appendix M**), and as indicated in the full analytical tables (**Appendix N**) provided for the SI results. These data are of sufficient quality to meet the objectives and requirements of the PQAPP (Arcadis 2019) and MLAAP QAPP Addendum (Arcadis 2020). Data qualifiers applied to laboratory analytical results for samples collected during the SI at MLAAP are provided in the data tables, data validation reports, and the Data Usability Summary Table located at the end of DUSR. Qualifiers for data shown on figures are defined in the notes on figures.

6.5 Office of the Secretary of Defense Risk Screening Levels

The OSD risk screening levels for PFOS, PFOA, and PFBS in groundwater (tap water) and soil were calculated using the USEPA's RSL calculator for residential and industrial/commercial worker receptor scenarios and current toxicity values. These risk screening levels are shown in **Table 6-3**.

Table 6-3 OSD Risk Screening Levels Calculated for PFOS, PFOA, PFBS in Tap Water and Soil Using USEPA's Regional Screening Level Calculator

Chemical	Residential Scenario Risk Screening Levels Calculated Using USEPA RSL Calculator		Industrial/Commercial Scenario Risk Screening Levels Calculated Using USEPA RSL Calculator
	Tap Water (ng/L or ppt) [1]	Soil (mg/kg or ppm) [1,2]	Soil (mg/kg or ppm) [1,2]
PFOS	40	0.13	1.6
PFOA	40	0.13	1.6
PFBS	600	1.9	25

Notes:

1. Risk screening levels for tap water and soil provided by the OSD 2021 Memorandum: Investigating Per- and Polyfluoroalkyl Substances within the Department of Defense Cleanup Program. September 15 (**Appendix A**).
2. All soil data will be screened against both the Residential Scenario and Industrial/Commercial risk screening levels, regardless of the current and projected land use of the AOPI.

mg/kg = milligram per kilogram
ng/L = nanograms per liter
ppm = parts per million
ppt = parts per trillion

The OSD residential tap water risk screening levels will be used to compare all groundwater data for this Army PFAS PA/SI. While the current and most likely future land uses of the AOPIs at MLAAP are industrial/commercial, both residential and industrial/commercial soil risk screening levels for PFOS, PFOA, and PFBS will be used to evaluate detected soil concentrations. The data from the SI sampling event are compared to the OSD risk screening levels in **Section 7**. If concentrations of PFOS, PFOA, or PFBS are detected greater than the applicable OSD risk screening levels, further study in a remedial investigation is recommended in **Section 8**.

7 SUMMARY AND DISCUSSION OF SI RESULTS

This section summarizes the analytical results obtained from samples collected during the SI at MLAAP (field duplicate results are provided in the associated tables). Sampled media and QA/QC samples were analyzed for the constituents prescribed per Worksheet #18 of the QAPP Addendum (Arcadis 2020). The sample results discussion below focuses on the PFOS, PFOA, and PFBS analytical results because they have OSD risk screening levels. The Army will make subsequent investigation decisions based on these constituents' concentrations relative to the OSD risk screening levels.

Tables 7-1 and **7-2** provide a summary of the groundwater and soil analytical results for PFOS, PFOA, and PFBS. **Table 7-3** summarizes AOPIs and whether their SI results exceed the OSD risk screening levels. **Appendix N** includes the full suite of analytical results for these media, as well as for the QA/QC and IDW samples. An overview of AOPIs at MLAAP with OSD risk screening level exceedances is depicted on **Figure 7-1**. **Figures 7-2** through **7-12** show the PFOS, PFOA, and PFBS analytical results in groundwater and soil for each AOPI. Non-detected results are reported as less than the LOQ. Detections of PFOS, PFOA, and/or PFBS greater than the applicable OSD risk screening levels are highlighted in summary tables and on figures. Because none of the AOPIs had samples with concentrations of PFOS, PFOA, or PFBS exceeding OSD risk screening levels, no highlights are shown in the summary tables and figures. Final qualifiers applied to the data by the laboratory and the project chemist (as defined in **Section 6.4.3**) are presented on the analytical tables. Groundwater data collected during the SI are reported in ng/L, or parts per trillion, and soil data are reported in mg/kg, or parts per million.

Field parameters measured for groundwater during low-flow purging during sample collection are provided on the field forms in **Appendix K**. Soil lithological descriptions are provided on the field forms in **Appendix K**. The results of the SI are grouped by AOPI and discussed for each medium as applicable.

Table 7-3 AOPIs and OSD Risk Screening Level Exceedances

AOPI Name	OSD Exceedances (Yes/No/NS)
Active Fire Station	No
Area K Fire Systems Testing	No
Line Z Flare Composition Facility	No
O-Line Ponds/O-Line Lagoons	No
OU3 GWTP*	NS
Open Burning Ground	No
Active Industrial Landfill	No
Ammunition Destruction Area	No
Line E	No
Active WWTP	No
Spray Fields	No
Line K Former Metal Plating Facility	No

Notes:

* - The AOPI was not sampled during this SI. Addressed by non-detect results for soil and groundwater samples from the O-Line Ponds/O-Line Lagoons AOPI (the origin of water discharged by the OU3 GWTP).

NS – not sampled

7.1 Active Fire Station

The subsections below summarize the soil and groundwater PFOS, PFOA, and PFBS analytical results associated with Active Fire Station.

7.1.1 Groundwater

One groundwater sample was collected from a boring advanced using HSA at the Active Fire Station AOPI (MLAAP-FS-1-GW; **Figure 7-2**).

PFOA was detected below the OSD tap water risk screening level (40 ng/L) in this sample (4.7 ng/L). PFBS was detected below the OSD tap water risk screening level (600 ng/L) in this sample (30 ng/L). PFOS was not detected in the groundwater sample.

The PFAS groundwater analytical results are provided in **Table 7-1**.

7.1.2 Soil

Soil samples were collected from four hand auger borings at the Active Fire Station AOPI (MLAAP-FS-1-SO, MLAAP-FS-2-SO, MLAAP-FS-3-SO, and MLAAP-FS-4-SO; **Figure 7-2**).

PFOS was detected at concentrations below the residential OSD risk screening level (0.13 mg/kg) at all four sample locations, at concentrations ranging from 0.00091 mg/kg in MLAAP-FS-3-SO to 0.0047 mg/kg at MLAAP-FS-1-SO. PFOA and PFBS were not detected in any of the four soil samples.

The PFAS soil analytical results are provided in **Table 7-2**.

7.2 Area K Fire Systems Testing

The subsections below summarize the soil and groundwater PFOS, PFOA, and PFBS analytical results associated with Area K Fire Systems Testing.

7.2.1 Groundwater

One groundwater sample was collected from a boring advanced using HSA at the Area K Fire Systems Testing AOPI (MLAAP-AREAK-1-GW; **Figure 7-3**). A summary of PFOS, PFOA, and PFBS groundwater analytical results is provided in **Table 7-1**.

PFOS, PFOA, and PFBS were not detected in the groundwater sample.

7.2.2 Soil

Soil samples were collected from three hand auger borings at the Area K Fire Systems Testing (MLAAP-AREAK-1-SO, MLAAP-AREAK-2-SO, and MLAAP-AREAK-3-SO; **Figure 7-3**), from a depth of 0 to 2 feet bgs. A summary of PFOS, PFOA, and PFBS soil analytical results is provided in **Table 7-2**.

PFOS, PFOA, and PFBS were not detected in any of the three soil samples.

7.3 Line Z Flare Composition Facility

The subsections below summarize the soil and groundwater PFOS, PFOA, and PFBS analytical results associated with Line Z Flare Composition Facility.

7.3.1 Groundwater

Groundwater samples were collected from two existing monitoring wells (MI408 and MI114) near the Line Z Flare Composition Facility AOPI (**Figure 7-4**). A summary of PFOS, PFOA, and PFBS groundwater analytical results is provided in **Table 7-1**.

PFOS, PFOA, and PFBS were not detected in either of the two groundwater samples.

7.3.2 Soil

Soil samples were collected from three hand auger borings at the Line Z Flare Composition Facility (MLAAP-LINEZ-1-SO, MLAAP-LINEZ-2-SO, and MLAAP-LINEZ-3-SO; **Figure 7-4**), from a depth of 0 to 2 feet bgs. A summary of PFOS, PFOA, and PFBS soil analytical results is provided in **Table 7-2**.

PFOS, PFOA, and PFBS were not detected in any of the three soil samples.

7.4 O-Line Ponds/O-Line Lagoons

The subsections below summarize the soil and groundwater PFOS, PFOA, and PFBS analytical results associated with O-Line Ponds/O-Line Lagoons.

7.4.1 Groundwater

Groundwater samples were collected from four existing monitoring wells (MI671, MW16S, MI634, and MI004) near the O-Line Ponds/O-Line Lagoons AOPI (**Figure 7-5**). A summary of PFOS, PFOA, and PFBS groundwater analytical results is provided in **Table 7-1**.

PFOS, PFOA, and PFBS were not detected in any of the four groundwater samples.

7.4.2 Soil

One soil sample was collected via hand auger at the O-Line Ponds/O-Line Lagoons (MLAAP-OLINE-1-SO; **Figure 7-5**), from a depth of 0 to 2 feet bgs. A summary of PFOS, PFOA, and PFBS soil analytical results is provided in **Table 7-2**.

PFOS, PFOA, and PFBS were not detected in the soil sample.

7.5 Open Burning Ground

The subsections below summarize the soil and groundwater PFOS, PFOA, and PFBS analytical results associated with Open Burning Ground.

7.5.1 Groundwater

Groundwater samples were collected from three existing monitoring wells (MI261, MI250, and MI258) at the Open Burning Ground AOPI (**Figure 7-6**). A summary of PFOS, PFOA, and PFBS groundwater analytical results is provided in **Table 7-1**.

PFOS, PFOA, and PFBS were not detected in any of the three groundwater samples.

7.5.2 Soil

Soil samples were collected from four hand auger borings at the Open Burning Ground (MLAAP-OBG-1-SO, MLAAP-OBG-2-SO, MLAAP-OBG-3-SO, and MLAAP-OBG-4-SO; **Figure 7-6**), from a depth of 0 to 2 feet bgs. A summary of PFOS, PFOA, and PFBS soil analytical results is provided in **Table 7-2**.

PFOS, PFOA, and PFBS were not detected in any of the four soil samples.

7.6 Active Industrial Landfill

The subsections below summarize the groundwater PFOS, PFOA, and PFBS analytical results associated with Active Industrial Landfill. No soil samples were collected.

7.6.1 Groundwater

One groundwater sample was collected from an existing monitoring well (ILF3) near the Active Industrial Landfill AOPI (**Figure 7-7**). A summary of PFOS, PFOA, and PFBS groundwater analytical results is provided in **Table 7-1**.

PFOS, PFOA, and PFBS were not detected in this groundwater sample.

7.7 Ammunition Destruction Area

The subsections below summarize the groundwater PFOS, PFOA, and PFBS analytical results associated with Ammunition Destruction Area.

7.7.1 Groundwater

Groundwater samples were collected from two existing monitoring wells (MI272 and MI268) near the Ammunition Destruction Area AOPI (**Figure 7-8**). A summary of PFOS, PFOA, and PFBS groundwater analytical results is provided in **Table 7-1**.

PFOS, PFOA, and PFBS were not detected in either of these two groundwater samples.

7.8 Line E

The subsections below summarize the soil and groundwater PFOS, PFOA, and PFBS analytical results associated with Line E.

7.8.1 Groundwater

One groundwater sample was collected from an existing monitoring well (MI369) near the Line E AOPI (**Figure 7-9**). A summary of PFOS, PFOA, and PFBS groundwater analytical results is provided in **Table 7-1**.

PFOS, PFOA, and PFBS were not detected in this groundwater sample.

7.8.2 Soil

One soil sample was collected via hand auger at the Line E (MLAAP-LINEE-1-SO; **Figure 7-9**), from a depth of 0 to 2 feet bgs. A summary of PFOS, PFOA, and PFBS soil analytical results is provided in **Table 7-2**.

PFOS, PFOA, and PFBS were not detected in this soil sample.

7.9 Active WWTP

The subsections below summarize the soil PFOS, PFOA, and PFBS analytical results associated with Active WWTP.

7.9.1 Soil

One soil sample was collected via hand auger at the Active WWTP (MLAAP-WWTP-1-SO; **Figure 7-10**), from a depth of 0 to 2 feet bgs. A summary of PFOS, PFOA, and PFBS soil analytical results is provided in **Table 7-2**.

PFOS, PFOA, and PFBS were not detected in this soil sample.

7.10 Spray Fields

The subsections below summarize the soil and groundwater PFOS, PFOA, and PFBS analytical results associated with Spray Fields.

7.10.1 Groundwater

Groundwater samples were collected from two existing monitoring wells (MI026 and MI399) near the Spray Fields AOPI (**Figure 7-11**). A summary of PFOS, PFOA, and PFBS groundwater analytical results is provided in **Table 7-1**.

PFOS, PFOA, and PFBS were not detected in either of these two groundwater samples.

7.10.2 Soil

Soil samples were collected from three hand auger borings at the Spray Fields (MLAAP-SF-1-SO, MLAAP-SF-2-SO, and MLAAP-SF-3-SO; **Figure 7-11**), from a depth of 0 to 2 feet bgs. A summary of PFOS, PFOA, and PFBS soil analytical results is provided in **Table 7-2**.

PFOA was detected at concentrations below the residential OSD risk screening level (0.13 mg/kg) at two sample locations: MLAAP-SF-1-SO (0.0048 mg/kg) and MLAAP-SF-3-SO (0.0032 mg/kg). PFOA was not detected at MLAAP-SF-2-SO. PFOS and PFBS were not detected in any of these three soil samples.

7.11 Line K Former Metal Plating Facility

The subsections below summarize the soil and groundwater PFOS, PFOA, and PFBS analytical results associated with Line K Former Metal Plating Facility.

7.11.1 Groundwater

One groundwater sample was collected from an existing monitoring well (MI023) near Line K Former Metal Plating Facility AOPI (**Figure 7-12**). A summary of PFOS, PFOA, and PFBS groundwater analytical results is provided in **Table 7-1**.

PFOS, PFOA, and PFBS were not detected in this groundwater sample.

7.11.2 Soil

Soil samples were collected from two hand auger borings at the Line K Former Metal Plating Facility (MLAAP-LINEK-1-SO and MLAAP-LINEK-2-SO; **Figure 7-12**), from a depth of 0 to 2 feet bgs. A summary of PFOS, PFOA, and PFBS soil analytical results is provided in **Table 7-2**.

PFOS was detected at a concentration below the residential OSD risk screening level (0.13 mg/kg) at MLAAP-LINEK-2-SO (0.00053 mg/kg). PFOS was not detected at MLAAP-LINEK-1-SO. PFOA and PFBS were not detected in either of these two soil samples.

7.12 TOC, pH, and Grain Size

In addition to sampling soil for PFOS, PFOA, and PFBS, one soil sample per AOPI was analyzed for TOC, pH, moisture content, and grain size data as they may be useful in future fate and transport studies. The majority of TOC results for soil samples ranged from 2,080 to 9,210 mg/kg, with one sample result of 22,900 mg/kg. The TOC at this installation was typically within range of organic content in soil. The combined percentage of fines in soils ranged from 52.9 to 85.2% with an average of 79.9%. PFAS constituents tend to be more mobile in soils with less than 20% fines (silt and clay) and lower TOC. The percent solids of the fines was typical for clay (80 to 100%). The pH of the soil was slightly acidic (5.2 to 7.5). Based on the geochemical data obtained during the SI at the installation, PFAS constituents may be relatively less mobile than in soils with more fines and greater TOC content.

7.13 Blank Samples

PFOS, PFOA, and PFBS were not detected in any of the blank samples collected during the SI work. The full analytical results for blank samples collected during the SI are included in **Appendix N**.

7.14 Conceptual Site Models

The preliminary CSMs presented in the QAPP Addendum (Arcadis 2020) were re-evaluated and updated, if necessary, based on the SI sampling results. The CSMs presented on **Figures 7-13** through **7-22** and in this section therefore represent the current understanding of the potential for human exposure. For some AOPIs, the CSM is the same and thus shown on the same figure.

Many of the PFAS constituents found in AFFF and metal plating operations are surfactants (which do not volatilize) and are found in a charged or ionic state at environmentally-relevant pH (i.e., pH 5 to 9 standard units). PFOS, PFOA, and PFBS are each negatively charged at environmentally-relevant pH. The media potentially affected by PFOS, PFOA, PFBS releases at Army installations are soil, groundwater, surface water, and sediment. Once released to the environment, a primary factor that inhibits the movement of PFAS constituents is the presence of organic matter and organic co-constituents in soils and sediments. Generally, PFAS constituents are mobile in the potentially affected media, and they are not known to be fully broken down by natural processes.

Based on the historical use, storage, and/or disposal of PFAS-containing materials at the AOPIs, affected media are likely to consist of soil and groundwater and, at some AOPIs, could include surface water and sediment.

Release and transport mechanisms include dissolution/desorption from soil to groundwater, transport via sediment carried in and dissolution to stormwater and surface water, surface water recharge of groundwater, and adsorption/desorption between surface water and sediment. Generic categories of potential human receptors and their associated exposure scenarios that are typically evaluated in a CERCLA human health risk assessment were considered and include on-installation site workers (e.g., industrial/ commercial workers, utility workers, or future construction workers who could be exposed to chemicals in soil at an AOPI or to chemicals in tap water in an industrial/commercial building), on-installation residents (e.g., adults and children who could be exposed to chemicals in tap water in a residence), and on-installation recreational users (e.g., hikers or hunters who could be exposed to chemicals in waterways at an installation). Off-installation receptor types could include drinking water receptors (i.e., commercial/industrial workers or residents) and recreational users.

Human exposure pathways are shown as “complete”, “potentially complete”, or “incomplete” on the CSM figures. A complete exposure pathway consists of a constituent source and release mechanism, a transport or retention medium, an exposure point where human contact with the contaminated medium could occur, and an exposure route at the exposure point. If any of these elements is missing, the exposure pathway is incomplete. Pathways are “potentially complete” where data are insufficient to conclude the pathway is either “complete” or “incomplete”. Additionally, the CSMs do not include ecological receptors and exposure pathways. The potential for ecological exposures to PFOS, PFOA, and PFBS may be evaluated at a future date if those pathways warrant further consideration.

CSMs were developed for each individual AOPI and are combined where source media, potential migration pathways and exposure media, and human exposure pathways are congruent. The following exposure pathway determinations apply to all CSMs:

- MLAAP does not have any residential housing or permanent residents; therefore, all exposure pathways for on-installation residents are incomplete.
- The AOPIs are not likely to be regularly accessed by on-installation recreational users, or by off-installation receptors. Therefore, the soil exposure pathways for these receptors are incomplete.
- Recreational users are not likely to contact groundwater during outdoor recreational activities; therefore, the groundwater exposure pathway for on-installation recreational users is incomplete.

Additional exposure pathway descriptions for each CSM are listed below by figure.

Figure 7-13 shows the CSM for the Active Fire Station AOPI. AFFF was stored in Building F-50 and Building F-172. There are no known AFFF spills or releases; however, information about the Active Fire station prior to the early 2000s was unavailable.

- PFOS was detected in soil at this AOPI, and site workers could contact constituents in soil via incidental ingestion, dermal contact, and inhalation of dust. Therefore, the soil exposure pathway for on-installation site workers is complete.
- PFOA and PFBS were detected in groundwater at this AOPI. The AOPI is upgradient of a drinking water well used to supply potable water at MLAAP (Well S-99). Therefore, the groundwater exposure pathway (via drinking water ingestion and dermal contact) for on-installation site workers is potentially complete.
- Groundwater originating at this AOPI flows off-post through the installation's western boundary. Due to the absence of land use controls preventing potable use of groundwater in this area, the groundwater exposure pathway (via drinking water ingestion and dermal contact) for off-installation receptors is potentially complete.

Figure 7-14 shows the CSM for the Area K Fire Systems Testing AOPI. At least one reported firefighting training exercise occurred in the past at this AOPI, potentially releasing AFFF to soil and/or paved surfaces.

- PFOS, PFOA, and PFBS were not detected in soil at this AOPI; therefore, the soil exposure pathway for on-installation site workers is incomplete.
- PFOS, PFOA, and PFBS were not detected in groundwater grab samples collected downgradient of the AOPI. Additionally, the AOPI is not upgradient of drinking water wells at MLAAP. Therefore, the groundwater exposure pathways for all receptors are incomplete.

Figure 7-15 shows the CSM for the Line Z Flare Composition Facility, Open Burning Ground, and Line E AOPIs. Confirmed and potential releases Teflon® to soil and/or paved surfaces have occurred at these AOPIs.

- PFOS, PFOA, and PFBS were not detected in soil at these AOPIs; therefore, the soil exposure pathway for on-installation site workers is incomplete.

- PFOS, PFOA, and PFBS were not detected in groundwater samples collected from monitoring wells downgradient of the AOPIs. Therefore, the groundwater exposure pathways for all receptors are incomplete.
- Based on the non-detect results for soil and groundwater, it can be inferred there is not a source of PFAS to surface water and sediment at these AOPIs. Therefore, the surface water and sediment exposure pathways are also incomplete.

Figure 7-16 shows the CSM for the O-Line Ponds/O-Line Lagoons AOPI. This wastewater treatment area received water potentially containing Teflon®.

- PFOS, PFOA, and PFBS were not detected in soil at this AOPI; therefore, the soil exposure pathway for on-installation site workers is incomplete.
- PFOS, PFOA, and PFBS were not detected in groundwater samples collected from monitoring wells downgradient of the AOPI. Additionally, the AOPI is not upgradient of drinking water wells at MLAAP. Therefore, the groundwater exposure pathways for all receptors are incomplete.
- Based on the non-detect results for soil and groundwater, it can be inferred there is not a source of PFOS, PFOA, or PFBS to surface water and sediment at these AOPIs. Therefore, the surface water and sediment exposure pathways are also incomplete.

Figure 7-17 shows the CSM for the OU3 GWTP AOPI. The area received groundwater potentially containing PFAS (Teflon®) from the O-Line Ponds/O-Line Lagoons AOPI and released effluent to an outfall on an unnamed tributary to the RFOR.

- There was no historical release to soil at this AOPI; therefore, soil is not a potential exposure medium in this CSM figure.
- Groundwater sampling was not conducted at this AOPI; however, PFOS, PFOA, or PFBS were not detected in groundwater or soil samples at the O-Line Ponds/O-Line Lagoons AOPI, which is the primary source for contamination at the OU3 GWTP AOPI. Therefore, the groundwater exposure pathways for all receptors are incomplete.
- Based on the non-detect results for soil and groundwater at the O-Line Ponds/O-Line Lagoons AOPI, it can be inferred there is not a source of PFOS, PFOA, or PFBS to surface water and sediment at the OU3 GWTP AOPI. Therefore, the surface water and sediment exposure pathways are also incomplete.

Figure 7-18 shows the CSM for the Active Industrial Landfill AOPI. Teflon®-containing ash from burning of Teflon® flares was containerized and placed in this landfill.

- Potential PFAS-containing wastes at the Active Industrial Landfill are covered, and land use controls are in place. Therefore, site workers (i.e., installation personnel) are not able to contact constituents in soil, and the soil exposure pathway for on-installation site workers is incomplete.
- PFOS, PFOA, and PFBS were not detected in groundwater samples collected from monitoring wells downgradient of the AOPI. Additionally, the AOPI is not upgradient of drinking water wells at MLAAP. Therefore, the groundwater exposure pathways for all receptors are incomplete.

Figure 7-19 shows the CSM for the Ammunition Destruction Area AOPI. The area received soils potentially containing PFOA originating at the O-Line Ponds/O-Line Lagoons and treated at the Building A-50 Soil Bioremediation Facility between 2001 and 2008.

- Soil sampling was not conducted at this AOPI because the exact locations of bioapplication are unknown; however, PFOS, PFOA, and PFBS were not detected in soil at the O-Line Ponds/O-Line Lagoons AOPI, which would be a source for PFOS, PFOA, or PFBS at the Ammunition Destruction Area AOPI. Therefore, the soil exposure pathway for on-installation site workers is incomplete.
- PFOS, PFOA, and PFBS were not detected in groundwater samples collected from monitoring wells downgradient of the AOPIs. Therefore, the groundwater exposure pathways for all receptors are incomplete.
- Based on the non-detect results for soil at the Line Z and O-Line AOPIs and for groundwater at the Ammunition Destruction Area AOPI, it can be inferred there is not a source of PFOS, PFOA, or PFBS to surface water and sediment at this AOPI. Therefore, the surface water and sediment exposure pathways are also incomplete.

Figure 7-20 shows the CSM for the Active WWTP AOPI. The facility received wastewater potentially containing AFFF and/or Teflon® and released effluent to the lined WWTP lagoon.

- PFOS, PFOA, and PFBS were not detected in the soil at this AOPI; therefore, the soil exposure pathway for on-installation site workers is incomplete.
- Based on the non-detect results for soil, it can be inferred there is not a source of PFOS, PFOA, or PFBS to surface water or sediment and downgradient groundwater. Therefore, the surface water, sediment, and groundwater exposure pathways for all receptors are incomplete.

Figure 7-21 shows the CSM for the Spray Fields AOPI. The area received wastewater effluent potentially containing Teflon® and/or AFFF.

- PFOA was detected in soil at this AOPI, and site workers could contact constituents in soil via incidental ingestion, dermal contact and inhalation of dust. Therefore, the soil exposure pathway for on-installation site workers is complete.
- PFOS, PFOA, and PFBS were not detected in groundwater samples collected from monitoring wells downgradient of the AOPIs. Additionally, the AOPI is not upgradient of drinking water wells at MLAAP. Therefore, the groundwater exposure pathways for all receptors are incomplete.

Figure 7-22 shows the CSM for the Line K Former Metal Plating Facility AOPI. The area could have released metal plating wastes potentially including PFOA, PFOS, and PFBS.

- PFOS was detected in soil at this AOPI, and site workers could contact constituents in soil via incidental ingestion, dermal contact and inhalation of dust. Therefore, the soil exposure pathway for on-installation site workers is complete.
- PFOS, PFOA, and PFBS were not detected in groundwater samples collected from monitoring wells downgradient of the AOPIs. Additionally, the AOPI is not upgradient of drinking water wells at MLAAP. Therefore, the groundwater exposure pathways for all receptors are incomplete.

Following the SI sampling, three out of the twelve AOPIs were considered to have complete or potentially complete exposure pathways. Although the CSMs indicate complete or potentially complete exposure pathways may exist, the recommendation for remedial investigation is based on the comparison of analytical results for PFOS, PFOA, and PFBS to the OSD risk screening levels (**Table 6-3**).

8 CONCLUSIONS AND RECOMMENDATIONS

The PFAS PA/SI included two distinct efforts. The PA identified AOPIs at MLAAP based on the use, storage, and/or disposal of PFAS-containing materials, in accordance with the 2018 Army Guidance for Addressing Releases of Per-and Polyfluoroalkyl Substances (Army 2018). The SI included multi-media sampling at AOPIs to determine whether or not a release of PFOS, PFOA, and PFBS to the environment occurred.

OSD provided residential risk screening levels based on the USEPA oral reference dose for PFOS, PFOA, and PFBS in soil and groundwater (tap water) and industrial/commercial risk screening levels for PFOS, PFOA, and PFBS in soil (**Appendix A**). A combination of document review, internet searches, interviews with installation personnel, and an installation site visit were used to identify specific areas of suspected PFOS, PFOA, and PFBS use, storage, and/or disposal at MLAAP. Following the evaluation, 12 AOPIs were identified.

MLAAP sources drinking water from three production wells (C-5, S-99, and T-99) for consumption by on-installation personnel (**Figure 2-2**). Assuming a general groundwater flow direction of north-northwest, wells C-5 and T-99 are not downgradient of any AOPIs and are not likely affected by historical releases. Well S-99 is located in the northwest portion of the installation and is downgradient or cross-gradient and within 5 miles of several AOPIs: the Active Fire Station, Line Z Flare Composition Facility, Open Burning Ground, Ammunition Destruction Area, and Line E. Only the CSM for the Active Fire Station has a potentially complete exposure pathway for groundwater. Wells C-5 and S-99 were sampled for PFOA and PFOS as part of the Fiscal Year 2017 AMC Water Quality Survey and results were non-detect.

During the SI at MLAAP, 11 of the 12 AOPIs were sampled to identify presence or absence of PFOS, PFOA, and PFBS at each AOPI. Wastewater discharged by the OU3 GWTP to a tributary of the RFOR originated at the O-Line Ponds/O-Line Lagoons. Non-detect results for PFOS, PFOA, and PFBS in SI soil and groundwater samples from the O-Line Ponds/O-Line Lagoons AOPI indicate that wastewater discharged at the OU3 GWTP AOPI is not impacted by PFOS, PFOA, or PFBS. The SI scope of work was completed in accordance with the Final PQAPP (Arcadis 2019) and the MLAAP QAPP Addendum (Arcadis 2020).

Three AOPIs had detections of PFOS, PFOA, and/or PFBS in groundwater and/or soil. None of the AOPIs had detections exceeding OSD risk screening levels. PFOS and/or PFOA were detected in soil samples at three AOPIs: Active Fire Station, Spray Fields, and Line K Former Metal Plating Facility. All detections were below the PFOS and PFOA residential OSD risk screening levels for soil (0.13 mg/kg and 0.13 mg/kg, respectively). PFOS was detected in all four soil samples from the Active Fire Station with a maximum concentration of 0.0047 mg/kg, and in one of two soil samples at the Line K Former Metal Plating Facility with a concentration of 0.00053 mg/kg. PFOA was detected in two of three soil samples at the Spray Fields with a maximum concentration of 0.0048 mg/kg. PFBS was not detected in any soil samples.

PFOA and PFBS were detected in groundwater samples at the Active Fire Station AOPI. All detections were below the PFOA and PFBS OSD risk screening levels for tap water (40 ng/L and 600 ng/L, respectively). One groundwater sample and one field duplicate were collected at the Active Fire Station. The maximum concentrations between the two samples include PFOA detected at 4.7 ng/L, while PFBS was detected at 30 ng/L. PFOS was not detected in any groundwater samples.

Following the SI sampling, three AOPIs with confirmed PFOS, PFOA, and/or PFBS presence were considered to have potentially complete or complete exposure pathways. The following exposure pathways are complete or potentially complete based on PFAS detections at concentrations greater than their LODs:

- The soil exposure pathways for on-installation site workers are complete for three AOPIs where PFOS or PFOA compounds were detected at concentrations below the OSD risk screening level: Active Fire Station, Spray Fields and Line K Former Metal Plating Facility. The AOPIs are not likely to be accessed by on-installation recreational users and residents or by off-installation receptors. Therefore, the soil exposure pathways for on-installation recreational users and residents as well as off-installation receptors are incomplete.
- The groundwater exposure pathway via groundwater for on-installation site workers is potentially complete for Active Fire Station, where PFOA and PFBS compounds were detected in groundwater at concentrations lower than the OSD risk screening level.

Although the CSMs indicate complete or potentially complete exposure pathways may exist, the recommendation for future study in a remedial investigation or no action at this time is based on the comparison of the SI analytical results for PFOS, PFOA, and PFBS to the OSD risk screening levels (**Table 6-3**). **Table 8-1** below summarizes the AOPIs identified at MLAAP, PFOS, PFOA, and PFBS sampling; and recommendations for each AOPI. Further investigation is not warranted at MLAAP. In accordance with CERCLA, site-specific risk will be assessed during a future phase to evaluate whether remedial actions are required.

Table 8-1 Summary of AOPIs Identified during the PA; PFOS, PFOA, and PFBS Sampling at MLAAP; and Recommendations

AOPI Name	PFOS, PFOA, and/or PFBS Detected Greater than OSD Risk Screening Levels? (Yes/No/ND/NS)		Recommendation
	GW	SO	
Active Fire Station	No	No	No action at this time
Area K Fire Systems Testing	ND	ND	No action at this time
Line Z Flare Composition Facility	ND	ND	No action at this time
O-Line Ponds/ O-Line Lagoons	ND	ND	No action at this time
OU3 GWTP	NS/ND*	NS/ND*	No action at this time
Open Burning Ground	ND	ND	No action at this time

AOPI Name	PFOS, PFOA, and/or PFBS Detected Greater than OSD Risk Screening Levels? (Yes/No/ND/NS)		Recommendation
	GW	SO	
Active Industrial Landfill	ND	NS	No action at this time
Ammunition Destruction Area	ND	NS	No action at this time
Line E	ND	ND	No action at this time
Active WWTP	NS	ND	No action at this time
Spray Fields	ND	No	No action at this time
Line K Former Metal Plating Facility	ND	No	No action at this time

Notes:
* - Samples were not collected within the OU3 GWTP AOPI during this SI. The surrogate soil and groundwater samples collected from the O-Line Ponds/O-Line Lagoons AOPI (the origin of water discharged by the OU3 GWTP) address the presence/absence of PFOS, PFOA, and PFBS at both AOPIs.
GW – groundwater
ND – non-detect
NS – not sampled
SO – soil

Data collected during the PA (**Sections 3** through **5**) and SI (**Sections 6** through **7**) were sufficient to draw conclusions and recommendations summarized above. The data limitations relevant to the development of this PA/SI for PFOS, PFOA, and PFBS at MLAAP are discussed below.

Records gathered for the use, storage and/or disposal of PFAS-containing materials were reviewed during the PA process. Documentation specific to AFFF may have been limited (e.g., each AFFF use; procurement records, documentation of AFFF used during crash responses or fire training activities) due to lack of recordkeeping requirements for the full timeline of common AFFF practices. Anecdotal accounts of AFFF use (and therefore likely PFOS, PFOA, and PFBS use) were limited to available installation personnel, whose knowledge of AFFF use may have been restricted by their time spent at the installation or previous roles held that limited their relevant knowledge of potential AFFF (or other PFAS-containing material) use.

A comprehensive well survey was not completed as part of this PA; therefore, the information reviewed regarding off-post wells is limited to what is contained in the off-post well search results (**Appendix E**).

The searches for ecological receptors and off-post PFOS, PFOA, and PFBS sources were not exhaustive and were limited to easily identifiable and readily available information evaluated during the relevant documents research, installation personnel interviews, and site reconnaissance.

Finally, the available PFOS, PFOA, and PFBS analytical data is limited to on-post shallow groundwater samples from borings at two AOPIs and 16 monitoring wells at 10 AOPIs, and shallow soil samples from nine AOPIs. No residential wells or private wells were included in the SI. Available data, including PFOS,

PFOA, and PFBS, is listed in **Appendix N**, which were analyzed per the selected analytical method. Results from this PA/SI indicate further study in a remedial investigation is not warranted at MLAAP in accordance with the guidance provided by the OSD.

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ACRONYMS

%	percent
AFFF	aqueous film-forming foam
AMC	Army Materiel Command
AO	American Ordnance, LLC
AOPI	area of potential interest
Arcadis	Arcadis U.S., Inc.
Army	United States Army
bgs	below ground surface
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CSM	conceptual site model
DoD	Department of Defense
DQO	data quality objective
DUSR	Data Usability Summary Report
EB	equipment blank
EDR	Environmental Data Resources, Inc.
ELAP	Environmental Laboratory Accreditation Program
GIS	geographic information system
GW	groundwater
GWTP	groundwater treatment plant
HSA	hollow stem auger
IDW	investigation-derived waste
installation	United States Army or Reserve installation
IRP	Installation Restoration Program
LAP	load, assemble, and package
LOD	limit of detection
LOQ	limit of quantitation
mg/kg	milligrams per kilogram (parts per million)
MLAAP	Milan Army Ammunition Plant
ND	non-detect

ng/L	nanograms per liter (parts per trillion)
NPDES	National Pollution Discharge Elimination System
NS	not sampled
OSD	Office of the Secretary of Defense
OU	Operable Unit
PA	preliminary assessment
PFAS	per- and polyfluoroalkyl substances
PFBS	perfluorobutanesulfonic acid
PFOA	perfluorooctanoic acid
PFOS	perfluorooctane sulfonate
POC	point of contact
ppm	parts per million
ppt	parts per trillion
PQAPP	Programmatic Uniform Federal Policy-Quality Assurance Project Plan
PWS	public water system
QA	quality assurance
QAPP	Quality Assurance Project Plan
QC	quality control
QSM	Quality Systems Manual
RFOR	Rutherford Fork of the Obion River
RSL	Regional Screening Level
SDS	safety data sheet
SI	site inspection
SO	soil
SOP	standard operating procedure
SSHP	Site Safety and Health Plan
TGI	technical guidance instruction
TOC	total organic carbon
U.S.	United States
USACE	United States Army Corps of Engineers
USAEC	United States Army Environmental Command

USEPA	United States Environmental Protection Agency
WCOP	Wolfe Creek Ordnance Plant
WWTP	wastewater treatment plant

TABLES

Table 2-1 On-Post Drinking Water Supply Wells
USAEC PFAS Preliminary Assessment/Site Inspection
Milan Army Ammunition Plant, Tennessee

Well ID	Well Type	Total Well Depth (ft bgs)	Well Casing Diameter (inches)	Top of Screen Depth (ft bgs)	Completion Date	Well Status
C5	Water Supply	263	8.0	221	1980	Active
S99	Water Supply	270	12.0	210	No record	Active
T99	Water Supply	191	12.0	131	No record	Active

Notes:
bgs = below ground surface
ft = feet
ID = identification

Table 2-2 Historical PFOS, PFOA, and PFBS Analytical Results
USAEC PFAS Preliminary Assessment/Site Inspection
Milan Army Ammunition Plant, Tennessee

Public Water System Name		Milan Water Dept	Milan Arsenal #1	Milan Arsenal #1	Jackson Water System	Jackson Water System	Jackson Water System	Jackson Water System	Lexington Water Systems	Lexington Water Systems	Lexington Water Systems	Lexington Water Systems
Public Water System Identifier		TN0000458	TN0000798	TN0000798	TN0000299	TN0000299	TN0000299	TN0000299	TN0000402	TN0000402	TN0000402	TN0000402
Location		Building Y-102 Tap	Well House C-5	Well House S-99	North Plant	South Plant	South Plant	North Plant	Clearwell Plant	Clearwell Plant	Clearwell Plant	Clearwell Plant
Sample ID		Y-103	C-5	S-99	201310180349AM	201310240400AM	201404190074AM	201404300770AM	3327806	3375857	201503190478AM	201506120242AM
Sample Date		11/15/2016	11/15/2016	11/15/2016	10/15/2013	10/22/2013	4/15/2014	4/22/2014	9/22/2015	12/16/2015	3/16/2015	6/10/2015
Chemical Name	OSD Risk Screening Level* in ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L
Perfluorooctanoic acid (PFOA)	40	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Perfluorobutanesulfonic acid (PFBS)	600	NA	NA	NA	ND	ND	ND	ND	ND	ND	ND	ND
Perfluorooctane sulfonate (PFOS)	40	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

Notes and Acronyms:

Units are provided in nanograms per liter (ng/L)

*Risk screening level for tap water. To be conservative, the OSD tap water risk screening levels will be used to compare all groundwater and potable-use surface water for this Army PFAS PA/SI program.

Samples were analyzed using EPA Method 537; Detection limits: PFOA = <0.02 µg/L, PFOS = <0.04 µg/L

ID - identification

NA - not available

ND - non-detect; compound was not detected above the detection limit

ng/L - nanograms per liter

OSD - Office of the Secretary of Defense

Source:

https://www.epa.gov/dwucmr/occurrence-data-unregulated-contaminant-monitoring-rule#3

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Table 6-1 Monitoring Well Construction Details
USAEC PFAS Preliminary Assessment/Site Inspection
Milan Army Ammunition Plant, Tennessee

ARCADIS

Area of Potential Interest	Sampling Location ID[1]	Total Well Depth	Measuring Point Elevation	Measuring Point	May 2020 Depth to Groundwater from MP	May 2020 Groundwater Elevation	Screened Interval	Casing Diameter	Dedicated Bladder Pump
		(ft bgs)	(ft amsl)		(ft)	(ft amsl)	(ft bgs)	(inches)	(Y/N)
Ammunition Destruction Area	MLAAP-MI268-052620	120	488.53	Top of casing	74.3	414.23	49 - 79	4.0	N
	MLAAP-MI272-052620	120	507.23	Top of casing	93.12	414.11	29 - 59	4.0	N
Line E	MLAAP-MI369-052220	109.5	450.65	Top of casing	60.78	389.87	46 - 76	4.0	N
Line K Metal Plating Facility	MLAAP-MI023-052220	59	429.46	Top of casing	31.65	397.81	42 - 52	4.0	N
Line Z Flare Composition Facility	MLAAP-MI114-052220	52	424.39	Top of casing	41.25	383.14	117 - 127	4.0	N
	MLAAP-MI408-052220	70.5	426.84	Top of casing	44.45	382.39	110 - 120	4.0	N
Spray Fields	MLAAP-MI026-052720	76	432.50	Top of casing	47.44	385.06	50 - 100	4.0	N
	MLAAP-MI399-052720	110	437.16	Top of casing	50.05	387.11	80 - 90	4.0	N
O-Line Ponds/O-Line Lagoons	MLAAP-MI004-052820	79	454.5	Top of casing	57.55	396.95	93 - 103	4.0	N
	MLAAP-MI634-052820	85	448.89	Top of casing	49.96	398.93	110 - 120	2.0	N
	MLAAP-MI671-052820	100	453.9	Top of casing	55.6	398.30	110 - 120	4.0	N
	MLAAP-MW16S-052820	90	442.71	Top of casing	45.26	397.45	99.5 - 109.5	2.0	N

Area of Potential Interest	Sampling Location ID[1]	Total Well Depth (ft bgs)	Measuring Point Elevation (ft amsl)	Measuring Point	May 2020 Depth to Groundwater from MP (ft)	May 2020 Groundwater Elevation (ft amsl)	Screened Interval (ft bgs)	Casing Diameter (inches)	Dedicated Bladder Pump (Y/N)
Open Burning Ground	MLAAP-MI250-052720	130	517.95	Top of casing	107.97	409.98	100 - 110	4.0	N
	MLAAP-MI258-052720	120	504.73	Top of casing	91.92	412.81	60 - 70	4.0	N
	MLAAP-MI261-052720	112	499.91	Top of casing	88.16	411.75	75 - 85	4.0	N

Notes:

1. Permanent wells were not installed at the HSA sampling locations. The total depth listed indicates the total depth of the temporary borehole; the screened interval listed for HSA sampling points indicates the interval at which the drill casing was retracted for collection of a grab groundwater sample.

Acronyms/Abreviations

amsl - above mean sea level
bgs - below ground surface
ft - feet
GS - ground surface
HSA - hollow stem auger
ID - identification
MP - measuring point
N - No
NC - not calculated
NM - not measured (not surveyed)
TOC - top of casing
Y - Yes

Table 7-1 - Groundwater PFOS, PFOA, and PFBS Analytical Results
USAEC PFAS Preliminary Assessment/Site Inspection
Milan Army Ammunition Plant, Tennessee

					Analyte	PFOS (ng/l)		PFOA (ng/l)		PFBS (ng/L)	
					OSD Tap Water Risk Screening Level	40		40		600	
Associated AOPI	Location Type	Location	Sample ID / Parent Sample ID	Sample Date	Sample Type	Result	Qual	Result	Qual	Result	Qual
Active Fire Station	Monitoring Well	MLAAP-FS-1	MLAAP-FS-1-GW-052120	05/21/2020	N	3.7	U	**4.3**		**28**	
			MLAAP-FD-1-GW-052120 / MLAAP-FS-1-GW-052120	05/21/2020	FD	3.8	U	**4.7**		**30**	
Area K Fire Systems Testing	Monitoring Well	MLAAP-AREAK-1	MLAAP-AREAK-1-GW-051920	05/19/2020	N	3.9	U	3.9	U	3.9	U
Line Z Flare Composition Facility	Monitoring Well	MLAAP-MI408	MLAAP-MI408-052220	05/22/2020	N	4.0	U	4.0	U	4.0	U
	Monitoring Well	MLAAP-MI114	MLAAP-MI114-052220	05/22/2020	N	4.0	U	4.0	U	4.0	U
O-Line Ponds/O-Line Lagoons	Monitoring Well	MLAAP-MI671	MLAAP-MI671-052820	05/28/2020	N	4.0	U	4.0	U	4.0	UJ
	Monitoring Well	MLAAP-MI634	MLAAP-MI634-052820	05/28/2020	N	3.8	U	3.8	U	3.8	U
	Monitoring Well	MLAAP-MW16S	MLAAP-MW16S-052820	05/28/2020	N	3.6	U	3.6	U	3.6	U
	Monitoring Well	MLAAP-MI004	MLAAP-MI004-052820	05/28/2020	N	3.7	U	3.7	U	3.7	U
Open Burning Ground	Monitoring Well	MLAAP-MI261	MLAAP-MI261-052720	05/27/2020	N	3.7	U	3.7	U	3.7	U
	Monitoring Well	MLAAP-MI250	MLAAP-MI250-052720	05/27/2020	N	3.8	U	3.8	U	3.8	U
	Monitoring Well	MLAAP-MI258	MLAAP-MI258-052720	05/27/2020	N	3.8	U	3.8	U	3.8	U
Active Industrial Landfill	Monitoring Well	MLAAP-ILF3-1	MLAAP-ILF3-052720	05/27/2020	N	3.7	U	3.7	U	3.7	U
Ammunition Destruction Area	Monitoring Well	MLAAP-MI272	MLAAP-MI272-052620	05/26/2020	N	3.8	U	3.8	U	3.8	U
	Monitoring Well	MLAAP-MI268	MLAAP-MI268-052620	05/26/2020	N	3.7	U	3.7	U	3.7	U
Line E	Monitoring Well	MLAAP-MI369	MLAAP-MI369-052220	05/22/2020	N	3.7	U	3.7	U	3.7	U
Spray Fields	Monitoring Well	MLAAP-MI026	MLAAP-MI026-052720	05/27/2020	N	4.2	U	4.2	U	4.2	U
	Monitoring Well	MLAAP-MI399	MLAAP-MI399-052720	05/27/2020	N	3.8	U	3.8	U	3.8	U
Line K Metal Plating Facility	Monitoring Well	MLAAP-MI023	MLAAP-MI023-052220	05/22/2020	N	3.7	U	3.7	U	3.7	U

Notes:
1. **Bolded** values indicate the result was detected greater than the limit of detection.
2. Grey shaded values indicate the result was detected greater than the Office of the Secretary of Defense (OSD) risk screening levels for tap water (OSD. 2021. Memorandum: Investigating Per- and Polyfluoroalkyl Substances within the Department of Defense Cleanup Program. September). No concentrations of PFBS, PFOS, or PFOA exceeded the OSD risk screening levels.

Acronyms/Abbreviations:
AOPI - area of potential interest
FD - field duplicate sample
ID - identification
N - primary sample
ng/L - nanograms per liter (parts per trillion)
OSD - Office of the Secretary of Defense
PFAS - per- and polyfluoroalkyl substances
PFBS - perfluorobutanesulfonic acid
PFOA - perfluorooctanoic acid
PFOS - perfluorooctane sulfonate
Qual - qualifier

Qualifier	Description
U	The analyte was analyzed for but the result was not detected above the limit of quantitiation (LOQ).
UJ	The analyte was analyzed for but was not detected. The reported limit of quantiation (LOQ) is approximate and may be inaccurate or imprecise.

Table 7-2 - Soil PFOS, PFOA, and PFBS Analytical Results
USAEC PFAS Preliminary Assessment/Site Inspection
Milan Army Ammunition Plant, Tennessee

			Analyte		PFOS (mg/kg)		PFOA (mg/kg)		PFBS (mg/kg)	
			OSD Industrial/Commercial Risk Screening Level		1.6		1.6		25	
			OSD Residential Risk Screening Level		0.13		0.13		1.9	
Associated AOPI	Location Type	Location	Sample ID / Parent Sample ID	Sample Date	Sample Type	Result	Qual	Result	Qual	Result	Qual
Active Fire Station	Soil	MLAAP-FS-1	MLAAP-FS-1-SO-052120	05/21/2020	N	**0.00069**	J	0.0011	U	0.0011	U
			MLAAP-FD-1-SO-052120 / MLAAP-FS-1-SO-052120	05/21/2020	FD	**0.0047**		0.0011	U	0.0011	U
	Soil	MLAAP-FS-2	MLAAP-FS-2-SO-052120	05/21/2020	N	**0.0036**		0.0011	U	0.0011	U
	Soil	MLAAP-FS-3	MLAAP-FS-3-SO-052120	05/21/2020	N	**0.00091**	J	0.0011	U	0.0011	U
	Soil	MLAAP-FS-4	MLAAP-FS-4-SO-052120	05/21/2020	N	**0.0016**		0.0011	U	0.0011	U
Area K Fire Systems Testing	Soil	MLAAP-AREAK-1	MLAAP-AREAK-1-SO-051920	05/19/2020	N	0.0012	U	0.0012	U	0.0012	U
	Soil	MLAAP-AREAK-2	MLAAP-AREAK-2-SO-051920	05/19/2020	N	0.0011	U	0.0011	U	0.0011	U
			MLAAP-FD-2-SO-051920 / MLAAP-AREAK-2-SO-051920	05/19/2020	FD	0.0011	U	0.0011	U	0.0011	U
	Soil	MLAAP-AREAK-3	MLAAP-AREAK-3-SO-051920	05/19/2020	N	0.001	U	0.001	U	0.001	U
Line Z Flare Composition Facility	Soil	MLAAP-LINEZ-1	MLAAP-LINEZ-1-SO-052220	05/22/2020	N	0.0011	U	0.0011	U	0.0011	U
	Soil	MLAAP-LINEZ-2	MLAAP-LINEZ-2-SO-052220	05/22/2020	N	0.0011	U	0.0011	U	0.0011	U
	Soil	MLAAP-LINEZ-3	MLAAP-LINEZ-3-SO-052220	05/22/2020	N	0.001	U	0.001	U	0.001	U
O-Line Ponds/O-Line Lagoons	Soil	MLAAP-OLINE-1	MLAAP-OLINE-1-SO-052820	05/28/2020	N	0.0011	U	0.0011	U	0.0011	U
Open Burning Ground	Soil	MLAAP-OBG-1	MLAAP-OBG-1-SO-052620	05/26/2020	N	0.0011	U	0.0011	U	0.0011	U
	Soil	MLAAP-OBG-2	MLAAP-OBG-2-SO-052620	05/26/2020	N	0.0012	U	0.0012	U	0.0012	U
	Soil	MLAAP-OBG-3	MLAAP-OBG-3-SO-052620	05/26/2020	N	0.0011	U	0.0011	U	0.0011	U
	Soil	MLAAP-OBG-4	MLAAP-OBG-4-SO-052620	05/26/2020	N	0.0011	U	0.0011	U	0.0011	U
Line E	Soil	MLAAP-LINEE-1	MLAAP-LINEE-1-SO-052220	05/22/2020	N	0.0011	U	0.0011	U	0.0011	U
Active WWTP	Soil	MLAAP-WWTP-1	MLAAP-WWTP-1-SO-052720	05/27/2020	N	0.0017	U	0.0017	U	0.0017	U
Spray Fields	Soil	MLAAP-SF-1	MLAAP-SF-1-SO-052720	05/27/2020	N	0.0011	U	**0.0048**		0.0011	U
	Soil	MLAAP-SF-2	MLAAP-SF-2-SO-052720	05/27/2020	N	0.0011	U	0.0011	U	0.0011	U
	Soil	MLAAP-SF-3	MLAAP-SF-3-SO-052720	05/27/2020	N	0.0012	U	**0.0032**		0.0012	U
Line K Metal Plating Facility	Soil	MLAAP-LINEK-1	MLAAP-LINEK-1-SO-052220	05/22/2020	N	0.0012	U	0.0012	U	0.0012	U
	Soil	MLAAP-LINEK-2	MLAAP-LINEK-2-SO-052220	05/22/2020	N	**0.00053**	J	0.001	U	0.001	U

Notes:
1. **Bolded** values indicate the result was detected greater than the limit of detection.
2. Data are compared to the Office of the Secretary of Defense (OSD) risk screening levels for both the residential as well as the industrial/commercial scenarios (OSD. 2021. Memorandum: Investigating Per- and Polyfluoroalkyl Substances within the Department of Defense Cleanup Program. September). No concentrations of PFBS, PFOS, or PFOA exceeded the OSD risk screening levels.

Acronyms/Abbreviations:
AOPI = Area of Potential Interest
FD = field duplicate sample
ID = identification
mg/kg = milligrams per kilogram (parts per million)
N = primary sample
PFAS = per- and polyfluoroalkyl substances
PFBS = perfluorobutanesulfonic acid
PFOA = perfluorooctanoic acid
PFOS = perfluorooctane sulfonate
Qual = qualifier
WWTP = wastewater treatment plant

Qualifier Description:
J = The analyte was positively identified; however the associated numerical value is an estimated concentration only.
U = The analyte was analyzed for but the result was not detected above the limit of quantitation (LOQ).

FIGURES

USAEC PFAS Preliminary Assessment / Site Inspection
Milan Army Ammunition Plant, TN

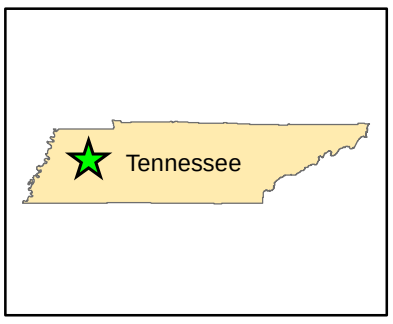
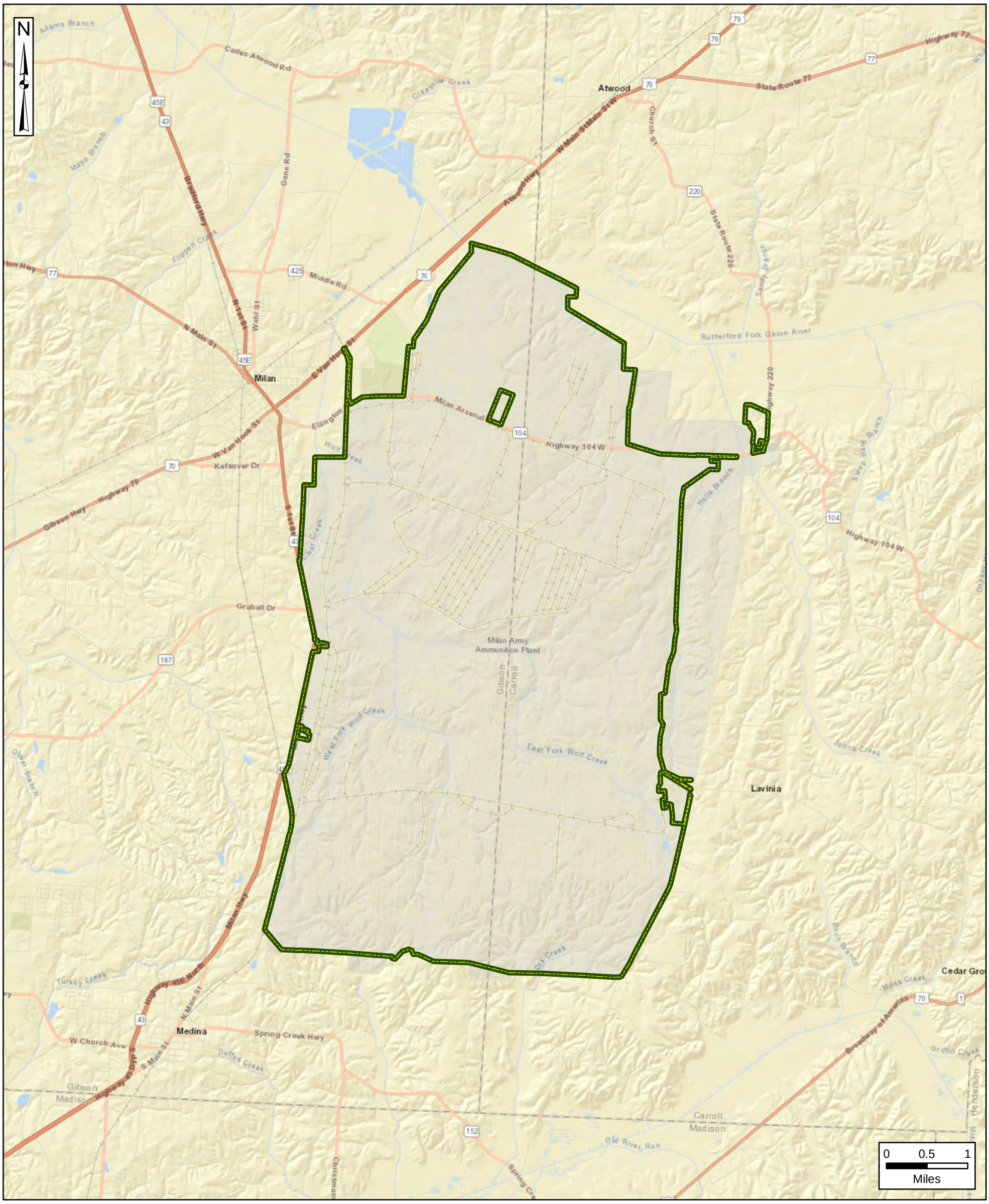


Figure 2-1
Site Location



Installation Boundary

Data Sources:
ESRI ArcGIS Online, StreetMap

Coordinate System:
WGS 1984, UTM Zone 16 North

USAEC PFAS Preliminary Assessment / Site Inspection
Milan Army Ammunition Plant, TN

Figure 2-2
Site Layout

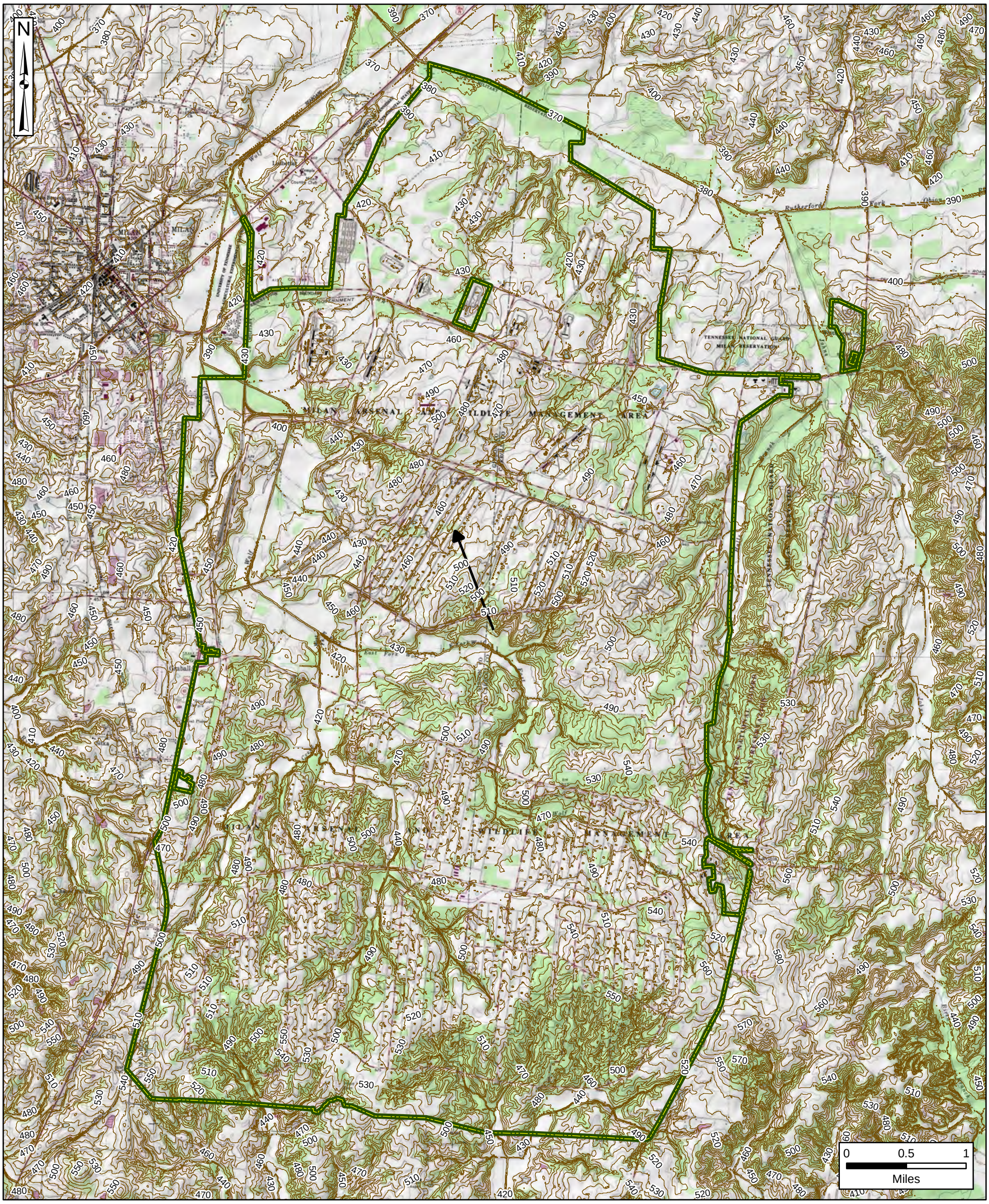
Installation Boundary
River/Stream (Perennial)
Stream (Intermittent)
Water Body
Surface Water Flow Direction
Groundwater Flow Direction
Water Supply Well

Data Sources:
MLAAP, GIS Data, 2019
USGS, NHD Data, 2019
ESRI ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 16 North

USAEC PFAS Preliminary Assessment / Site Inspection
Milan Army Ammunition Plant, TN

Figure 2-3
Topographic Map



Installation Boundary

Elevation Contour (10 feet)

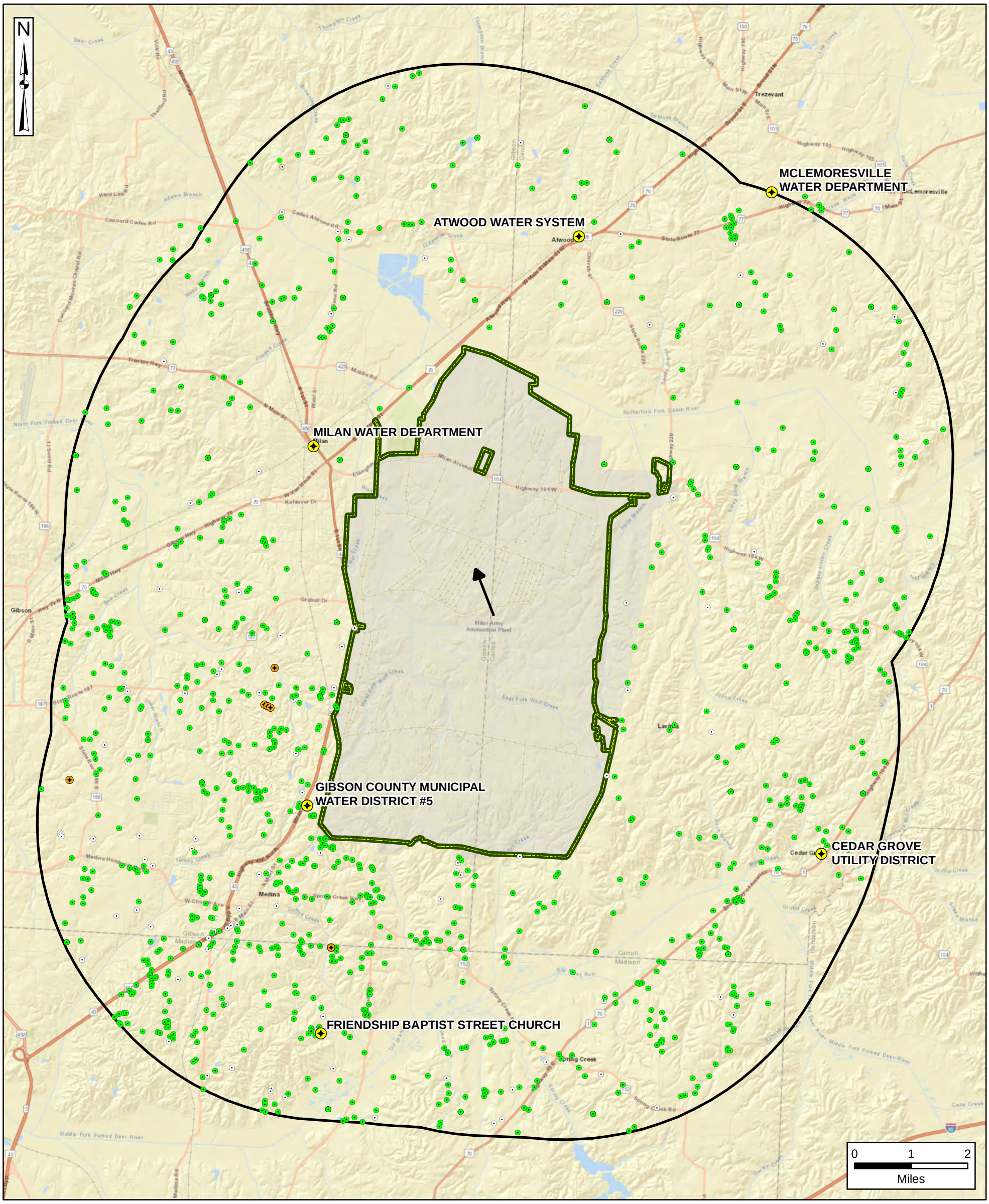
Groundwater Flow Direction

Data Sources:
MLAAP, GIS Data, 2019
ESRI ArcGIS Online, USGS Topo

Coordinate System:
WGS 1984, UTM Zone 16 North

USAEC PFAS Preliminary Assessment / Site Inspection
Milan Army Ammunition Plant, TN

Figure 2-4
Off-Post Potable Supply Wells



Installation Boundary
5-Mile Radius
Groundwater Flow Direction
Public Water System Supply Well
Other Public Supply Well
Domestic Well
Other Designated Use Water Well

Notes:
1. Water supply well locations and identifications were provided by Environmental Data Resources, Inc. (EDR). The functional status of the wells may not be known.
2. Other designated use wells include commercial/irrigation wells and wells with unreported use.

Data Sources:
MLAAP, GIS Data, 2019
EDR, Well Data, 2018
ESRI ArcGIS Online, StreetMap

Coordinate System:
WGS 1984, UTM Zone 16 North

USAEC PFAS Preliminary Assessment / Site Inspection
Milan Army Ammunition Plant, TN

Figure 5-2
AOPI Locations

Installation Boundary
River/Stream (Perennial)
Stream (Intermittent)
Water Body
Presumed Surface Runoff Flow Direction
Groundwater Flow Direction

AOPI
Water Supply Well
Public Water System Supply Well

Other Public Supply Well
Domestic Well
Other Designated Use Water Well

AOPI = area of potential interest
GWTP = groundwater treatment plant
WWTP = wastewater treatment plant

Data Sources:
MLAAP, GIS Data, 2019
USGS, NHD Data, 2019
EDR, Well Data, 2018
ESRI ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 16 North

USAEC PFAS Preliminary Assessment / Site Inspection
Milan Army Ammunition Plant, TN

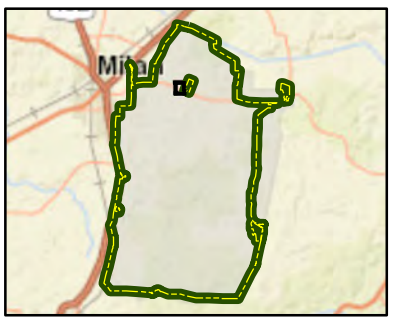
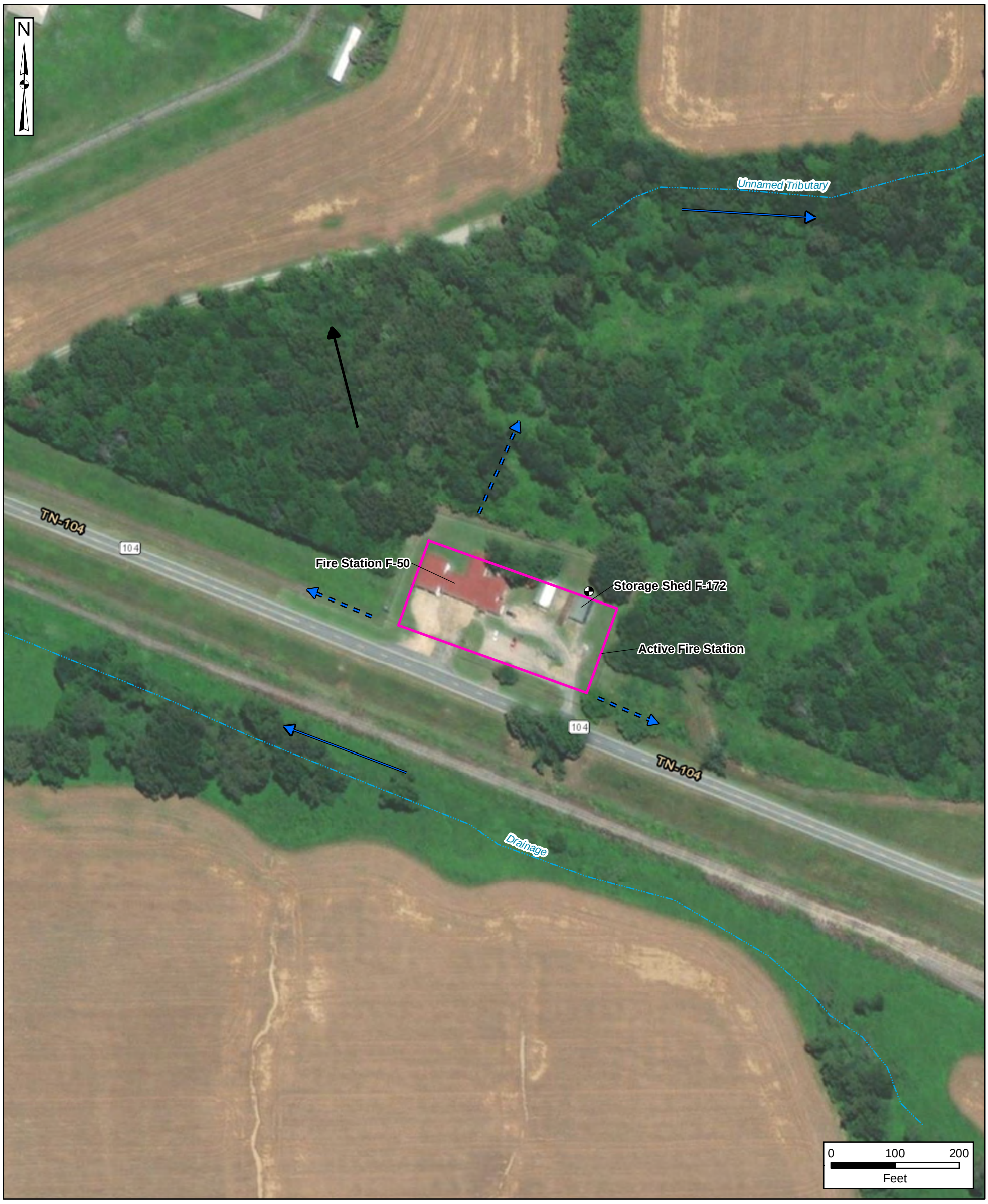


Figure 5-3
Aerial Photo of
Active Fire Station



Installation Boundary
AOPI
Stream (Intermittent)
Monitoring Well
Presumed Surface Runoff Flow Direction
Surface Water Flow Direction
Groundwater Flow Direction

AOPI = area of potential interest

Data Sources:
MLAAP, GIS Data, 2019
USGS, NHD Data, 2019
ESRI ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 16 North

USAEC PFAS Preliminary Assessment / Site Inspection
Milan Army Ammunition Plant, TN

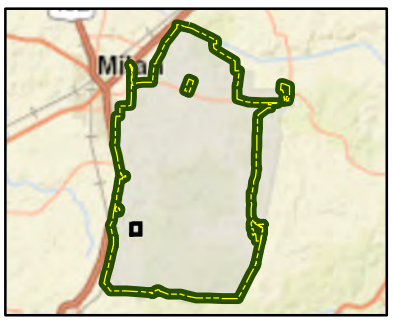


Figure 5-4
Aerial Photo of
Area K Fire Systems Testing

Installation Boundary
AOPI
AOPI = area of potential interest
Stream (Intermittent)
Presumed Surface Runoff Flow Direction
Surface Water Flow Direction
Groundwater Flow Direction

Data Sources:
USGS, NHD Data, 2019
ESRI ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 16 North

USAEC PFAS Preliminary Assessment / Site Inspection
Milan Army Ammunition Plant, TN

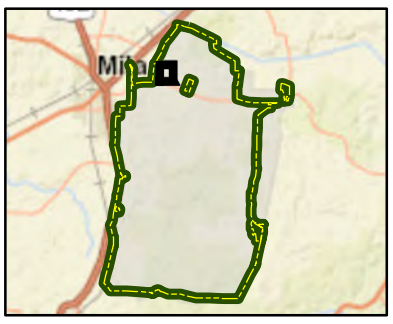
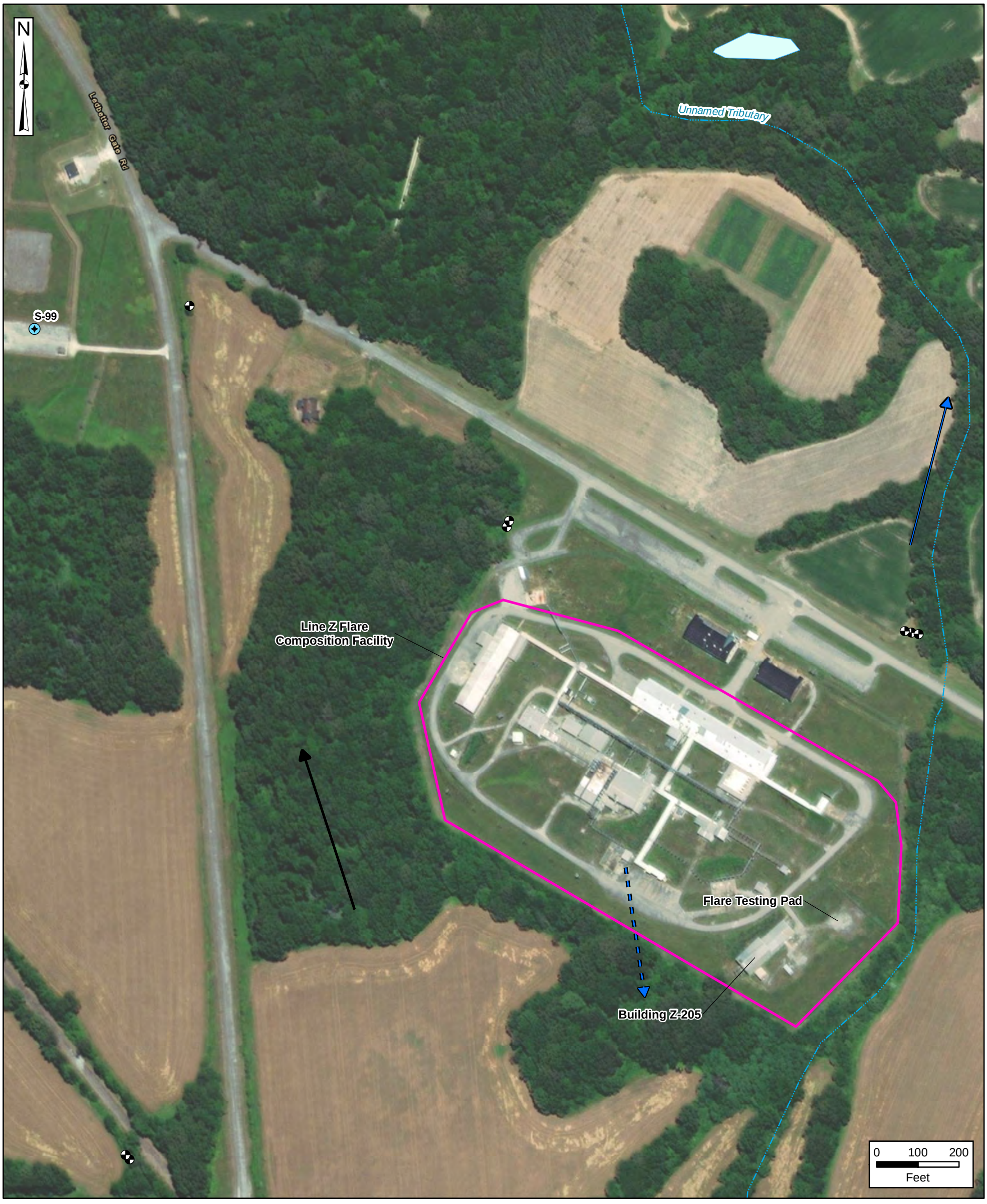


Figure 5-5
Aerial Photo of
Line Z Flare Composition Facility



Installation Boundary
Stream (Intermittent)
Water Body
Presumed Surface Runoff Flow Direction
Surface Water Flow Direction
Groundwater Flow Direction
AOPI
Water Supply Well
Monitoring Well

AOPI = area of potential interest

Data Sources:
MLAAP, GIS Data, 2019
USGS, NHD Data, 2019
ESRI ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 16 North

USAEC PFAS Preliminary Assessment / Site Inspection
Milan Army Ammunition Plant, TN

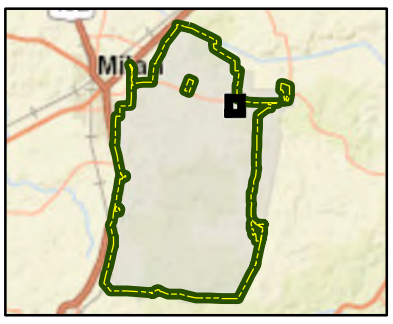


Figure 5-6
Aerial Photo of
O-Line Ponds/O-Line Lagoons

Installation Boundary
River/Stream (Perennial)
Stream (Intermittent)
Presumed Surface Runoff Flow Direction
Surface Water Flow Direction
Groundwater Flow Direction
AOPI
Monitoring Well

AOPI = area of potential interest

Data Sources:
MLAAP, GIS Data, 2019
USGS, NHD Data, 2019
ESRI ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 16 North

USAEC PFAS Preliminary Assessment / Site Inspection
Milan Army Ammunition Plant, TN

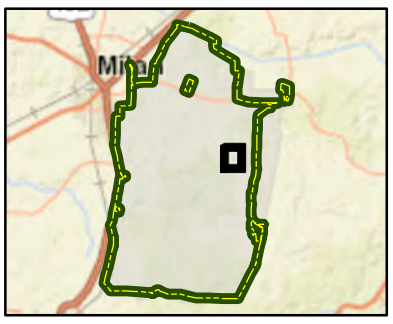
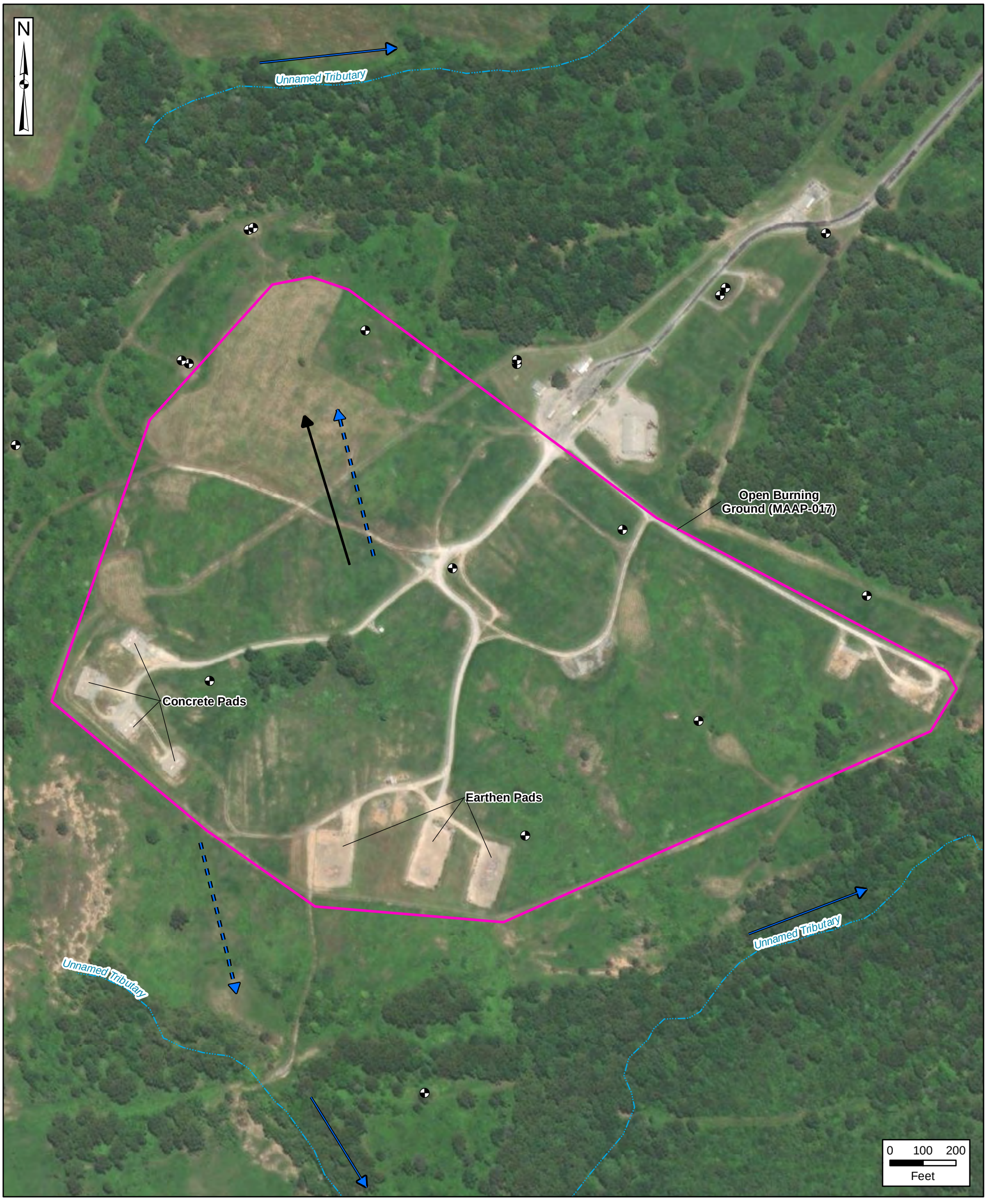


Figure 5-7
Aerial Photo of
Open Burning Ground



Installation Boundary
Stream (Intermittent)
Presumed Surface Runoff Flow Direction
Surface Water Flow Direction
Groundwater Flow Direction
AOPI
Monitoring Well

AOPI = area of potential interest

Data Sources:
MLAAP, GIS Data, 2019
USGS, NHD Data, 2019
ESRI ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 16 North

USAEC PFAS Preliminary Assessment / Site Inspection
Milan Army Ammunition Plant, TN

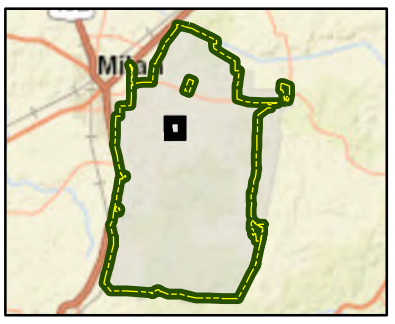


Figure 5-8
Aerial Photo of
Active Industrial Landfill

Installation Boundary
Stream (Intermittent)
Presumed Surface Runoff Flow Direction
Surface Water Flow Direction
Groundwater Flow Direction
AOPI
Monitoring Well

AOPI = area of potential interest

Data Sources:
MLAAP, GIS Data, 2019
USGS, NHD Data, 2019
ESRI ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 16 North

USAEC PFAS Preliminary Assessment / Site Inspection
Milan Army Ammunition Plant, TN

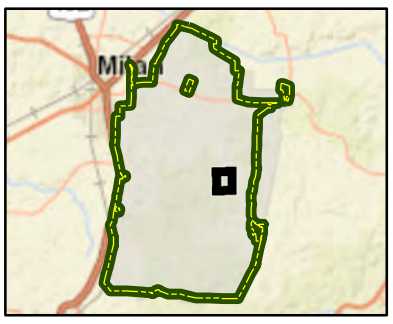
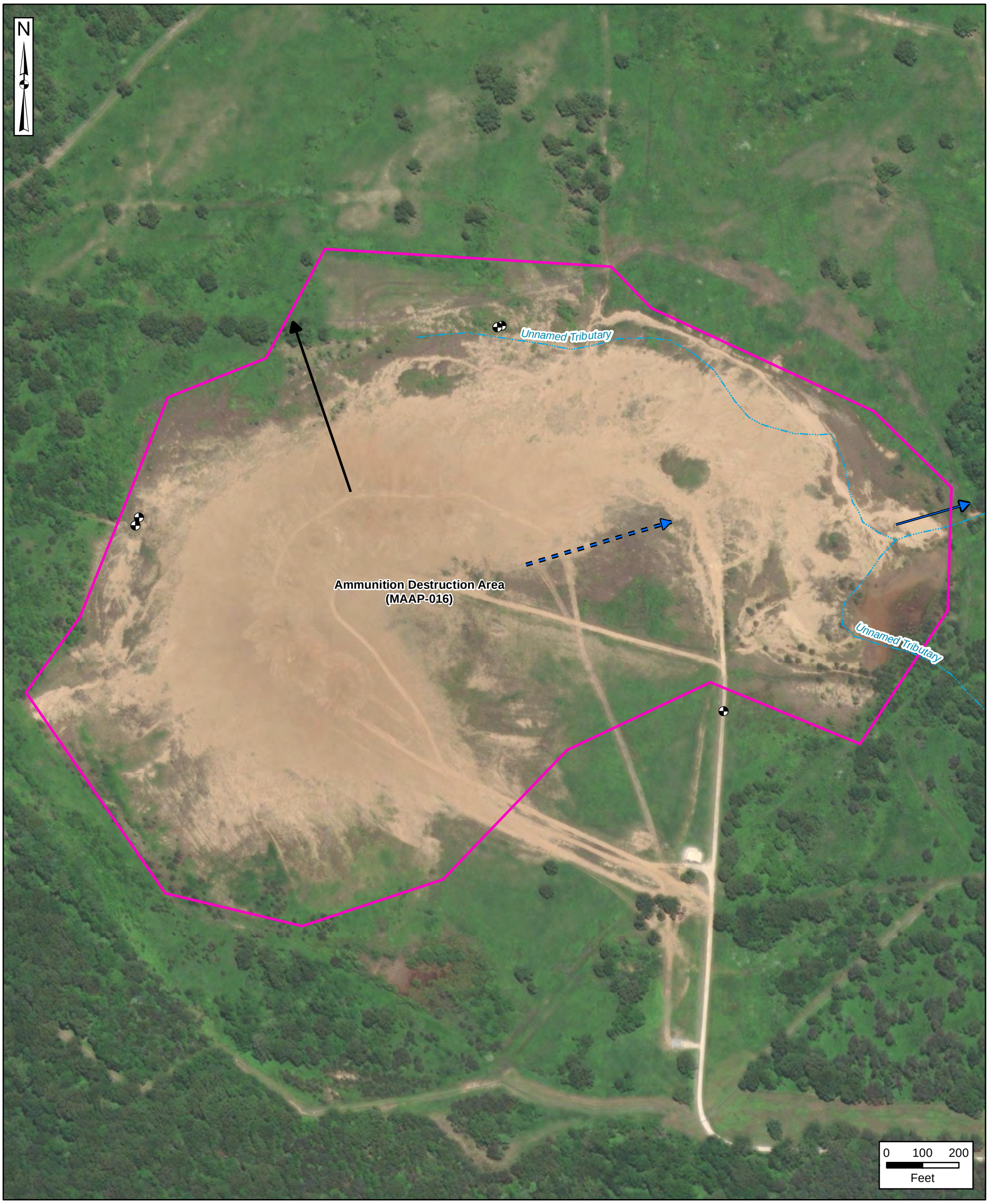


Figure 5-9
Aerial Photo of
Ammunition Destruction Area



Installation Boundary
AOPI
Stream (Intermittent)
Monitoring Well
Groundwater Flow Direction
Presumed Surface Runoff Flow Direction
Surface Water Flow Direction

AOPI = area of potential interest

Data Sources:
MLAAP, GIS Data, 2019
USGS, NHD Data, 2019
ESRI ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 16 North

USAEC PFAS Preliminary Assessment / Site Inspection
Milan Army Ammunition Plant, TN

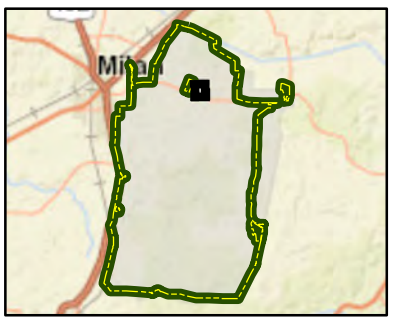
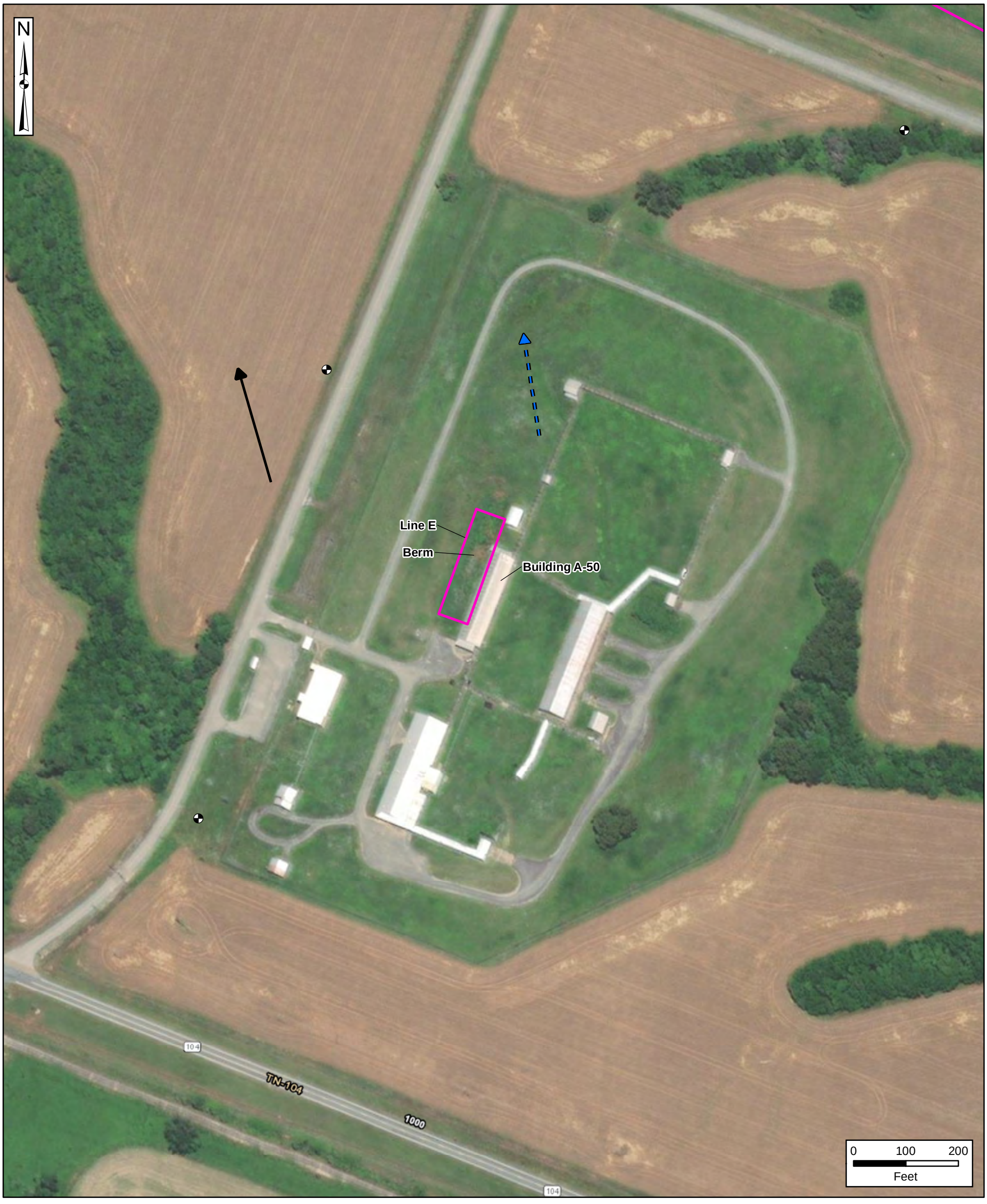


Figure 5-10
Aerial Photo of
Line E



Installation Boundary
AOPI
Presumed Surface Runoff Flow Direction
Monitoring Well
Groundwater Flow Direction

AOPI = area of potential interest

Data Sources:
MLAAP, GIS Data, 2019
ESRI ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 16 North

USAEC PFAS Preliminary Assessment / Site Inspection
Milan Army Ammunition Plant, TN

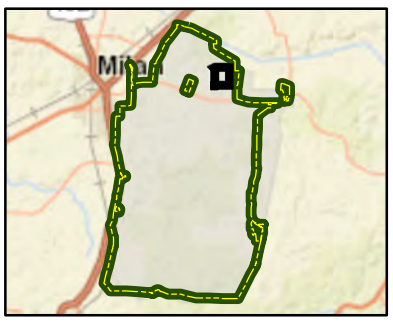


Figure 5-11
Aerial Photo of
Active WWTP

Installation Boundary
River/Stream (Perennial)
Presumed Surface Runoff Flow Direction
Surface Water Flow Direction
Groundwater Flow Direction
AOPI
Outfall
Monitoring Well

AOPI = area of potential interest
WWTP = wastewater treatment plant

Data Sources:
MLAAP, GIS Data, 2019
USGS, NHD Data, 2019
ESRI ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 16 North

USAEC PFAS Preliminary Assessment / Site Inspection
Milan Army Ammunition Plant, TN

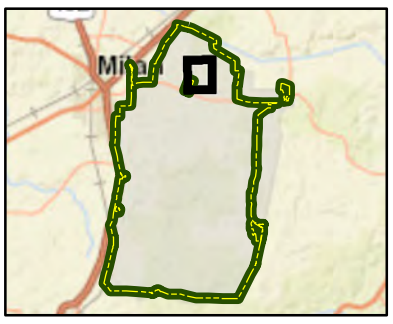
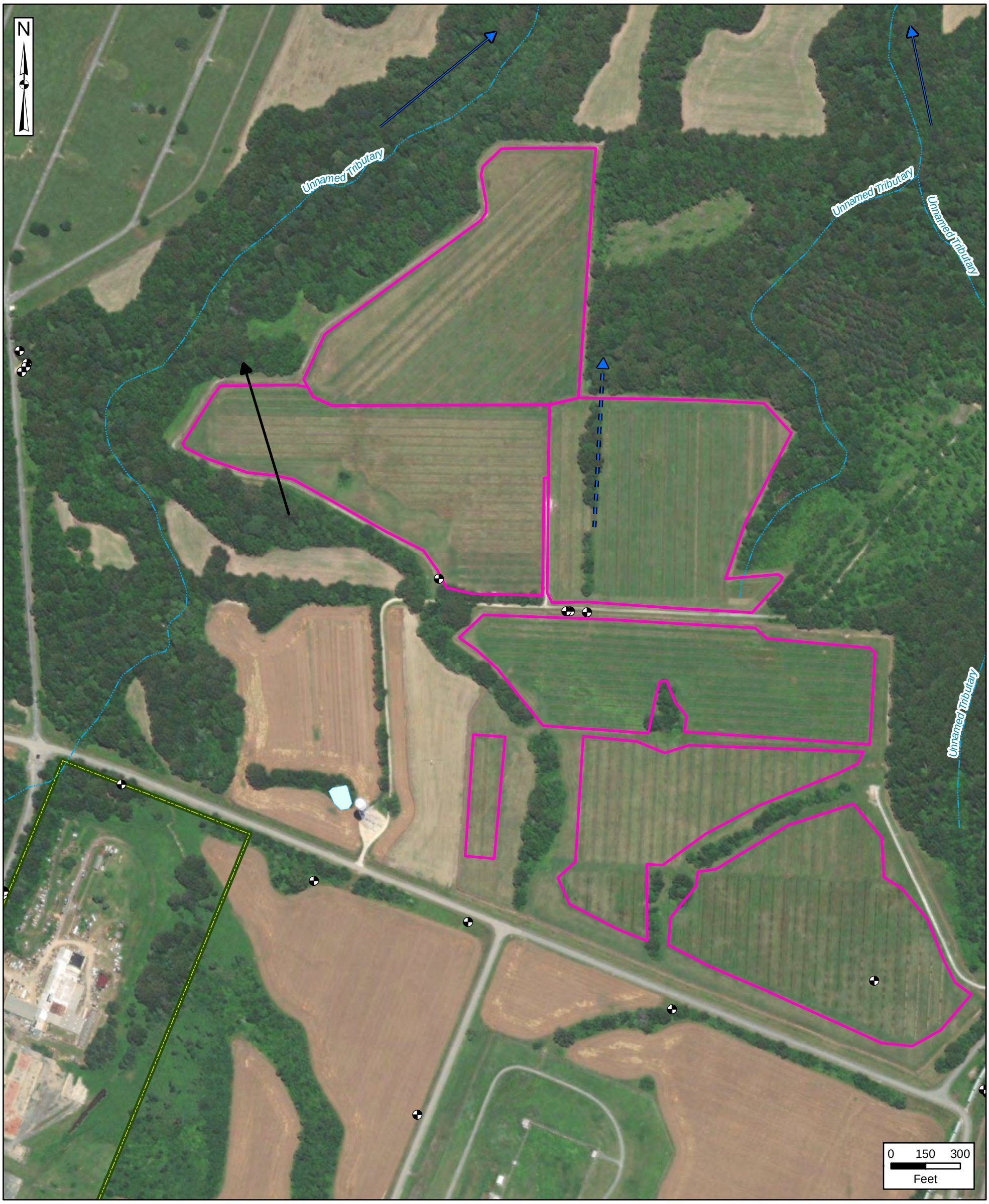


Figure 5-12
Aerial Photo of
Spray Fields



Installation Boundary
Stream (Intermittent)
Water Body
Presumed Surface Runoff Flow Direction
Surface Water Flow Direction
Groundwater Flow Direction
AOPI
Monitoring Well

AOPI = area of potential interest

Data Sources:
MLAAP, GIS Data, 2019
USGS, NHD Data, 2019
ESRI ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 16 North

USAEC PFAS Preliminary Assessment / Site Inspection
Milan Army Ammunition Plant, TN

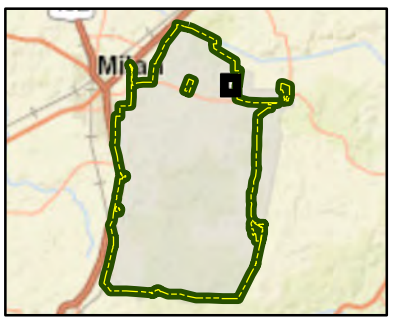
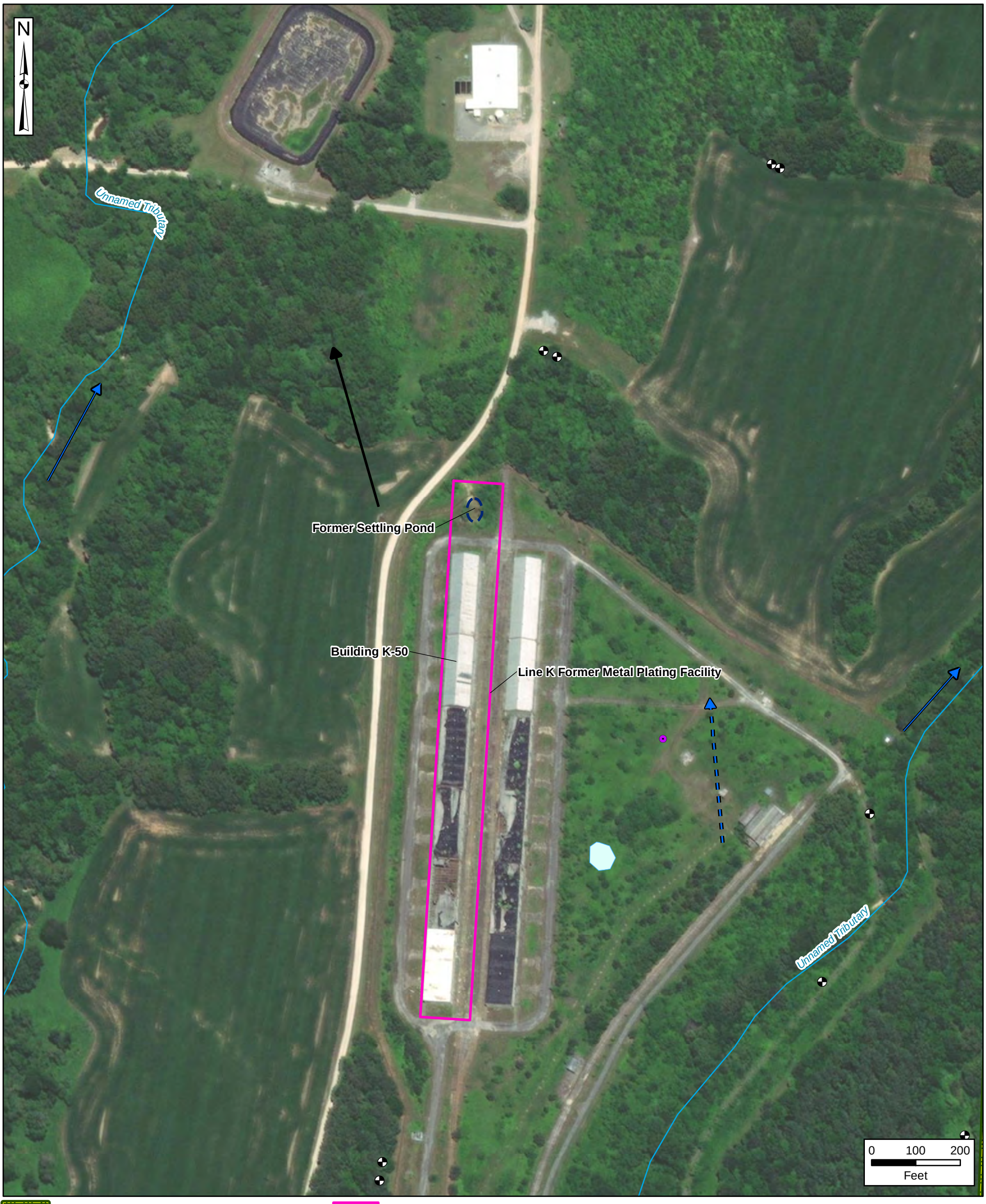


Figure 5-13
Aerial Photo of
Line K Former Metal Plating Facility



Installation Boundary
River/Stream (Perennial)
Water Body
Presumed Surface Runoff Flow Direction
Surface Water Flow Direction
Groundwater Flow Direction
AOPI
Monitoring Well
Commercial/Irrigation Well
Former Settling Pond

AOPI = area of potential interest

Data Sources:
MLAAP, GIS Data, 2019
USGS, NHD Data, 2019
ESRI ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 16 North

USAEC PFAS Preliminary Assessment / Site Inspection
Milan Army Ammunition Plant, TN

Figure 7-1
AOPI Locations and
OSD Risk Screening Level Exceedances

Note: There were no OSD risk screening level exceedances at any AOPIs.

- Installation Boundary
- River/Stream (Perennial)
- Stream (Intermittent)
- Water Body
- Presumed Surface Runoff Flow Direction
- Groundwater Flow Direction
- AOPI
- Water Supply Well
- Public Water System Supply Well
- Other Public Supply Well
- Domestic Well
- Other Designated Use Water Well

AOPI = area of potential interest
GWTP = groundwater treatment plant
OSD = Office of the Secretary of Defense
WWTP = wastewater treatment plant

Data Sources:
MLAAP, GIS Data, 2019
USGS, NHD Data, 2019
EDR, Well Data, 2018
ESRI ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 16 North

USAEC PFAS Preliminary Assessment / Site Inspection
Milan Army Ammunition Plant, TN

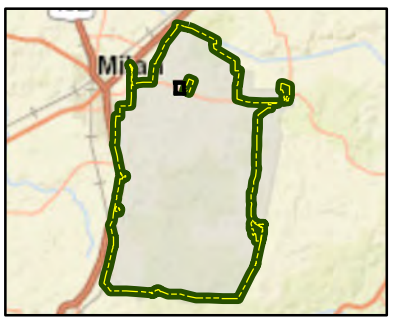


Figure 7-2
Active Fire Station
PFOS, PFOA, and PFBS Analytical Results

MLAAP-FS-1-GW	
Date	5/21/2020
Depth	55 ft bgs
PFOS	3.7 U [3.8 U]
PFOA	**4.3 [4.7]**
PFBS	**28 [30]**

MLAAP-FS-3-SO	
Date	5/21/2020
Depth	0-2 ft bgs
PFOS	**0.00091 J**
PFOA	0.0011 U
PFBS	0.0011 U

MLAAP-FS-1-SO	
Date	5/21/2020
Depth	0-2 ft bgs
PFOS	**0.00069 J [0.0047]**
PFOA	0.0011 U [0.0011 U]
PFBS	0.0011 U [0.0011 U]

MLAAP-FS-2-SO	
Date	5/21/2020
Depth	0-2 ft bgs
PFOS	**0.0036**
PFOA	0.0011 U
PFBS	0.0011 U

MLAAP-FS-4-SO	
Date	5/21/2020
Depth	0-2 ft bgs
PFOS	**0.0016**
PFOA	0.0011 U
PFBS	0.0011 U

Notes:
1. Groundwater results (shown in blue) are in nanograms per liter (ng/L), or parts per trillion.
2. Soil results (shown in yellow) are in milligrams per kilogram (mg/kg), or parts per million.
3. Duplicate sample results are shown in brackets.
4. Bolded values indicate detections.

Qualifiers:
J = The analyte was positively identified; however, the associated numerical value is an estimated concentration only.
U = The analyte was analyzed for, but was not detected above the limit of quantitation (LOQ).

0 100 200
Feet

Installation Boundary
Stream (Intermittent)
Presumed Surface Water Flow Direction
Surface Water Flow Direction
Groundwater Flow Direction
AOPI
Monitoring Well
Soil Sampling Location
Groundwater Sampling Location

AOPI = area of potential interest
ft bgs = feet below ground surface
PFBS = perfluorobutanesulfonic acid
PFOA = perfluorooctanoic acid
PFOS = perfluorooctane sulfonate

Data Sources:
MLAAP, GIS Data, 2019
USGS, NHD Data, 2019
ESRI ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 16 North

USAEC PFAS Preliminary Assessment / Site Inspection
Milan Army Ammunition Plant, TN

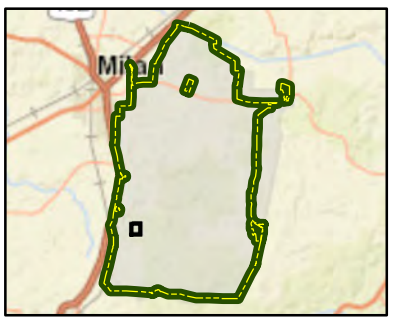


Figure 7-3
Area K Fire Systems Testing
PFOS, PFOA, and PFBS Analytical Results

MLAAP-AREAK-1	
Date	5/19/2020
Date	60.1 ft bgs
PFOS	3.9 U
PFOA	3.9 U
PFBS	3.9 U

MLAAP-AREAK-1-SO	
Date	5/19/2020
Depth	0-2 ft bgs
PFOS	0.0012 U
PFOA	0.0012 U
PFBS	0.0012 U

MLAAP-AREAK-2-SO	
Date	5/19/2020
Depth	0-2 ft bgs
PFOS	0.0011 U [0.0011 U]
PFOA	0.0011 U [0.0011 U]
PFBS	0.0011 U [0.0011 U]

MLAAP-AREAK-3-SO	
Date	5/19/2020
Depth	0-2 ft bgs
PFOS	0.0010 U
PFOA	0.0010 U
PFBS	0.0010 U

Area K Fire Systems Testing
Lagoon
Building K-323
Unnamed Tributary

Notes:
1. Groundwater results (shown in blue) are in nanograms per liter (ng/L), or parts per trillion.
2. Soil results (shown in yellow) are in milligrams per kilogram (mg/kg), or parts per million.
3. Duplicate sample results are shown in brackets.

Qualifiers:
U = The analyte was analyzed for, but was not detected above the limit of quantitation (LOQ).

0 100 200
Feet

Installation Boundary
Stream (Intermittent)
Presumed Surface Runoff Flow Direction
Surface Water Flow Direction
Groundwater Flow Direction
AOPI
Soil Sampling Location
Groundwater Sampling Location

AOPI = area of potential interest
ft bgs = feet below ground surface
PFBS = perfluorobutanesulfonic acid
PFOA = perfluorooctanoic acid
PFOS = perfluorooctane sulfonate

Data Sources:
MLAAP, GIS Data, 2019
USGS, NHD Data, 2019
ESRI ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 16 North

USAEC PFAS Preliminary Assessment / Site Inspection
Milan Army Ammunition Plant, TN

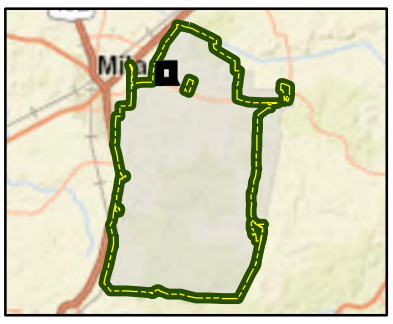


Figure 7-4
Line Z Flare Composition Facility
PFOS, PFOA, and PFBS Analytical Results

N

Ledbetter Gate Rd

Unnamed Tributary

S-99

MLAAP-MI408	
Date	5/22/2020
Depth	44.45 ft bgs
PFOS	4.0 U
PFOA	4.0 U
PFBS	4.0 U

MLAAP-MI114	
Date	5/22/2020
Depth	41.25 ft bgs
PFOS	4.0 U
PFOA	4.0 U
PFBS	4.0 U

Line Z Flare Composition Facility

MLAAP-LINEZ-3-SO	
Date	5/22/2020
Depth	0-2 ft bgs
PFOS	0.0010 U
PFOA	0.0010 U
PFBS	0.0010 U

Flare Testing Pad

Building Z-205

MLAAP-LINEE-1-SO	
Date	5/22/2020
Depth	0-2 ft bgs
PFOS	0.0011 U
PFOA	0.0011 U
PFBS	0.0011 U

MLAAP-LINEZ-2-SO	
Date	5/22/2020
Depth	0-2 ft bgs
PFOS	0.0011 U
PFOA	0.0011 U
PFBS	0.0011 U

0 100 200
Feet

Notes:
1. Groundwater results (shown in blue) are in nanograms per liter (ng/L), or parts per trillion.
2. Soil results (shown in yellow) are in milligrams per kilogram (mg/kg), or parts per million.

Qualifiers:
U = The analyte was analyzed for, but was not detected above the limit of quantitation (LOQ).

Installation Boundary
AOPI
Stream (Intermittent)
Water Supply Well
Water Body
Monitoring Well
Presumed Surface Runoff Flow Direction
Groundwater Sampling Location - Existing Well
Surface Water Flow Direction
Soil Sampling Location
Groundwater Flow Direction

AOPI = area of potential interest
ft bgs = feet below ground surface
PFBS = perfluorobutanesulfonic acid
PFOA = perfluorooctanoic acid
PFOS = perfluorooctane sulfonate

Data Sources:
MLAAP, GIS Data, 2019
USGS, NHD Data, 2019
ESRI ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 16 North

USAEC PFAS Preliminary Assessment / Site Inspection
Milan Army Ammunition Plant, TN

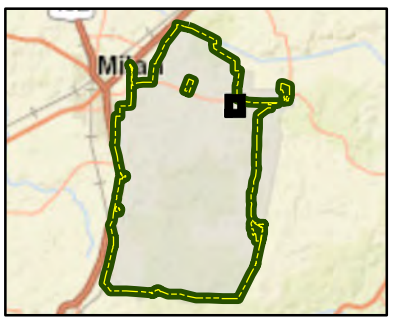


Figure 7-5
O-Line Ponds/O-Line Lagoons
PFOS, PFOA, and PFBS Analytical Results

N

1928
TN-104
TN-104
TN-104
Drainage
Unnamed Tributary
O-Line Ponds/O-Line Lagoons (MAAP-014)

MLAAP-MW16S	
Date	5/28/2020
Depth	45.26 ft bgs
PFOS	3.6 U
PFOA	3.6 U
PFBS	3.6 U

MLAAP-MI671	
Date	5/28/2020
Depth	55.6 ft bgs
PFOS	4.0 U
PFOA	4.0 U
PFBS	4.0 UJ

MLAAP-MI004	
Date	5/28/2020
Depth	57.55 ft bgs
PFOS	3.7 U
PFOA	3.7 U
PFBS	3.7 U

MLAAP-MI634	
Date	5/28/2020
Depth	49.96 ft bgs
PFOS	3.8 U
PFOA	3.8 U
PFBS	3.8 U

MLAAP-OLINE-1-SO	
Date	5/28/2020
Depth	0-2 ft bgs
PFOS	0.0011 U
PFOA	0.0011 U
PFBS	0.0011 U

Notes:
1. Groundwater results (shown in blue) are in nanograms per liter (ng/L), or parts per trillion.
2. Soil results (shown in yellow) are in milligrams per kilogram (mg/kg), or parts per million.

Qualifiers:
J = The analyte was positively identified; however, the associated numerical value is an estimated concentration only.
U = The analyte was analyzed for, but was not detected above the limit of quantitation (LOQ).

0 100 200
Feet

Installation Boundary
River/Stream (Perennial)
Stream (Intermittent)
Presumed Surface Runoff Flow Direction
Surface Water Flow Direction
Groundwater Flow Direction
AOPI
Monitoring Well
Groundwater Sampling Location - Existing Well
Soil Sampling Location

AOPI = area of potential interest
ft bgs = feet below ground surface
PFBS = perfluorobutanesulfonic acid
PFOA = perfluorooctanoic acid
PFOS = perfluorooctane sulfonate

Data Sources:
MLAAP, GIS Data, 2019
USGS, NHD Data, 2019
ESRI ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 16 North

USAEC PFAS Preliminary Assessment / Site Inspection
Milan Army Ammunition Plant, TN

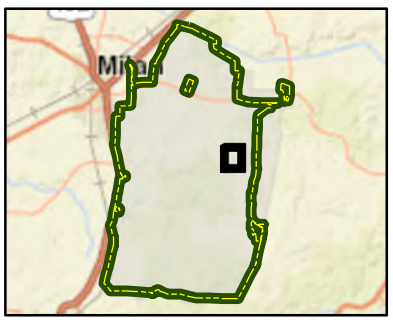


Figure 7-6
Open Burning Ground
PFOS, PFOA, and PFBS Analytical Results

MLAAP-MI250	
Date	5/27/2020
Depth	107.97 ft bgs
PFOS	3.8 U
PFOA	3.8 U
PFBS	3.8 U

MLAAP-MI258	
Date	5/27/2020
Depth	91.92 ft bgs
PFOS	3.8 U
PFOA	3.8 U
PFBS	3.8 U

MLAAP-OBG-1-SO	
Date	5/26/2020
Depth	0-2 ft bgs
PFOS	0.0011 U
PFOA	0.0011 U
PFBS	0.0011 U

MLAAP-MI261	
Date	5/27/2020
Depth	88.16 ft bgs
PFOS	3.7 U
PFOA	3.7 U
PFBS	3.7 U

MLAAP-OBG-2-SO	
Date	5/26/2020
Depth	0-2 ft bgs
PFOS	0.0012 U
PFOA	0.0012 U
PFBS	0.0012 U

MLAAP-OBG-3-SO	
Date	5/26/2020
Depth	0-2 ft bgs
PFOS	0.0011 U
PFOA	0.0011 U
PFBS	0.0011 U

MLAAP-OBG-4-SO	
Date	5/26/2020
Depth	0-2 ft bgs
PFOS	0.0011 U
PFOA	0.0011 U
PFBS	0.0011 U

Unnamed Tributary
Open Burning Ground (MAAP-017)
Concrete Pads
Earthen Pads
Unnamed Tributary
Unnamed Tributary

Notes:
1. Groundwater results (shown in blue) are in nanograms per liter (ng/L), or parts per trillion.
2. Soil results (shown in yellow) are in milligrams per kilogram (mg/kg), or parts per million.

Qualifiers:
U = The analyte was analyzed for, but was not detected above the limit of quantitation (LOQ).

0 100 200
Feet

Installation Boundary
AOPI
Stream (Intermittent)
Monitoring Well
Presumed Surface Runoff Flow Direction
Groundwater Sampling Location - Existing Well
Surface Water Flow Direction
Soil Sampling Location
Groundwater Flow Direction

AOPI = area of potential interest
ft bgs = feet below ground surface
PFBS = perfluorobutanesulfonic acid
PFOA = perfluorooctanoic acid
PFOS = perfluorooctane sulfonate

Data Sources:
MLAAP, GIS Data, 2019
USGS, NHD Data, 2019
ESRI ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 16 North

USAEC PFAS Preliminary Assessment / Site Inspection
Milan Army Ammunition Plant, TN

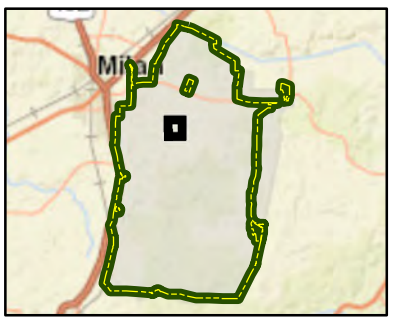


Figure 7-7
Active Industrial Landfill
PFOS, PFOA, and PFBS Analytical Results

MLAAP-ILF3-1	
Date	5/27/2020
Depth	78.45 ft bgs
PFOS	3.7 U
PFOA	3.7 U
PFBS	3.7 U

Active Industrial Landfill

Unnamed Tributary

0 100 200
Feet

Notes:
1. Groundwater results (shown in blue) are in nanograms per liter (ng/L), or parts per trillion.

Qualifiers:
U = The analyte was analyzed for, but was not detected above the limit of quantitation (LOQ).

Installation Boundary
Stream (Intermittent)
Presumed Surface Runoff Flow Direction
Surface Water Flow Direction
Groundwater Flow Direction
AOPI
Monitoring Well
Groundwater Sampling Location - Existing Well

AOPI = area of potential interest
ft bgs = feet below ground surface
PFBS = perfluorobutanesulfonic acid
PFOA = perfluorooctanoic acid
PFOS = perfluorooctane sulfonate

Data Sources:
MLAAP, GIS Data, 2019
USGS, NHD Data, 2019
ESRI ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 16 North

USAEC PFAS Preliminary Assessment / Site Inspection
Milan Army Ammunition Plant, TN

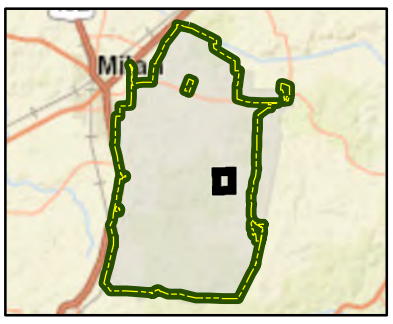
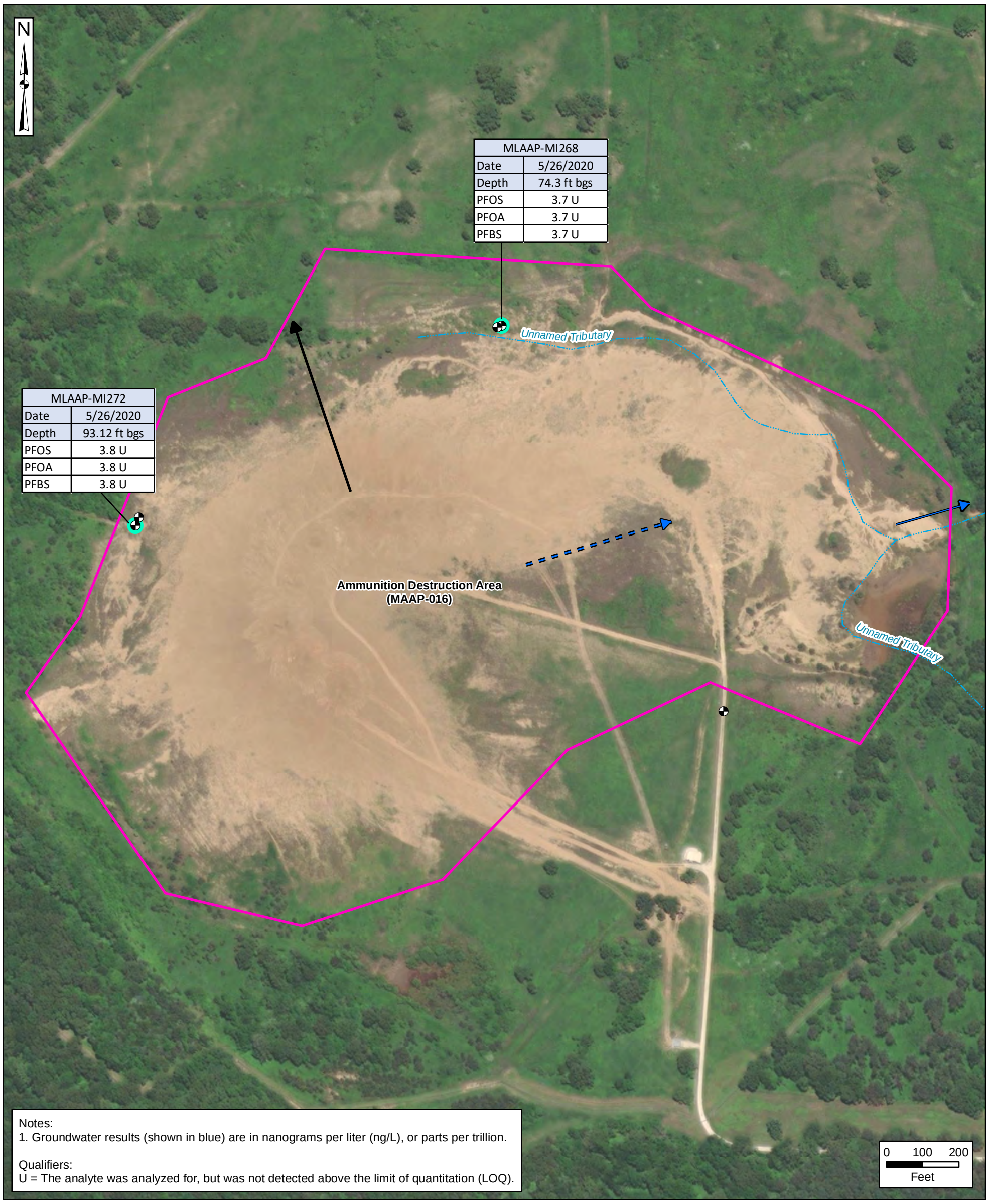


Figure 7-8
Ammunition Destruction Area
PFOS, PFOA, and PFBS Analytical Results



Notes:
1. Groundwater results (shown in blue) are in nanograms per liter (ng/L), or parts per trillion.

Qualifiers:
U = The analyte was analyzed for, but was not detected above the limit of quantitation (LOQ).

Installation Boundary
AOPI
Stream (Intermittent)
Monitoring Well
Groundwater Flow Direction
Groundwater Sampling Location - Existing Well
Presumed Surface Runoff Flow Direction
Surface Water Flow Direction

AOPI = area of potential interest
ft bgs = feet below ground surface
PFBS = perfluorobutanesulfonic acid
PFOA = perfluorooctanoic acid
PFOS = perfluorooctane sulfonate

Data Sources:
MLAAP, GIS Data, 2019
USGS, NHD Data, 2019
ESRI ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 16 North

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Milan Army Ammunition Plant, TN

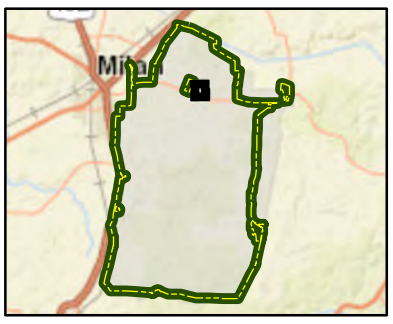

Figure 7-9
Line E
PFOS, PFOA, and PFBS Analytical Results

MLAAP-MI369	
Date	5/22/2020
Depth	60.78 ft bgs
PFOS	3.7 U
PFOA	3.7 U
PFBS	3.7 U

MLAAP-LINEE-1-SO	
Date	5/22/2020
Depth	0-2 ft bgs
PFOS	0.0011 U
PFOA	0.0011 U
PFBS	0.0011 U

Line E
Berm
Building A-50
104
TN-104
0 100 200
Feet

Notes:
1. Groundwater results (shown in blue) are in nanograms per liter (ng/L), or parts per trillion.
2. Soil results (shown in yellow) are in milligrams per kilogram (mg/kg), or parts per million.

Qualifiers:
U = The analyte was analyzed for, but was not detected above the limit of quantitation (LOQ).

Installation Boundary
AOPI
Presumed Surface Runoff Flow Direction
Monitoring Well
Groundwater Flow Direction
Groundwater Sampling Location - Existing Well
Soil Sampling Location

AOPI = area of potential interest
ft bgs = feet below ground surface
PFBS = perfluorobutanesulfonic acid
PFOA = perfluorooctanoic acid
PFOS = perfluorooctane sulfonate

Data Sources:
MLAAP, GIS Data, 2019
ESRI ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 16 North

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Milan Army Ammunition Plant, TN

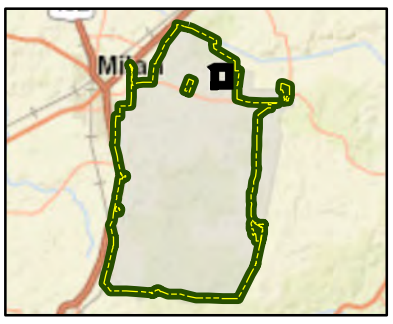
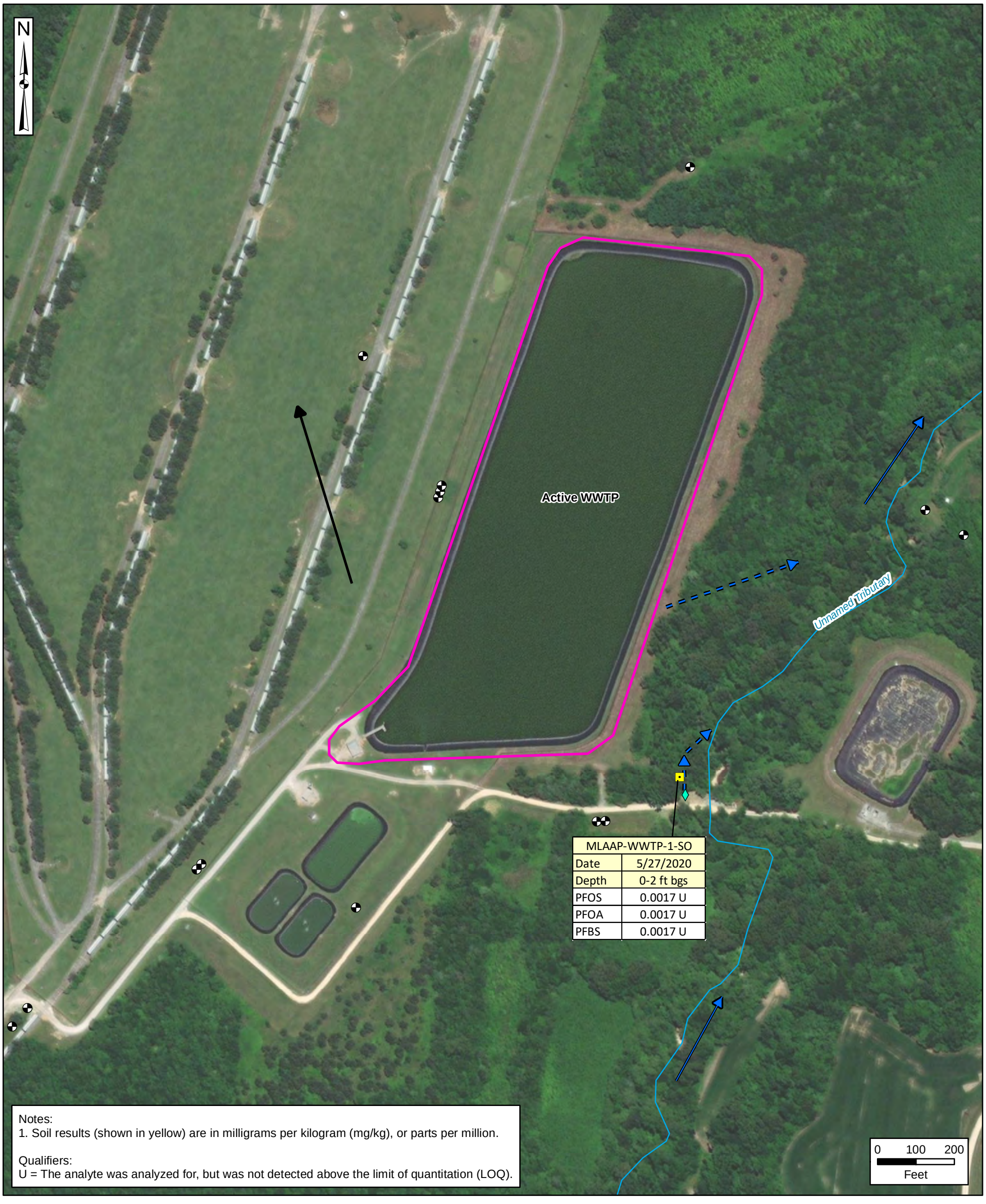


Figure 7-10
Active WWTP
PFOS, PFOA, and PFBS Analytical Results



Notes:
1. Soil results (shown in yellow) are in milligrams per kilogram (mg/kg), or parts per million.

Qualifiers:
U = The analyte was analyzed for, but was not detected above the limit of quantitation (LOQ).

Installation Boundary
River/Stream (Perennial)
Presumed Surface Runoff Flow Direction
Surface Water Flow Direction
Groundwater Flow Direction
AOPI
Outfall
Monitoring Well
Soil Sampling Location

AOPI = area of potential interest
ft bgs = feet below ground surface
PFBS = perfluorobutanesulfonic acid
PFOA = perfluorooctanoic acid
PFOS = perfluorooctane sulfonate
WWTP = wastewater treatment plant

Data Sources:
MLAAP, GIS Data, 2019
USGS, NHD Data, 2019
ESRI ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 16 North

USAEC PFAS Preliminary Assessment / Site Inspection
Milan Army Ammunition Plant, TN

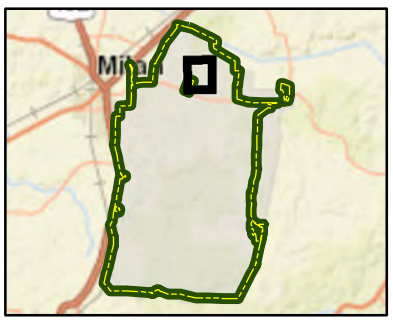


Figure 7-11
Spray Fields
PFOS, PFOA, and PFBS Analytical Results

MLAAP-MI026	
Date	5/27/2020
Depth	47.44 ft bgs
PFOS	4.2 U
PFOA	4.2 U
PFBS	4.2 U

MLAAP-SF-1-SO	
Date	5/27/2020
Depth	0-2 ft bgs
PFOS	0.0011 U
PFOA	**0.0048**
PFBS	0.0011 U

MLAAP-SF-2-SO	
Date	5/27/2020
Depth	0-2 ft bgs
PFOS	0.0011 U
PFOA	0.0011 U
PFBS	0.0011 U

MLAAP-MI399	
Date	5/27/2020
Depth	50.05 ft bgs
PFOS	3.8 U
PFOA	3.8 U
PFBS	3.8 U

MLAAP-SF-3-SO	
Date	5/27/2020
Depth	0-2 ft bgs
PFOS	0.0012 U
PFOA	**0.0032**
PFBS	0.0012 U

Notes:
1. Groundwater results (shown in blue) are in nanograms per liter (ng/L), or parts per trillion.
2. Soil results (shown in yellow) are in milligrams per kilogram (mg/kg), or parts per million.
3. Bolded values indicate detections.

Qualifiers:
U = The analyte was analyzed for, but was not detected above the limit of quantitation (LOQ).

0 150 300
Feet

Installation Boundary
AOPI
Stream (Intermittent)
Monitoring Well
Water Body
Groundwater Sampling Location - Existing Well
Presumed Surface Runoff Flow Direction
Soil Sampling Location
Surface Water Flow Direction
Groundwater Flow Direction

AOPI = area of potential interest
ft bgs = feet below ground surface
PFBS = perfluorobutanesulfonic acid
PFOA = perfluorooctanoic acid
PFOS = perfluorooctane sulfonate

Data Sources:
MLAAP, GIS Data, 2019
USGS, NHD Data, 2019
ESRI ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 16 North

USAEC PFAS Preliminary Assessment / Site Inspection
Milan Army Ammunition Plant, TN

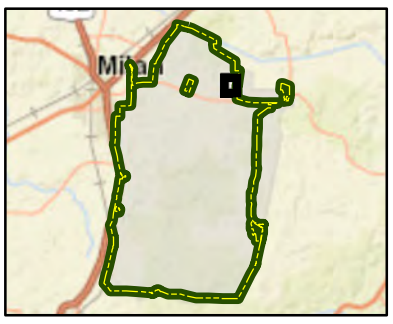


Figure 7-12
Line K Former Metal Plating Facility
PFOS, PFOA, and PFBS Analytical Results

MLAAP-MI023	
Date	5/22/2020
Depth	31.65 ft bgs
PFOS	3.7 U
PFOA	3.7 U
PFBS	3.7 U

MLAAP-LINEK-1-SO	
Date	5/22/2020
Depth	0-2 ft bgs
PFOS	0.0012 U
PFOA	0.0012 U
PFBS	0.0012 U

MLAAP-LINEK-2-SO	
Date	5/22/2020
Depth	0-2 ft bgs
PFOS	**0.00053 J**
PFOA	0.0010 U
PFBS	0.0010 U

Unnamed Tributary
Former Settling Pond
Building K-50
Line K Former Metal Plating Facility
Unnamed Tributary
N
0 100 200
Feet

Notes:
1. Groundwater results (shown in blue) are in nanograms per liter (ng/L), or parts per trillion.
2. Soil results (shown in yellow) are in milligrams per kilogram (mg/kg), or parts per million.
3. Bolded values indicate detections.

Qualifiers:
J = The analyte was positively identified; however, the associated numerical value is an estimated concentration only.
U = The analyte was analyzed for, but was not detected above the limit of quantitation (LOQ).

- Installation Boundary
- River/Stream (Perennial)
- Water Body
- Presumed Surface Runoff Flow Direction
- Surface Water Flow Direction
- Groundwater Flow Direction
- AOPI
- Monitoring Well
- Commercial/Irrigation Well
- Groundwater Sampling Location - Existing Well
- Soil Sampling Location
- Former Settling Pond

AOPI = area of potential interest
ft bgs = feet below ground surface
PFBS = perfluorobutanesulfonic acid
PFOA = perfluorooctanoic acid
PFOS = perfluorooctane sulfonate

Data Sources:
MLAAP, GIS Data, 2019
USGS, NHD Data, 2019
ESRI ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 16 North

Source Media	Release / Transport Mechanisms	Environmental Media	Release / Transport Mechanisms	Exposure Media	Exposure Route	Human Receptors			
						On-Installation			Off-Installation
						Site Worker	Resident	Recreational User	All Types of Receptors [1]
Potential AFFF releases to Soil and/or Paved Surfaces				Soil	Ingestion	●	○	○	○
					Dermal Contact	●	○	○	○
					Inhalation (dust)	●	○	○	○
	Desorption / Dissolution	Groundwater		Groundwater	Ingestion	◐	○	○	◐
					Dermal Contact	◐	○	○	◐

Legend:

● = Complete Exposure Pathway

◐ = Potentially Complete Exposure Pathway

○ = Incomplete Exposure Pathway

Notes:
[1] All types of off-installation receptors include potential drinking water receptors.
[2] AOPI - Area of Potential Interest.

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Conceptual Site Model - Active Fire Station AOPI
USAEC PFAS Preliminary Assessment / Site Inspection
Milan Army Ammunition Plant, Tennessee

Figure 7-13

Source Media	Release / Transport Mechanisms	Environmental Media	Release / Transport Mechanisms	Exposure Media	Exposure Route	Human Receptors			
						On-Installation			Off-Installation
						Site Worker	Resident	Recreational User	All Types of Receptors [1]
AFFF Releases to Soil and/or Paved Surfaces				Soil	Ingestion	◯	◯	◯	◯
					Dermal Contact	◯	◯	◯	◯
					Inhalation (dust)	◯	◯	◯	◯
	Desorption / Dissolution	Groundwater		Groundwater	Ingestion	◯	◯	◯	◯
					Dermal Contact	◯	◯	◯	◯

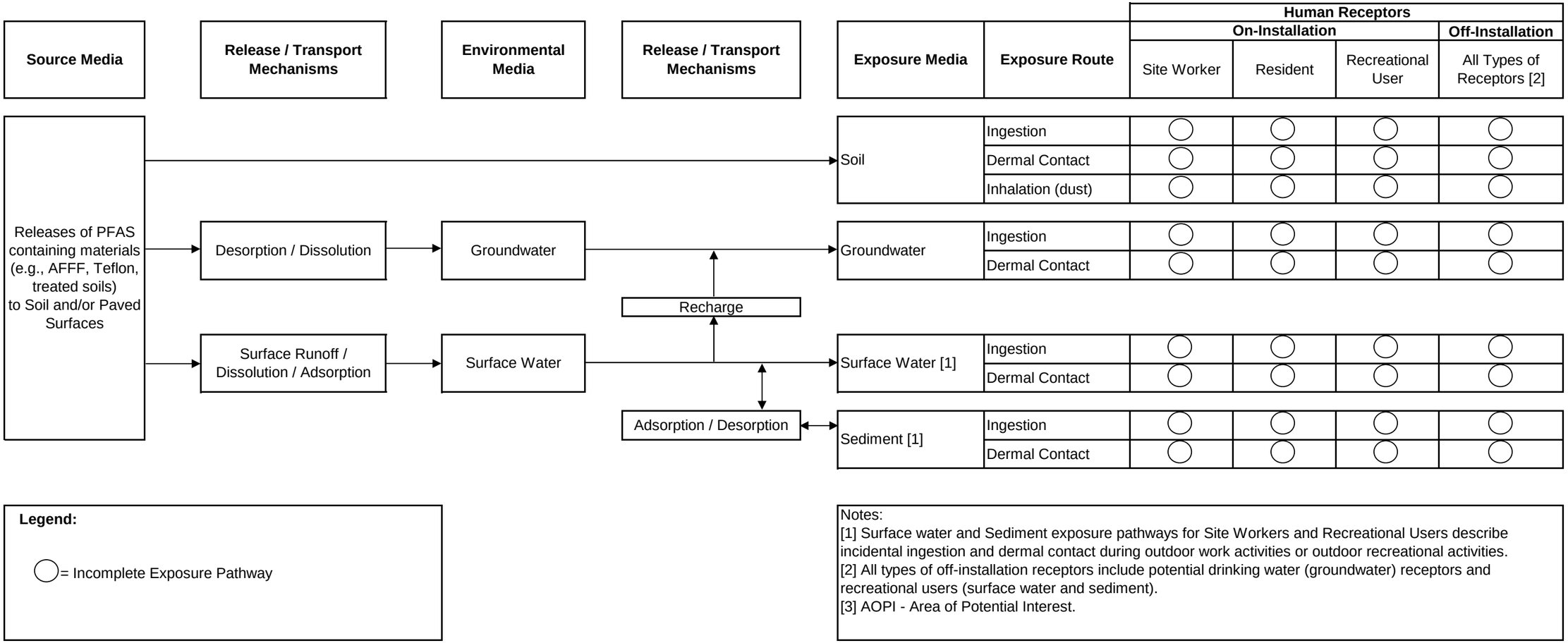
Legend:

◯ = Incomplete Exposure Pathway

Notes:
[1] All types of off-installation receptors include potential drinking water receptors [2]
AOPI - Area of Potential Interest

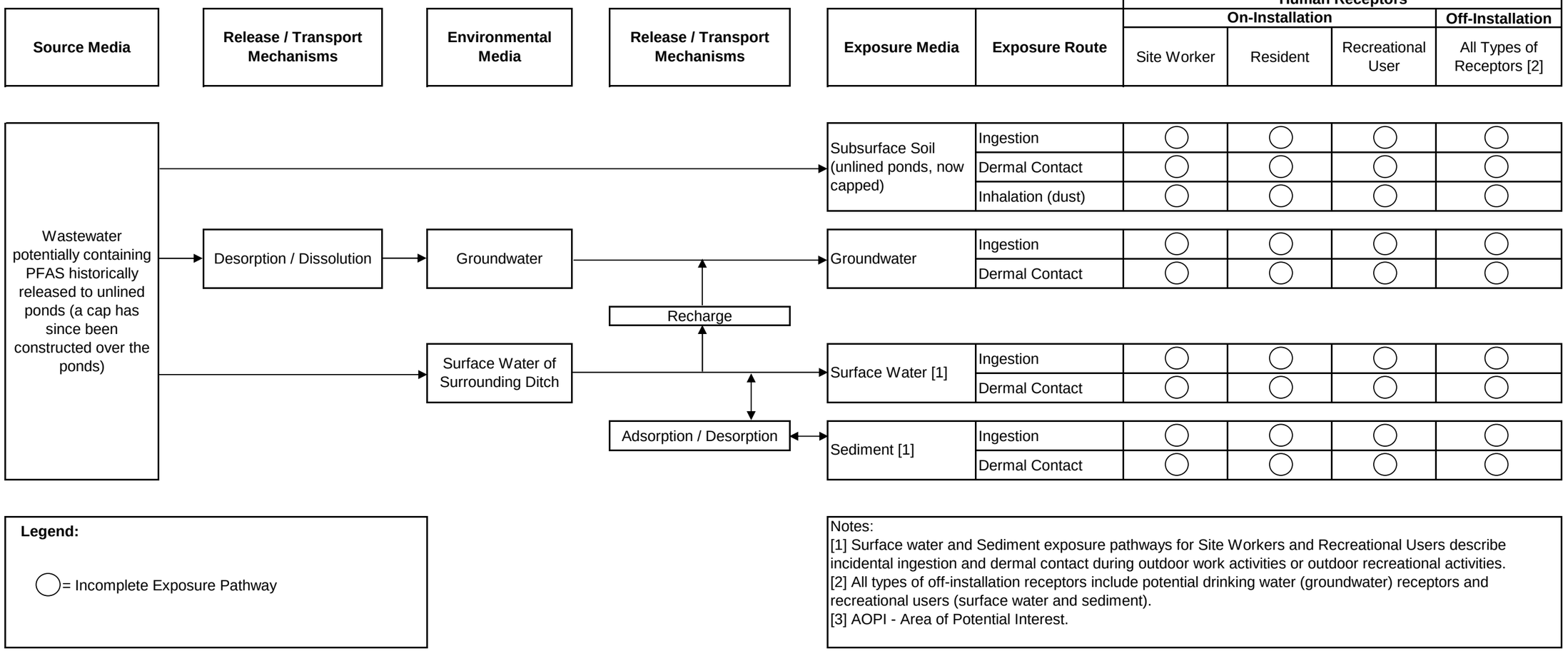
Conceptual Site Model - Area K Fire Systems Testing AOPI
USAEC PFAS Preliminary Assessment / Site Inspection
Milan Army Ammunition Plant, Tennessee

Figure 7-14



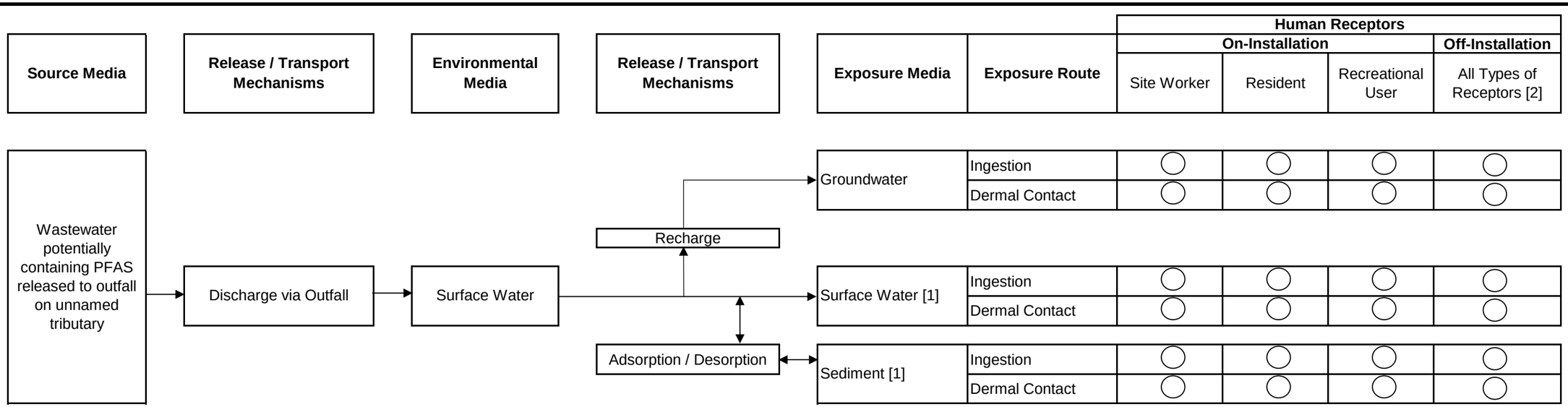
Conceptual Site Model - Line Z Flare Composition Facility, Open Burning Ground, and Line E AOPIs
USAEC PFAS Preliminary Assessment / Site Inspection

Figure 7-15



Conceptual Site Model - O-Line Ponds/O-Line Lagoons AOPI
USAEC PFAS Preliminary Assessment / Site Inspection
Milan Army Ammunition Plant, Tennessee

Figure 7-16



Conceptual Site Model - Operable Unit 3 Groundwater Treatment Plant AOPI
USAEC PFAS Preliminary Assessment / Site Inspection
Milan Army Ammunition Plant, Tennessee

Figure 7-17

Source Medium	Release / Transport Mechanisms	Environmental Media	Release / Transport Mechanisms	Exposure Media	Exposure Route	Human Receptors			
						On-Installation			Off-Installation
						Site Worker	Resident	Recreational User	All Types of Receptors [1]
Releases of PFAS containing material (e.g., ash containing Teflon) to Soil				Subsurface Soil (covered landfill)	Ingestion	◯	◯	◯	◯
					Dermal Contact	◯	◯	◯	◯
					Inhalation (dust)	◯	◯	◯	◯
	Desorption / Dissolution	Groundwater		Groundwater	Ingestion	◯	◯	◯	◯
					Dermal Contact	◯	◯	◯	◯

Legend:

◯ = Incomplete Exposure Pathway

Notes:
[1] All types of off-installation receptors include potential drinking water receptors.
[2] AOPI - Area of Potential Interest.

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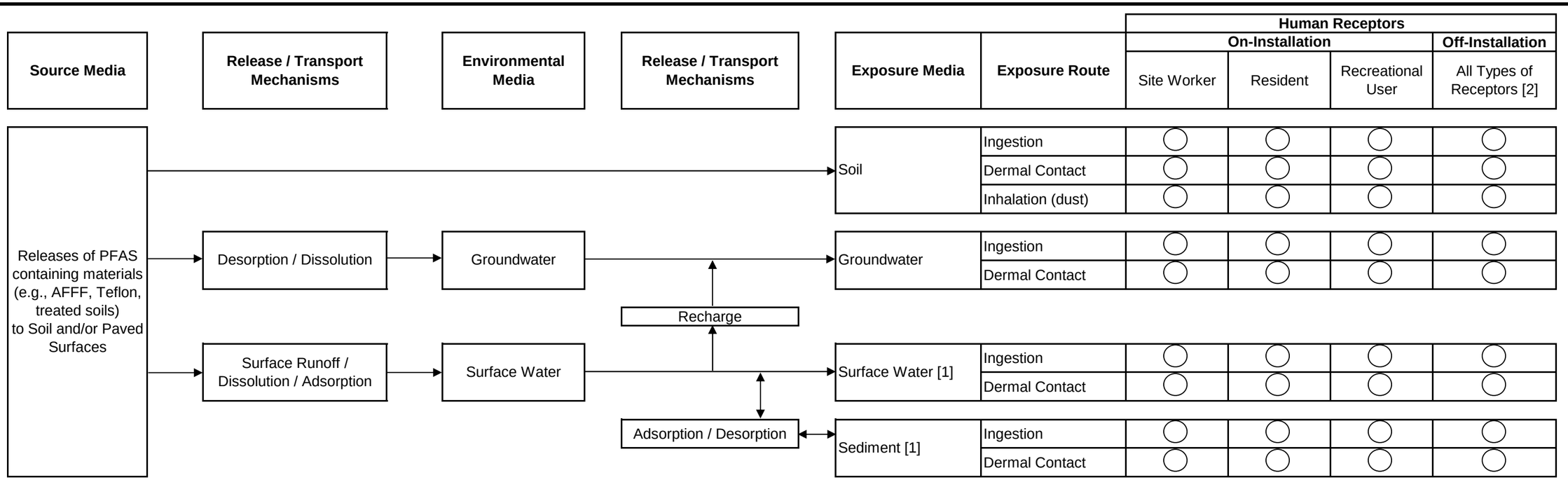
Conceptual Site Model - Active Industrial Landfill AOPI
USAEC PFAS Preliminary Assessment / Site Inspection
Milan Army Ammunition Plant, Tennessee

Figure 7-18



Legend:

◯ = Incomplete Exposure Pathway

Notes:
[1] Surface water and Sediment exposure pathways for Site Workers and Recreational Users describe incidental ingestion and dermal contact during outdoor work activities or outdoor recreational activities.
[2] All types of off-installation receptors include potential drinking water (groundwater) receptors and recreational users (surface water and sediment).
[3] AOPI - Area of Potential Interest.

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Conceptual Site Model - Ammunition Destruction AOPI
USAEC PFAS Preliminary Assessment / Site Inspection
Milan Army Ammunition Plant, Tennessee

Figure 7-19

Source Media	Release / Transport Mechanisms	Environmental Media	Release / Transport Mechanisms	Exposure Media	Exposure Route	Human Receptors: On-Installation: Site Worker	Human Receptors: On-Installation: Resident	Human Receptors: On-Installation: Recreational User	Human Receptors: Off-Installation: All Types of Receptors [2]
Wastewater potentially containing PFAS released to outfall on unnamed tributary	Discharge via Outfall			Soil near Outfall Location	Ingestion	◯	◯	◯	◯
					Dermal Contact	◯	◯	◯	◯
					Inhalation (dust)	◯	◯	◯	◯
				Groundwater	Ingestion	◯	◯	◯	◯
					Dermal Contact	◯	◯	◯	◯
		Surface Water	Recharge	Surface Water [1]	Ingestion	◯	◯	◯	◯
					Dermal Contact	◯	◯	◯	◯
			Adsorption / Desorption	Sediment [1]	Ingestion	◯	◯	◯	◯
					Dermal Contact	◯	◯	◯	◯

Legend:

◯ = Incomplete Exposure Pathway

Notes:
[1] Surface water and Sediment exposure pathways for Site Workers and Recreational Users describe incidental ingestion and dermal contact during outdoor work activities or outdoor recreational activities.
[2] All types of off-installation receptors include potential drinking water (groundwater) receptors and recreational users (surface water and sediment). [3]
AOPI - Area of Potential Interest.

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Conceptual Site Model - Active WWTP AOPI
USAEC PFAS Preliminary Assessment / Site Inspection
Milan Army Ammunition Plant, Tennessee

Figure 7-20

Source Media	Release / Transport Mechanisms	Environmental Media	Release / Transport Mechanisms	Exposure Media	Exposure Route	Human Receptors			
						On-Installation			Off-Installation
						Site Worker	Resident	Recreational User	All Types of Receptors [1]
Surface Applications of Soils potentially containing PFAS				Soil	Ingestion	●	○	○	○
					Dermal Contact	●	○	○	○
					Inhalation (dust)	●	○	○	○
	Desorption / Dissolution	Groundwater		Groundwater	Ingestion	○	○	○	○
					Dermal Contact	○	○	○	○

Legend:

● = Complete Exposure Pathway

○ = Incomplete Exposure Pathway

Notes:
[1] All types of off-installation receptors include potential drinking water receptors. [2]
AOPI - Area of Potential Interest.

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Conceptual Site Model - Spray Fields AOPI
USAEC PFAS Preliminary Assessment / Site Inspection
Milan Army Ammunition Plant, Tennessee

Figure 7-21

Source Media	Release / Transport Mechanisms	Environmental Media	Release / Transport Mechanisms	Exposure Media	Exposure Route	Human Receptors			
						On-Installation			Off-Installation
						Site Worker	Resident	Recreational User	All Types of Receptors [1]
Wastewater potentially containing PFAS released to Historical Settling Pond (assume not capped)				Soil (formerly settling pond sediments, assume not capped)	Ingestion	●	○	○	○
					Dermal Contact	●	○	○	○
					Inhalation (dust)	●	○	○	○
	Desorption / Dissolution	Groundwater		Groundwater	Ingestion	○	○	○	○
					Dermal Contact	○	○	○	○

Legend:

● = Complete Exposure Pathway

○ = Incomplete Exposure Pathway

Notes:

[1] All types of off-installation receptors include potential drinking water receptors. [2]

AOPI - Area of Potential Interest.

Conceptual Site Model - Line K Former Metal Plating Facility AOPI

USAEC PFAS Preliminary Assessment / Site Inspection

Milan Army Ammunition Plant, Tennessee

Figure 7-22

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