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

Pohakuloa Training Area and Kilauea Military Reservation, Hawaii

Prepared For:
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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), perfluorobutanesulfonic acid (PFBS), perfluorononanoic acid (PFNA), perfluorohexane sulfonate (PFHxS), and hexafluoropropylene oxide dimer acid (HFPO-DA) at Army installations nationwide because the Office of the Secretary of Defense (OSD) has developed risk-based screening levels for these chemicals. 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 report provides the PA/SI for Pohakuloa Training Area (PTA) and Kilauea Military Reservation (KMR), which are both located on the island of Hawaii, and was completed in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), National Oil and Hazardous Substances Pollution Contingency Plan, and Army/Department of Defense (DoD) policy and guidance.

PTA is an approximately 108,000-acre live-fire and maneuver training facility located on the island of Hawaii, approximately 30 miles west of Hilo and 30 miles southeast of Waimea. PTA is the largest live-fire and maneuver training complex within the U.S. Army Garrison – Hawaii (USAG-HI) and consists of the following: a training area with 19,148 acres of maneuver training land; 565 acres of live-fire static ranges; 566 acres of cantonment area; and, approximately 37,520 acres of land classified as unsuitable for training.

KMR, officially known as Kilauea Military Reservation, occupies approximately 54 acres on the northern rim of Kilauea crater at Hawaii Volcanoes National Park on the island of Hawaii. Located approximately 30 miles southwest of Hilo, KMR is bounded by Highway 11 (Mamalahoa Highway) to the north, Crater Rim Drive to the south, and undeveloped land to the east and west. The installation provides active and retired military, reservists, DoD civilians, families, and sponsored groups a recreation area.

The PTA PA identified six AOPIs for investigation during the SI phase. The KMR PA identified two AOPIs for investigation during the SI phase. SI sampling results from the six AOPIs at PTA and the two AOPIs at KMR were compared to risk-based screening levels calculated by the OSD for PFOS, PFOA, PFBS, PFNA, and PFHxS. Of the six PFAS compounds presented in the 06 July 2022 OSD memorandum, HFPO-DA (commonly referred to as GenX) was not included as an analyte at the time of this SI. Based on the conceptual site model developed during the PA and revised based on SI findings, the presence of HFPO-DA is not anticipated at PTA and KMR because HFPO-DA is generally not a component of military specification aqueous film forming foam (AFFF) and based on its history including distribution limitations that restricted use of HFPO-DA, it is generally not a component of other products the military used. In addition, it is unlikely that HFPO-DA would be an individual chemical of concern in the absence of other PFAS. Therefore, there are no HFPO-DA SI analytical results to screen against the 2022 OSD risk screening levels. PFOS, PFOA, PFBS, PFNA and/or PFHxS were detected in soil at five AOPIs at PTA; and all five AOPIs had PFOS, PFOA, PFBS, PFNA, and/or PFHxS present at concentrations greater than the risk-based screening levels. The PTA PA/SI identified the need for further study in a CERCLA

remedial investigation. PFOS, PFOA, PFBS, PFNA and/or PFHxS were detected in soil and/or sediment at two AOPIs at KMR; and one AOPI had PFOS, PFOA, PFBS, PFNA, and/or PFHxS present at concentrations greater than the risk-based screening levels. The KMR PA/SI identified 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, PFBS, PFNA, and PFHxS Sampling at PTA and KMR, and Recommendations

Installation Name	AOPI Name	PFOS, PFOA, PFBS, PFNA, and/or PFHxS detected greater than OSD Risk Screening Levels? (Yes/No/ND/NS)		Recommendation
		SO	GW	
PTA	Building 39: Former Fire Station	Yes	NS[1]	Further study in a remedial investigation
	Building 390: Fire Station	Yes	NS[1]	Further study in a remedial investigation
	Current and Former Fire-Training Pits	Yes	NS[1]	Further study in a remedial investigation
	Former Aqueous Film-Forming Foam Training Area	Yes	NS[1]	Further study in a remedial investigation
	Landing Zone Rob Helicopter Crash	ND	NS[1]	No action at this time
	Bradshaw Army Airfield Runway	Yes	NS[1]	Further study in a remedial investigation
KMR	Building 43: Former Fire Station	No	NS[2]	No action at this time
	Building 59: Fire Station #19	Yes	NS[2]	Further study in a remedial investigation

Notes:

1 = Historical reports indicate groundwater at PTA has been identified several hundred to more than 1,000 feet below ground surface (bgs). The significant depth to groundwater precludes collection of groundwater samples as part of this SI; instead, soil samples were collected to verify the presence of PFAS at PTA.

2 = KMR is underlain with accumulated surface lava flows of the Keamoku lava flow from Mauna Loa's southeastern flank and the Puna volcanic series and the intrusive rocks of Kilauea's dike-complex. There is no groundwater development in the area, nor is groundwater connected to a water source. Additionally, due to the rapid increase in temperature with depth, water that infiltrates the subsurface turns to steam, which precluded the collection of groundwater samples as part of this SI; instead, soil samples were collected to verify the presence of PFAS at KMR.

Light gray shading – detection greater than the OSD risk screening level

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), perfluorobutanesulfonic acid (PFBS), perfluorononanoic acid (PFNA), perfluorohexane sulfonate (PFHxS), and hexafluoropropylene oxide dimer acid (HFPO-DA) at Army installations nationwide because the Office of the Secretary of Defense (OSD) has developed risk-based screening levels for these chemicals. 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 Pohakuloa Training Area (PTA) and Kilauea Military Reservation (KMR) based on the use, storage and/or disposal of PFAS-containing materials, in accordance with the 2018 Army Guidance for Addressing Releases of PFAS (Army 2018). The SI included multi-media sampling at AOPIs to determine whether or not a release has occurred, and the analytical results were compared to the OSD PFOS, PFOA, PFBS, PFNA, and PFHxS risk screening levels to determine whether further investigation is warranted. Of the six PFAS compounds presented in the 06 July 2022 OSD memorandum, HFPO-DA (commonly referred to as GenX) was not included as an analyte at the time of this SI. Based on the conceptual site model (CSM) developed during the PA and revised based on SI findings, the presence of HFPO-DA is not anticipated at PTA and KMR because HFPO-DA is generally not a component of military specification (MIL-SPEC) aqueous film forming foam (AFFF) and based on its history including distribution limitations that restricted use of HFPO-DA, it is generally not a component of other products the military used. In addition, it is unlikely that HFPO-DA would be an individual chemical of concern in the absence of other PFAS. Therefore, there are no HFPO-DA SI analytical results to screen against the 2022 OSD risk screening levels. This report provides the PA/SI for PTA and KMR 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 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). On 18 May 2022, the USEPA published an update to the RSLs table. The May 2022 RSL table included six PFAS constituents: PFOS, PFOA, PFBS, PFNA, PFHxS, and HFPO-DA (USEPA 2022). On 06 July 2022, the OSD issued a memorandum to include revised risk screening levels based on the May 2022 USEPA RSLs (OSD 2022). The July 2022 Memorandum: Investigating Per- and Polyfluoroalkyl Substances within the Department of Defense Cleanup Program is provided for reference as **Appendix A**. 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

A 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 PTA and KMR, PA/SI development followed the process as described below. **Section 3** provides a summary of the PA activities completed, and **Section 6** provides a summary of the SI activities completed for PTA and KMR. 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), PTA, KMR, and Arcadis U.S., Inc. (Arcadis). The kickoff call occurred on 07 January 2019, 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 to gather information on the physical setting and site history at PTA and KMR.

A read-ahead package was prepared and submitted to the appropriate POCs 2 weeks before the site visit. The read-ahead package contains the following information:

- The Installation Management Command (IMCOM) operation order
- 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 kickoff 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 in conjunction with multiple other Hawaii installations between 05 and 22 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 PTA and KMR. The interviews focused on confirming information discussed in historical documents, collecting information that may have not been in historical documents, 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 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. An informal exit briefing was conducted on 21 March 2019 with U.S. Army Garrison Hawaii (USAG-HI) 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 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 installations to evaluate PFOS, PFOA, PFBS, PFNA, and PFHxS presence or absence at each AOPI and determine whether further investigation is warranted. An SI kickoff/scoping teleconference was held on 09 January 2020 to obtain concurrence on the SI sampling plan for PTA and KMR from USAEC, USACE, and USAG-HI.

The objectives of the SI kickoff/scoping teleconference were to:

- discuss the AOPIs selected for sampling and the proposed sampling plan for each AOPI
- identify specific installation access requirements and potential schedule conflicts
- discuss general SI deliverable and field work schedule information and logistics
- discuss health and safety considerations

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 PTA and KMR (Arcadis 2021) 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, PFBS, PFNA, and PFHxS analysis by liquid chromatography with tandem mass spectrometry and compliant with the DoD Quality Systems Manual (QSM) 5.3 (DoD and Department of Energy 2019). 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 PTA and KMR, 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 Installation Overview of Pohakuloa Training Area (PTA)

2.1.1 Site Location

PTA (**Figure 2-1**) is located at the intersection of three mountain ranges on the island of Hawaii: Mauna Kea, Mauna Loa, and the Hualalai Volcanic Mountains. The installation consists of 108,800 acres and is located 32 miles west of Hilo and 27 miles southeast of Waimea, which is the closest city to PTA (Army Defense Environmental Restoration Program [ADERP] 2016). **Figure 2-2** details the installation layout of PTA.

2.1.2 Mission and Brief Site History

The mission of PTA is to train, equip, and sustain Army forces in the Pacific Theater. Specifically, PTA is the largest live-fire and maneuver training complex within the USAG-HI. The training area consists of 19,148 acres of maneuver training land, 565 acres of live-fire static ranges, and 566 acres of cantonment area. The installation is used to train, equip, and sustain Army forces annually by approximately 18,000 Soldiers from the 25th Infantry Division, 8th Theater Sustainment Command, Marines from the 3rd Marine Regiment at Kaneohe Bay, the U.S. Air Force, National Guard, and Army Reserves. Approximately 37,520 acres of the PTA are classified as unsuitable for training (ADERP 2016).

2.1.3 Current and Projected Land Use

PTA was established in 1955 and originally encompassed approximately 740 acres of land for base camp development. An additional 84,220 acres were acquired in 1956 for firing ranges and impact areas. Subsequent lease acquisitions from the State of Hawaii and private landowners increased the total land area to 108,960 acres within portions of the Mauna Kea and Mauna Loa Forest reserves.

Currently, 85,057 acres at PTA are designated as impact area, of which 51,000 acres are used for testing high explosives. The Army leases about 23,900 acres of land for training and maneuver areas, rights-of-way for tank trails and crossings and for water pipelines over state, commercial, and private lands. An additional 6.4 acres of land at Kawaihae Bay (west shore of the island), Kawaihae Military Reservation, is used by the Army as a port facility for the assembly of equipment and supplies prior to shipment to PTA. Before the military's use of the installation property, the land was undeveloped (PRC Environmental Management, Inc. [PRC] 1997). There are no foreseeable future land use changes for PTA.

2.1.4 Climate

The Island of Hawaii is in the humid tropical Pacific, but elevation and orographic processes at PTA results in a climate classified as a cool, tropical dry climate. The installation is more "wet" at lower

elevations. The position of the installation is to the west and below the Humu'ula Saddle and on the leeward side of Mauna Kea. Moisture carried by the summer easterly trade winds is lost as precipitation with the increase in elevation, and rarely reaches PTA at higher elevation. Much of the installation is situated above the thermal inversion layer and is not influenced by the trade wind-orographic rainfall regime. Occasionally, moist air trapped below the inversion layer rises into the Saddle Region in the late afternoon. Fog is typical of late winter and early spring when trade winds fail. Mornings can be clear and sunny at lower and mid-installation elevations, and in the afternoon, a cloud belt can develop from about 750 to 1,675 meters (about 2,500 to 5,500 feet). Visibility becomes limited at lower elevations, whereas the base camp has clear skies. Fog and fog-drip is a source of precipitation and may equal rainfall on some parts of the island. However, the majority of the installation is above the thermal layer and dry. Drought is common when winter storms fail. The 59-year average annual precipitation at PTA Weather Station 107 is 35.4 centimeters (14.4 inches). Most rainfall occurs during the winter months. Diurnal temperature fluctuations are greater than the seasonal variations (USAG-HI 2010). The mean temperature at PTA ranges from 50 to 60 degrees Fahrenheit and the average rainfall is approximately 15 inches per year (PRC 1997). Temperatures at PTA are influenced by the high elevation and central location of the installation on the island of Hawaii (PRC 1997).

2.1.5 Topography

The elevation on Pohakuloa ranges from about 768 meters (2,520 feet) above mean sea level (amsl) near the northwestern corner of the installation where the boundary meets the Māmalahoa Highway to about 2,719 meters (8,920 feet) at the southeast corner of the installation on the slopes of Mauna Loa. The topography is nearly flat to gently rolling across the center of the installation (**Figure 2-3**). In this area, slopes increase or decrease in the southern and northern extents of the installation, respectively. The overall slope is about 6 percent (%) with large variations and a slightly west-northwest aspect (USAG-HI 2010).

2.1.6 Geology

PTA is situated at the intersection of the Mauna Kea, Mauna Loa, and Hualalai volcanic mountain ranges, the installation extends 6,800 feet up Mauna Kea and 9,000 feet up Mauna Loa (ADERP 2016). The northern portion of PTA is situated in the Mauna Kea Forest Reserve and the southern portion of PTA is in the Mauna Loa Forest Reserve (PRC 1997). The soil horizon is underlain with horizontally layered, accumulated lava flows of the Kau volcanic series (massive basaltic lavas resulting from frequent eruptions of Mauna Loa) (PRC 1997). There are no perennial surface water bodies (e.g., surface streams, lakes, or other bodies of water) on PTA, and intermittent stream channels quickly dry after rainfall (USAG-HI 2010). The following information is associated with the geology, surface soil, and surface water characteristics found at PTA (PRC 1997): the surficial geology is comprised primarily of lava flows consisting of approximately 40% pahoehoe lava and approximately 30% a'a lava; the hydraulic conductivity of massive lava flows underlying the area is relatively low; in general, the soils are coarse to medium textured, excessively drained, and formed on volcanic ash, pumice, and cinders; the majority of soil is generally permeable; and, due to the relatively low rainfall and the high permeability of the soils and underlying bedrock, there are no perennial streams within 15 miles of the PTA installation.

2.1.7 Hydrogeology

Available records indicate there are two types of groundwater beneath PTA, basal groundwater (which lies below the main water table) and high-level groundwater (which is water held at levels above basal groundwater by relatively impermeable rocks) (USAG-HI 1996). The depth to basal groundwater at PTA is estimated to be approximately 6,000 feet bgs (PRC 1997). Test borings drilled within the PTA cantonment area in 2013 identified the presence of a shallow perched aquifer at approximately 700 to 1,200 feet bgs, and a deeper saturated aquifer at approximately 1,800 to 5,786 feet bgs (Amarosa 2019). Volcanic aquifers can form connected geologic structures in the subsurface (Kreyns et al. 2020); however, the vertical subsurface distance between the two aquifers likely indicates that interconnection is minimal, if any. Additionally, a review of readily available documentation provides no evidence that the aquifers below PTA are hydrologically interconnected.

The following groundwater data is also available (USAG-HI 1996): groundwater was not encountered at a different test boring drilled to a depth of 1,001 feet bgs on the PTA installation; and, high-level groundwater has been encountered at depths of 1,280 feet bgs and 1,500 feet bgs in private wells drilled 12 miles northwest of PTA at elevations of 4,000 feet and 4,200 feet amsl (USAG-HI 1996). Currently, groundwater at PTA is not used as a source of potable water. A hydrological investigation to evaluate potential groundwater source(s) for potable water at PTA was scheduled to be conducted in 2019, with results “required in 2020” (Amarosa 2019). The results from the hydrological investigation were not readily available at the time of this PA/SI. The availability and use of groundwater sources at PTA for potable water in the future is unknown.

There is limited information regarding the direction of groundwater flow at PTA. A review of readily available documents identified no drinking water receptors downgradient of PTA. In general, groundwater moves southwest downgradient toward the sea and discharges at or near the coast (PRC 1997).

2.1.8 Surface Water Hydrology

Because of the high permeability of the soils and underlying bedrock, and relatively low rainfall at PTA, there are no perennial streams within 15 miles of the PTA installation. Within the same drainage area, however, at least seven intermittent streams drain surface water off the steep southwestern flank of Mauna Kea. Along the western boundary of the installation, the closest stream is Popolo Gulch, which converges with Auwaiakeokua Gulch to drain surface water toward the Waikoloa community. Within 2 miles of the cantonment area, three intermittent streams, Waikahalulu Gulch, Pohakuloa Gulch, and an unnamed gulch, collect runoff from the southern flank of Mauna Kea. Waikahalulu Gulch and the unnamed gulch extend on and off post while Pohakuloa Gulch is completely off post (PRC 1997).

2.1.9 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 PTA.

2.1.9.1 Stormwater Management System Description

Stormwater runoff at PTA flows to downgradient drainage ditches. The drainage ditches are not connected to any perennial water bodies that flow off-installation. Due to the high permeability of the soils and underlying bedrock, stormwater runoff likely quickly recharges groundwater (Arcadis 2021).

2.1.9.2 Sewer System Description

According to an interview conducted during the site visit, PTA has historically used cesspools (an underground container/pit for the temporary storage and infiltration of liquid waste and sewage) to manage untreated, raw sewage, however they are in the process of being closed and replaced by septic tanks at the time of this report. During the interview, it was noted that eight septic tanks and leach fields had been installed at the time of this report. Wastewater is processed through septic tanks (where they have already been installed), leaching fields, and underground injection wells which are managed in accordance with federal and state regulations. The newly installed septic tanks are used by the Army and have an Underground Injection Control permit issued by the State Department of Health, Safe Drinking Water Branch (USAG-HI 2010).

2.1.10 Potable Water Supply and Drinking Water Receptors

According to a historical environmental report for the installation, prior to 1994, PTA used high-level, perched water collected from springs at 8,600 feet to 10,400 feet amsl along the west side of Pohakuloa Gulch (PRC 1997). Historically, this drinking water was supplemented with Hawaii County water from Hilo and Waimea (PRC 1997). The report also indicates that, as of 1997, groundwater was not used as a drinking water source within a 4-mile radius downgradient of PTA, and PTA did not use drinking water from drilled wells, but instead used water hauled from the City of Waimea (PRC 1997). Additionally, two wells associated with Waiki'i Ranch, which are also not downgradient of PTA, are located northeast of PTA. These wells are designated for agricultural use and are also suspected to be used as a drinking water source. At the time of this report drinking water for PTA does not come from either of these sources and instead is hauled in from an off-site source.

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 PTA, which along with state and county geographic information system (GIS) provided by the installation identified several off-post public and private wells within 5 miles upgradient of the installation boundary (**Figure 2-4**). However, Army-owned wells and on-post wells/water sources, if present, are not shown or identified on figures in this PA/SI report due to operational security guidance/requirements. The EDR report providing well search results provided as **Appendix C**.

2.1.11 Ecological Receptors

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

Since 1997, PTA has conducted avian surveys annually and monitors for the presence of some federally listed species. Over the course of these studies, one federally listed endangered mammal (Lasiurus

cinereus semotus/ ‘ope‘ape‘a/Hawaiian hoary bat) and three birds (Branta sandvicensis—nēnē, Hawaiian goose; Buteo solitaries— ‘io, Hawaiian hawk; and Pterodroma sandwichensis—‘ua‘u, Hawaiian dark-rumped petrel) have been identified, along with a number of invertebrate species of concern. Other species that have a historical presence include the palila (Loxioides bailleui), Hawaiian crow (Crovus hawaiiensis), akepa (Loxops coccineus), and Hawaiian creeper (Oreomystis mana). Because these later species have not been seen for over 20 years on the installation, they are no longer included in any specific management actions (USAG-HI 2010).

PTA has 15 federally listed endangered, one federally listed threatened, and two candidate plants (**Table 2-2**). Three of the endangered plant species are located in the Ke‘āmuku Parcel. Twelve taxa have a Global Rank of G1, which recognizes these species as critically imperiled globally. This ranking extends to subspecies and variety for two taxa. Four taxa are categorized as imperiled globally (G2), with the ranking extending to variety for one of the taxa. The Army considers federal candidate species and G1-G2 and T1-T2 as species at risk. Proactive management that prevents federal listing is more cost-effective and less destructive to military training and testing (USAG-HI 2010).

Table 2-2 Federally Listed and Candidate Flora at PTA

Scientific Name	Common Name	Status	Heritage Global Rank
Asplenium peruvianum var. insulare	fragile fern	LE	G5 T1
Festuca hawaiiensis	Hawaiian fescue	C	G1
Haplostachys haplostachya	honohono	LE	G1
Isodendrion hosakae	aupaka	LE	G1
Kadua coriacea (Syn. Hedyotis coriacea)	kio‘ele	LE	G1
Lipochaeta venosa (Syn. Melanthera venosa)	nehe	LE	G1
Neraudia ovata	ma‘aloa	LE	G1
Portulaca sclerocarpa	‘ihi makole	LE	G2
Schiedea pubescens	Hairy schiedea	C	G1
Silene hawaiiensis	Hawaiian catchfly	LE	G2
Silene lanceolata	lanceleaf catchfly	LE	G1
Solanum incompletum	popolu ku mai	LE	G1
Spermolepis hawaiiensis	Hawaiian parsley	LE	G2
Stenogyne angustifolia var. angustifolia	creeping mint	LE	G2

Scientific Name	Common Name	Status	Heritage Global Rank
Tetramolopium arenarium var. arenarium	Mauna Kea pamakani	LE	G1 T1
Vigna o-wahuensis	no common name	LE	G1
Zanthoxylum hawaiiense	a‘e	LE	G1

LE – listed endangered
C – candidate for listing
G1 – species critically imperiled globally (typically 1 to 5 occurrences)
G2 – species imperiled globally (typically 6 to 20 occurrences)
G5 – species possibly extinct
T1 – subspecies or variety critically imperiled globally (typically 1 to 5 occurrences)

2.1.12 Previous PFAS Investigations

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

The USEPA conducted the third Unregulated Contaminant Monitoring Rule (UCMR3) monitoring between 2013 and 2015. UCMR3 is a national program that collects data for contaminants that are suspected to be present in drinking water and do not have health-based standards set under the Safe Drinking Water Act (USEPA 2016b). The UCMR3 included the analysis of PFOS, PFOA, PFBS, PFNA, and PFHxS in public water systems serving more than 10,000 people between 2013 and 2015. During monitoring events conducted in September 2013 and March 2014, samples were collected from three upgradient public supply wells in Waikoloa within a 5-mile radius of PTA. Results indicated that PFOS, PFOA, PFBS, PNFA, and PFHxS were not detected in any of the samples collected from the public supply wells. The minimum reporting level at the time of UCMR3 sampling was 40 ng/L for PFOS, 20 ng/L for PFOA, 90 ng/L for PFBS, 20 ng/L for PFNA, and 30 ng/L for PFHxS. The laboratory that analyzed the samples under UCMR3 met the USEPA’s UCMR3 Laboratory Approval Program application and Proficiency Testing criteria for USEPA Method 537 Version 1.1.

In response to the IMCOM Operations Order 16-088, drinking water samples were collected from PTA by the U.S. Army Public Health Center on 18 October 2016 for PFAS analysis (including PFOS, PFOA, PFBS, PFNA, and PFHxS) using USEPA Method 537 (Department of the Army 2016). None of the PFAS analytes were detected above the method reporting limit of 2.0 ng/L (0.002 micrograms per liter) in the drinking water samples. A PFAS Testing Report provided by USAG-HI indicated that samples were taken on installation at Building 161x and the samples were collected from post-treated/finished water that is trucked in from the Hawaii County Water System. The laboratory which analyzed samples met the USEPA’s Laboratory Approval Program application and Proficiency Testing criteria for USEPA Method 537 Version 1.1.

2.2 Installation Overview of Kilauea Military Reservation (KMR)

2.2.1 Site Location

KMR, officially known as Kilauea Military Reservation, occupies approximately 54 acres on the northern rim of Kilauea crater at Hawaii Volcanoes National Park on the island of Hawaii (**Figure 2-5**). Located approximately 30 miles southwest of Hilo, KMR is bounded by Highway 11 (Mamalahoa Highway) to the north, Crater Rim Drive to the south, and undeveloped land to the east and west (TLI Solutions, Inc. [TLI] 2007). **Figure 2-6** details the installation layout of KMR.

2.2.2 Mission and Brief Site History

KMR was established by a group of citizens in 1916 on 5 acres of land to create a training facility for the National Guard and a recreation area for the Army. Subsequent lease acquisitions have increased the total area to 54 acres. KMR was originally intended to be an encampment for the Hawaiian National Guard but was never used for that purpose. In October 1916, it became a recreation center and rest camp. Except for a period of time between 1941 and 1943, when it was used alternately to house Japanese prisoners of war and tactical troops, KMR has remained a rest and recreational facility at the time of this report (USAG-HI 1997). Since the 1960s, the camp has been located in its present site and has served as a rest and recreation area for all branches of military personnel. The installation mission as of 2006 is to provide active military, retired military, reservists, DoD civilians, families, and sponsored groups a recreation area (TLI 2007).

2.2.3 Current and Projected Land Use

Past and current operations at KMR are light industrial and residential. Generally, this includes infrastructure operations and maintenance, routine vehicle maintenance, fuel storage, and vehicle refueling. A total of 90 one, two, and three-bedroom cottages and apartments at KMR function as hotel style lodging for military service members and their families, however the population that is in residence in the area is unknown (USAG-HI 1994). Although KMR is currently used primarily for recreational purposes, historical records indicate the installation has a “park residence area”, which indicates KMR has residential housing (International Archaeological Research Institute, Inc. [IARI] 2000). There are no foreseeable future land use changes for KMR.

2.2.4 Climate

KMR is located in a transitional area between a humid montane rainforest (east of KMR) and montane seasonal environment (west of KMR) with a summer dry climate. The distribution and intensity of rainfall in the volcano region is tied to orographic conditions generated by the northeast trade winds (IARI 2000). The average annual precipitation at Hawaii Volcano National Park Headquarters (Station 54) from 01 October 1949 to 22 June 2015 was 106.84 inches (Western Regional Climate Center 2020). The mean annual temperature ranges from approximately 53 to 68 degrees Fahrenheit (IARI 2000).

2.2.5 Topography

At an elevation of 4,000 feet amsl, KMR is surrounded by the gentle southeast slope of Mauna Loa and the steep bluffs at the northern rim of Kilauea Caldera (**Figure 2-7**) (TLI 2007).

2.2.6 Geology

Kilauea is an active volcano that formed during the Pleistocene Age on the southeast flank of Mauna Loa, a larger and older neighboring volcano (TLI 2007). Volcanic features including calderas, pit craters, cinder cones, spatter ramparts, fumaroles, solfataras, pahoehoe and a'a lava flows, tree molds, lava tubes, and thermal areas can be found within Hawaii Volcanoes National Park (TLI 2007). KMR is located on a thin soil horizon over a thick section of basaltic flows, ash, and cinder (TLI 2007). KMR is underlain with accumulated surface lava flows of the Keamoku lava flow from Mauna Loa's southeastern flank and the Puna volcanic series and the intrusive rocks of Kilauea's dike-complex, where magma intruded into fissures beneath the summit caldera (TLI 2007).

2.2.7 Hydrogeology

There is no groundwater development, nor is groundwater connected to a water source, at KMR due to the volcanic nature of the island and close proximity to Kilauea volcano (TLI 2007). Subsurface temperatures increase rapidly with depth, causing any infiltrating water to turn into steam. Although there are steam vents within Hawaii Volcanoes National Park, there are no steam vents near KMR (TLI 2007).

2.2.8 Surface Water Hydrology

There are no perennial surface water bodies (e.g., surface streams, lakes, or other bodies of water) at KMR and, due to the porosity of the ground surface, and there are no streams nearby. Surface water runoff is limited due to permeable volcanic bedrock (TLI 2007).

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 PTA.

2.2.9.1 Stormwater Management System Description

Stormwater runoff at KMR quickly infiltrates the ground surface due to its porous nature, and then turns to steam due to increased temperatures with depth as described above (TLI 2007).

2.2.9.2 Sewer System Description

According to an interview conducted during the site visit, KMR formerly had cesspools to manage sewage, however they are now closed and were replaced by septic tanks as of 1984. There are also portable toilets located throughout the installation for sanitary waste disposal.

2.2.10 Potable Water Supply and Drinking Water Receptors

As discussed in **Section 2.2.7**, historical reports indicate there is no groundwater at KMR, nor is groundwater connected to a drinking water source; and, due to the rapid increase in temperature with depth, water that infiltrates the subsurface turns to steam (TLI 2007). Due to the porosity of the ground surface and permeable bedrock, there are no streams nearby and surface water runoff is limited. Drinking water at KMR is obtained through a rainwater catchment system and is supplemented with potable water from the City of Hilo.

An 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 KMR, which along with state and county GIS provided by the installation identified one off-post public supply wells within 5 miles of the installation boundary (**Figure 2-8**); additionally, in compliance with operational security requirements no on-installation or army-owned water supply features are shown on **Figure 2-8**. The EDR report providing well search results provided as **Appendix C**.

As noted above, an EDR DataMap™ Well Search Report for KMR, there is one public water supply well within 5 miles of KMR (EDR 2018). The well, located east of the installation, is identified as well number HI0000146 with an “active” status under the name Hawaii Volcanoes National Park. The EDR DataMap™ Well Search Report lists the “source” as “groundwater” (EDR 2018). The well identified and HI0000146 is likely not a groundwater well used at KMR for the following reasons.

The facility name listed on the EDR DataMap™ Well Search Report for this well has “catchment” in the name (i.e., the facility name for well HI0000146 is Volcano Catchment Chlorinator), indicating the water is likely from a catchment system.

2.2.11 Ecological Receptors

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

KMR has one federally listed endangered mammal (Lasiurus cinereus semotus/ ‘ope‘ape‘a/Hawaiian hoary bat) and two birds (Branta sandvicensis—nēnē, Hawaiian goose and Buteo solitaries—‘io, Hawaiian hawk). As of October 2003, there were 137 nēnēs at KMR and only 1,287 in the world. KMR also has one federally listed threatened plant (Silene hawaiiensis). The land is currently managed by the park for exotic species as part of the Keanakakoi Special Ecological Area (TLI 2007).

2.2.12 Previous PFAS Investigations

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

As stated in **Section 2.1.12**, the USEPA conducted UCMR3 monitoring between 2013 and 2015 to investigate if suspect contaminants without health-based standards set under the Safe Drinking Water Act were present in public water systems. None of the wells sampled during the UCMR3 monitoring were within a 5-mile radius of KMR.

In response to the IMCOM Operations Order 16-088, drinking water samples were collected from KMR by the U.S. Army Public Health Center on 18 October 2016 for PFAS analysis (including PFOS, PFOA, PFBS, PFNA, and PFHxS) using USEPA Method 537 (Department of the Army 2016). None of the PFAS analytes were detected above the method reporting limit of 2.0 ng/L (0.002 micrograms per liter) in the drinking water samples. A PFAS Testing Report provided by USAG-HI indicated that samples were taken on installation and collected from post-treated/finished water. The laboratory which analyzed samples met the USEPA's Laboratory Approval Program application and Proficiency Testing criteria for USEPA Method 537 Version 1.1.

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3 SUMMARY OF PA ACTIVITIES AT PTA AND KMR

To document areas where any potential current and/or historical PFAS-containing materials were used, stored and/or disposed at PTA and KMR, data was collected from three principal sources of information and are described in the subsections below:

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

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 (e.g., records reviewed, personnel interviews, internet searches). A summary of the observations made, and data collected through records reviews (**Appendix D**), installation personnel interviews (**Appendix E**), site reconnaissance photos (**Appendix F**) and site reconnaissance logs (**Appendix G**) during the PA process for PTA and KMR 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**.

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, PTA and KMR fire department documents, PTA and KMR Directorate Of Public Works documents, and GIS files. Internet searches were also conducted to identify publicly available and other relevant information. A list of the specific documents reviewed for PTA and KMR is provided in **Appendix D**.

3.2 Personnel Interviews

Interviews were conducted during the site visit. The list of roles for the installation personnel interviewed during the PA process for PTA and KMR is presented below.

- PTA Fire Chief
- PTA Deputy Commander
- PTA Cultural Resources Manager, Archeologist
- KMR Fire Fighter

The compiled interview logs are provided in **Appendix E**[1].

[1] At the time of the PA, KMR was referred to in interviews as Kilauea Military Camp (KMC). It was later requested by USAEC that the installation name be updated to Kilauea Military Reservation (KMR) to be consistent with already existing documents in HQAES.

3.3 Site Reconnaissance

Site reconnaissance and visual surveys were conducted at the preliminary locations identified at PTA and KMR 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 F**; photos were used to assist in verification of qualitative data collected in the field. The site reconnaissance logs are provided in **Appendix G**.

4 POTENTIAL PFAS USE, STORAGE, AND/OR DISPOSAL AREAS

PTA and KMR were evaluated for all potential current and historical use, storage, and/or disposal of PFAS-containing materials. As such, this section is organized to summarize the AFFF-related uses first, and all remaining potential PFAS-containing materials in the subsequent section.

4.1 Pohakuloa Training Area

4.1.1 AFFF Use, Storage, and Disposal Areas at PTA

AFFF Storage Areas and Fire Stations

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.

AFFF was historically stored and used by fire department personnel to fill fire trucks at the Building 39: Former Fire Station from 1969 until 1996, at which point the PTA fire department moved its operations to the Building 390: Fire Station. AFFF has been stored throughout the interior and exterior of the current fire station in various types of containers including, but not limited to, buckets and CONEX boxes. From approximately 1992 to 1999, spills were known to have occurred from buckets stacked on the exterior of the building. In 2019, there were approximately 310 gallons (sixty-two 5-gallon buckets) of AFFF stored in a shed west of the station building. The AFFF had been purchased approximately 8 years prior. Historically, truck maintenance activities were conducted at the station (until approximately 1999), and fire trucks were filled with AFFF on the fire station apron.

Fire Training Areas

The PTA Fire Department potentially used AFFF in historical firefighting training activities at two iterations of fire-fighting training pits, in a designated AFFF training area, at an airfield runway, and at the current fire training area. A former pit was used from an unknown date until 1984 and a newer pit was constructed in 1984 and operated until 2003. From 1992 to 1999, there were at least six to seven training events. During each event, 1,000 gallons of water and approximately 100 gallons of 3% AFFF were sprayed in a sweeping motion into the pit and the surrounding area. Liquid drained to nearby injection wells. Usage was likely less frequent before 1992 and after 1999. There have been no PFAS-containing materials used at the training pits since at least 2003. The Former AFFF Training Area was used for firefighting training one to two times per year from approximately 1999 to 2009 where foam was sprayed

towards and into a brush-filled drainage ditch. Training exercises were performed on the Bradshaw Army Airfield Runway from 1992 to 1997, to empty PFAS-containing materials from fire truck reservoirs prior to performing truck plumbing maintenance. Training was performed throughout the runway; however, most of the training was likely conducted on the ends of the runway. The specific location of each training exercise depended on the wind direction. Current fire training activities take place in a designated area south of the Bradshaw Airfield Runway; however, it was confirmed during the PA site visit interviews that no training with AFFF has taken place at this location since 2003 when the current fire chief arrived. There is no evidence of historical AFFF usage in the area prior to 2003.

Fire Response Activities

In addition to fire training activities, AFFF was potentially used related to emergency fire responses by the PTA Fire Department at the following locations:

- Landing Zone (LZ) Rob Helicopter Crash
- Forward Aircraft Refueling Point (FARP) 17 Fire Response
- OH-58 Kyla Helicopter Crash/Fire Response
- (Old) Saddle Road (on-post portion)
- Wildfire Responses (on-post portion)

In the late 1990s, a Marine CH-53 helicopter crashed at LZ Rob, a bulldozed lava rock landing zone. The crash did not generate a fire; however, fuel was released to the landing zone area. Response efforts included the use of 3,000 gallons of water and 90 gallons of AFFF.

During interviews conducted during the PA site visit to PTA, no specific evidence was identified confirming AFFF was used in response to the other fires listed above.

4.1.2 Other PFAS Use, Storage, and/or Disposal Areas at PTA

Following document research, personnel interviews, and site reconnaissance at PTA, landfills and former pesticide storage areas were also identified as preliminary locations for use, storage, and/or disposal of PFAS-containing materials. 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 5.1.1** and specific discussion regarding areas retained as AOPIs is presented in **Section 5.1.2**.

Landfills

Two historical landfills at PTA were identified. Following the PA site visit, information from interviews and acquired documents were reviewed and no specific evidence was identified confirming disposal of PFAS-containing waste at these landfills.

Pesticide Storage Areas

One building was identified as a potential storage area for PFAS-containing pesticides. 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 PTA 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.

4.1.3 Readily Identifiable Off-Post PFAS Sources at PTA

An exhaustive search to identify all potential off-post PFAS sources (i.e., not related to operations at PTA) is not part of the PA/SI. However, potential off-post PFAS sources within a 5-mile radius of the installation that were identified during the records search and site visit are described below:

- According to the interviews conducted during the PA, off-post emergency fire responses from the PTA Fire Department as requested by Hawaii County may have used AFFF to extinguish wildfires near PTA.
- The PTA Fire Department responded to vehicle crashes and associated fires along approximately 30 miles (mile marker 17 to 48) of old Saddle Road, which in areas extends beyond the bounds of the installation.

4.2 Kilauea Military Reservation

4.2.1 AFFF Use, Storage, and Disposal Areas at KMR

AFFF Storage Areas and Fire Stations

AFFF was historically stored and used by fire department personnel to fill fire trucks at the Building 43: Former Fire Station from 1942 until 1994, at which point the KMR Fire Department moved its operations to the Building 59: Fire Station #19. AFFF was stored in 5-gallon pails within the former station, fire trucks were filled with AFFF at the former station, and fire trucks containing AFFF were washed on the former fire station concrete apron. Rinse water generated when washing the trucks flowed onto the paved street to the west and then further south down the road. The roads near the former fire station have volcanic rock curbs with no storm or sewer drains present; as such, it is assumed that rinse water that flowed onto the street confined by the curb would then likely evaporate in the road. The station housed two fire trucks, each containing 60 gallons of AFFF. Four or five 5-gallon pails of 3% or 6% AFFF were stored within the building during a 1990 U.S. Army Toxic and Hazardous Materials Agency assessment.

Historically, the current fire station was used to store AFFF and fire trucks containing AFFF were washed on the station apron or driveway. Prior to approximately 2009, when a trench drain was installed on the station apron, the apron and station bays were known to flood during heavy rains. The trench drains discharge to a grassy area southwest of the station. According to firefighting staff, since at least 2009, no PFAS-containing materials have been used at KMR, including for training; however, one 5-gallon pail of AFFF was at the station during the PA site visit.

4.2.2 Other PFAS Use, Storage, and/or Disposal Areas at KMR

Following document research, personnel interviews, and site reconnaissance at KMR, no other areas were identified as preliminary locations for use, storage, and/or disposal of PFAS-containing materials. 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 5.2.1** and specific discussion regarding areas retained as AOPIs is presented in **Section 5.2.2**.

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 KMR 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.

4.2.3 Readily Identifiable Off-Post PFAS Sources at KMR

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

5 SUMMARY AND DISCUSSION OF PA RESULTS

The preliminary locations evaluated for potential use, storage, and/or disposal of PFAS-containing materials at PTA and KMR, 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, six areas at PTA and two areas at KMR have been identified as AOPIs. The process used for refining these areas is presented on **Figure 5-1**, below.

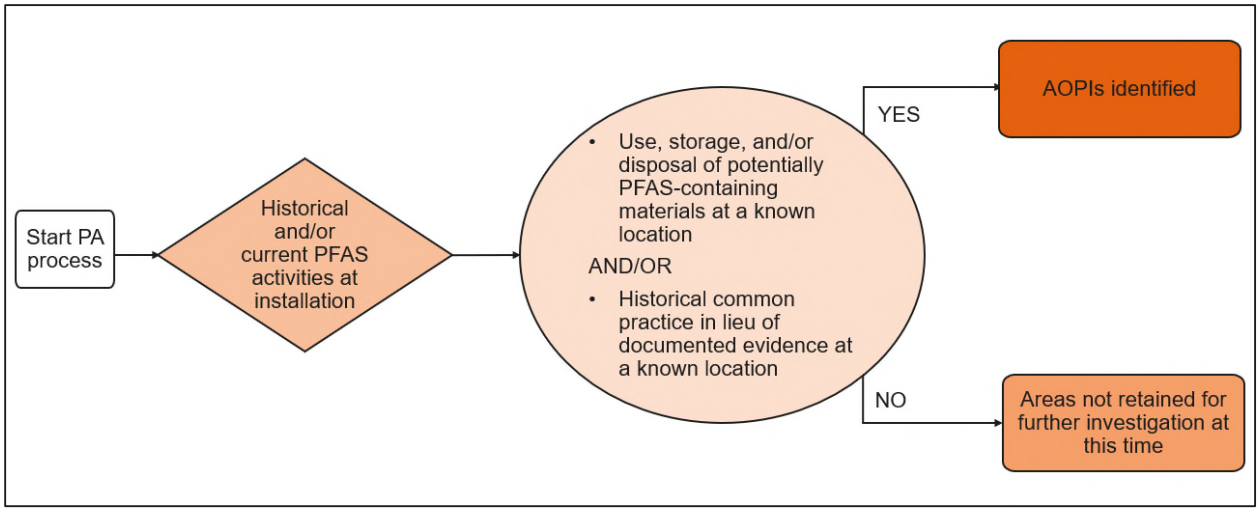

Figure 5-1: AOPI Decision Flowchart

The areas not retained for further investigation are presented in **Section 5.1.1** and **Section 5.2.1**. The areas retained as AOPIs are presented in **Section 5.1.2** and **Section 5.2.2**.

Data limitations for this PA/SI at PTA and KMR are presented in **Section 8**.

5.1 Pohakuloa Training Area

5.1.1 Areas Not Retained for Further Investigation at PTA

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**

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

Area Description	Dates of Operation	Relevant Site History	Rationale
FARP 17 Fire Response	Unknown	Fire response near the FARP 17 (training area). The Fire Chief believes no AFFF was used.	No evidence of PFAS-containing materials used, stored, and/or disposed of at this location.
OH-58 Kyla Helicopter Crash/Fire Response	Unknown	Location of a historical OH-58 helicopter crash. When interviewed during the PA the PTA Fire Chief stated he was confident that no AFFF was used in the response.	No evidence of PFAS-containing materials used, stored, and/or disposed of at this location.
Current Fire-Fighting Training Area	Unknown to Present	The current fire-fighting training area is located south of the Bradshaw Army Airfield runway. A helicopter prop is used for training. According to interviewees no training with AFFF or AFFF testing has taken place at this location.	No evidence of PFAS-containing materials used, stored, and/or disposed of at this location.
(Old) Saddle Road	Late 1960s to present	PTA responds to vehicle crashes/fires along approximately 30 miles of Saddle Road. There were frequent vehicle crashes/ fires along old Saddle Road. According to the PTA Fire Chief, the location of responses within the area of aid from mile marker 17 to 48 is no longer known due to the relocation and repaving of Saddle Road.	Specific locations are unknown.

Area Description	Dates of Operation	Relevant Site History	Rationale
Wildfire Responses	Likely late 1960s to present	Sometimes AFFF was used on wildland fires on PTA ranges. AFFF occasionally would get placed in brush trucks (300-gallon tank). for use after the Class A foam was depleted. AFFF may have been used on off-post wildland fires as assistance requested by Hawaii County. Activities conducted over a large area with no known specific instances or locations of AFFF use, and no known areas of on-post release associated with these responses.	Specific locations are unknown.
Landfill #1 and #2	Unknown to approximately1984	X-ray development solution from KMR (separate AOPI) was sent to PTA for disposal. Landfill 1 operated 1955 to 1977, and Landfill 2 operated from 1979 to 1993. No researched documentation stated that known PFAS-containing materials were disposed of at either facility.	No evidence of PFAS-containing materials used, stored, and/or disposed of at this location.
Building T-21: Former Pesticide Storage Shed	Unknown to 1980s	Former pesticide storage shed with a wood floor and a gravel driveway. Spills may have occurred, but none were confirmed. As indicated in **Section 4.1.2**, no readily available information provided evidence that pesticides at KMR were PFAS containing	No evidence of PFAS-containing materials used, stored, and/or disposed of at this location.

5.1.2 AOPIs at PTA

Overviews for each AOPI identified during the PA process are presented in this section. One of the AOPIs overlaps with PTA IRP site and/or Headquarters Army Environmental System (HQAES) site (**Figure 5-2**). The AOPI, overlapping IRP site identifier, HQAES number, and current site status are discussed within each AOPI subsection presented below. At the time of this PA, none of the PTA IRP sites have historically been investigated or are currently being investigated for the possible presence of PFAS.

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 **5-8**.

5.1.3 Building 39: Former Fire Station

The Building 39: Former Fire Station is identified as an AOPI following records research, personnel interviews, and site reconnaissance due to historical use of PFAS-containing materials and/or AFFF (**Figure 5-3**). Building 39 was operated as a fire station from 1969 through approximately 1996. AFFF was stored throughout the interior and exterior of the building, in various types of containers including, but not limited to, buckets and CONEX boxes. The buckets of AFFF were stacked vertically, which frequently resulted in the bottom buckets becoming cracked due to the weight of the buckets above. Fire trucks were filled with AFFF on the fire station apron. Truck maintenance activities were also conducted at the station.

5.1.4 Building 390: Fire Station

The Building 390: Fire Station is identified as an AOPI following records research, personnel interviews, and site reconnaissance due to historical use of PFAS-containing materials and/or AFFF (**Figure 5-4**). The current fire station was constructed circa 1983 to 1985. AFFF has been stored throughout the interior and exterior of the building in various types of containers including, but not limited to, buckets and CONEX boxes. From approximately 1992 to 1999, spills were known to have occurred from buckets stacked on the exterior of the building. In 2019, there were approximately 310 gallons (sixty-two 5-gallon buckets) of AFFF stored in a shed west of the station building. The AFFF had been purchased approximately 8 years prior. Historically, truck maintenance activities were conducted at the station (until approximately 1999), and fire trucks were filled with AFFF on the fire station apron.

5.1.5 Current and Former Fire-Fighting Training Pits

The Current and Former Fire-Fighting Training Pits (HQAES:2216A.1001) is identified as an AOPI following records research, personnel interviews, and site reconnaissance due to historical firefighting training activities (**Figure 5-5**). Two iterations of fire-fighting training pits were used at PTA: a former pit that was used from an unknown date until 1984 and a newer pit that was constructed in 1984 and operated until 2003. The former pit was constructed with loose rubber plates covered with dirt, surrounded by an earthen berm. Flammable liquids that were poured into the burn pit during fire training exercises may have seeped into the underlying soil and bedrock along the unsealed plate seams. The former pit was decommissioned due to an unsuitable design for flammable liquids and access problems. In 1984, the pit was renovated by installing a concrete pit and covering the surrounding fire break with red

cinder fill material. From 1992 to 1999, there were at least six to seven training events. During each event, 1,000 gallons of water and approximately 100 gallons of 3% AFFF were sprayed in a sweeping motion into the pit and the surrounding area. Liquid drained to nearby injection wells. Usage was likely less frequent before 1992 and after 1999. The pit was used a few times as a target for helicopter water drops in the 1990s. According to the interview with the PTA Fire Chief, here have been no PFAS-containing materials used at the training pits since at least 2003.

5.1.6 Former AFFF Training Area

The Former AFFF Training Area is identified as an AOPI following records research, personnel interviews, and site reconnaissance due to historical firefighting training activities (**Figure 5-6**). The Former AFFF Training Area, located near the Bradshaw Army Airfield control tower, was used for firefighting training one to two times per year from approximately 1999 to 2009. Foam was sprayed towards and into a brush-filled drainage ditch.

5.1.7 LZ Rob Helicopter Crash

The LZ Rob Helicopter Crash is identified as an AOPI following records research, personnel interviews, and site reconnaissance due to historical fire response using PFAS-containing materials (**Figure 5-7**). Circa the late 1990s, a Marine CH-53 helicopter crashed at LZ Rob, a bulldozed lava rock LZ. The crash did not generate a fire; however, fuel was released to the LZ area. Response efforts included the use of 3,000 gallons of water and 90 gallons of AFFF.

5.1.8 Bradshaw Army Airfield Runway

The Bradshaw Army Airfield Runway is identified as an AOPI following records research, personnel interviews, and site reconnaissance due to historical use and disposal of PFAS-containing materials (**Figure 5-8**). From 1992 to 1997, training exercises were performed on the Bradshaw Army Airfield Runway to empty PFAS-containing materials from fire truck reservoirs prior to performing truck plumbing maintenance. Training was performed throughout the runway; however, most of the training was likely conducted on the ends of the runway. The specific location of each training exercise depended on the wind direction.

5.2 Kilauea Military Reservation

5.2.1 Areas Not Retained for Further Investigation at KMR

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 5-2**.

Table 5-2. KMR Installation Areas Not Retained for Further Investigation

Area Description	Dates of Operation	Relevant Site History	Rationale
Building 47: Health Clinic	Unknown to approximately 1989	The Building was constructed in 1930, and historically used to process X-rays. Interviewee indicated these activities ceased at least prior to 1989. Spent X-ray development solution was sent to PTA for disposal (separate AOPI). Potential for spills on site exist, but none were confirmed.	No confirmed release of PFAS-containing material.

5.2.2 AOPIs at KMR

Overviews for each AOPI identified during the PA process are presented in this section. One of the AOPIs overlap with KMR IRP sites and/or Headquarters Army Environmental System (HQAES) sites (**Figure 5-9**). The AOPI, overlapping IRP site identifier, HQAES number, and current site status are discussed within each AOPI subsection presented below. At the time of this PA, none of the KMR IRP sites have historically been investigated or are currently being investigated for the possible presence of PFAS.

The AOPI locations are shown on **Figure 5-9** and details of each AOPI that also show the approximate extent of AFFF use (if applicable) are presented on **Figures 5-10** through **5-11**.

5.2.3 Building 43: Former Fire Station

The Building 43: Former Fire Station (HQAES: 2213A.1005) is identified as an AOPI following records research, personnel interviews, and site reconnaissance due to historical use of PFAS-containing materials and/or AFFF (**Figure 5-10**). Building 43 was constructed in 1942 and operated as a fire station until 1994. The fire station bay had a concrete floor with no drains. AFFF was stored in 5-gallon pails within the building, fire trucks were filled with AFFF at the station, and fire trucks containing AFFF were washed on the fire station concrete apron. Rinse water generated when washing the trucks flowed onto the street, which did not have storm or sewer drains. The station housed two fire trucks, each containing 60 gallons of AFFF. Four or five 5-gallon pails of 3% or 6% AFFF were stored within the building during a 1990 U.S. Army Toxic and Hazardous Materials Agency assessment.

5.2.4 Building 59: Fire Station #19

The Building 59: Fire Station #19 is identified as an AOPI following records research, personnel interviews, and site reconnaissance due to historical use of PFAS-containing materials and/or AFFF (**Figure 5-11**). Firefighting operations moved to Building 59 in 1994. Historically, the station was used to store AFFF and fire trucks containing AFFF were washed on the station apron or driveway. Prior to approximately 2009, when a trench drain was installed on the station apron, the apron and station bays were known to flood during heavy rains. The trench drains discharge to a grassy area southwest of the station. According to interviews conducted during the PA, since at least 2009, no PFAS-containing materials have been used at KMR, including for training; however, one 5-gallon pail of AFFF is currently stored at the station. There is no known historical use of PFAS-containing materials in response to a fire or crash on or off post.

6 SUMMARY OF SI ACTIVITIES

Based on the results of the PA at PTA and KMR, an SI for PFOS, PFOA, PFBS, PFNA, and PFHxS was conducted in accordance with CERCLA. SI sampling was completed at PTA at all six AOPIs and KMR at both AOPIs to evaluate presence or absence of PFOS, PFOA, PFBS, PFNA, and PFHxS in comparison with the OSD risk screening levels. As such, an installation-specific QAPP Addendum (Arcadis 2021) 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 August 2021 at PTA and December 2022 at KMR 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 2021) 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 PTA and KMR. 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**.

6.1 Data Quality Objectives

As identified during the DQO process and outlined in the site-specific QAPP Addendum (Arcadis 2021), the objective of the SI is to identify whether there has been a release to the environment at the AOPIs identified in the PA and to determine if further investigation is warranted. This SI evaluated soil and sediment for PFOS, PFOA, PFBS, PFNA, and PFHxS presence or absence 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.

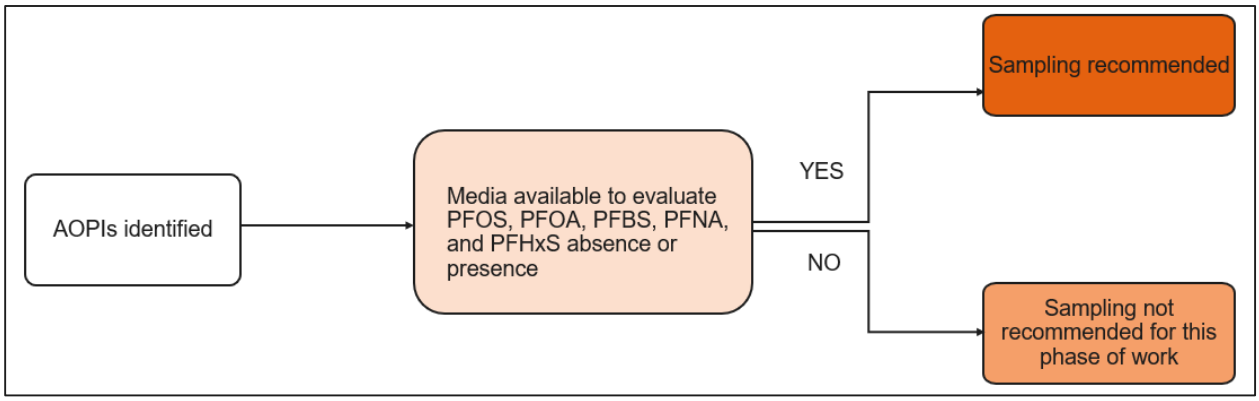

Figure 6-1: AOPI Sampling Decision Tree

6.2.1 Pohakuloa Training Area

The sampling design for SI sampling activities at PTA is detailed in Worksheet #17 of the QAPP Addendum (Arcadis 2021). For each of the six AOPIs at PTA (Building 39: Former Fire Station, Building 390: Fire Station, Current and Former Fire-Fighting Training Pits, Former AFFF Training Area, LZ Rob Helicopter Crash, and Bradshaw Army Airfield Runway) samples were collected at locations of known or suspected use, storage, and/or disposal of PFAS-containing materials, locations of surface runoff collection, and downgradient locations if exact use, storage, or disposal locations are unknown. Sample locations were selected based on site-specific historical evidence and surface runoff / surface conditions observed in the field at each sampled AOPI. Sample media types collected for each AOPI were based on media most likely to confirm the presence or absence of PFOS, PFOA, PFBS, PFNA, and PFHxS.

Soil samples were collected from each of the six AOPIs to evaluate PFOS, PFOA, PFBS, PFNA, and PFHxS presence at potential release areas, to evaluate the potential for those areas to be sources of PFAS to surface water and groundwater as an influence to drinking water, and to update the individual AOPI CSMs. The focus of the soil sampling was the upper 2 feet of soil. Soil samples were collected over the 0 to 2 feet bgs interval or an interval of 2 feet bgs below any surface coverings (asphalt). One soil sample per AOPI with planned soil sampling was also analyzed for total organic carbon (TOC), pH, and grain size. These data were collected as they may be useful in future fate and transport studies.

Historical reports indicate groundwater at PTA has been identified several hundred to more than 1,000 feet bgs. The significant depth to groundwater precludes collection of groundwater samples at PTA.

6.2.2 Kilauea Military Reservation

The sampling design for SI sampling activities at KMR is detailed in Worksheet #17 of the QAPP Addendum (Arcadis 2021). For both of the AOPIs at KMR (Building 43: Former Fire Station and Building 59: Fire Station #19) samples were collected at locations of known or suspected use, storage, and/or disposal of PFAS-containing materials, locations of surface runoff collection, and downgradient locations if exact use, storage, or disposal locations are unknown. Sample locations were selected based on site-specific historical evidence and surface runoff / surface conditions observed in the field at each sampled

AOPI. Sample media types collected for each AOPI were based on media most likely to confirm the presence or absence of PFOS, PFOA, PFBS, PFNA, and PFHxS.

Soil samples were collected from both AOPIs and a sediment sample from one AOPI (Building 59: Fire Station #19) to evaluate PFOS, PFOA, PFBS, PFNA, and PFHxS presence at potential release areas, to evaluate the potential for those areas to be sources of PFAS to surface water and groundwater as an influence to drinking water, and to update the individual AOPI CSMs. The focus of the soil sampling was the upper 2 feet of soil. Soil samples were collected over the 0 to 2 feet bgs interval or an interval of 2 feet bgs below any surface coverings (asphalt). One soil sample per AOPI with planned soil sampling was also analyzed for TOC, pH, and grain size. These data were collected as they may be useful in future fate and transport studies.

Groundwater sampling is not included as part of the SI at either of the AOPIs (Building 43: Former Fire Station and Building 59: Fire Station #19) at KMR. No wells exist onsite and historical reports indicate that there is no groundwater at KMR.

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 2021), and the safety procedures specified in the Accident Prevention Plan (Arcadis 2018) and SSHP (Arcadis 2021). 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 2021). 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, equipment calibration forms, tailgate health and safety forms, utility and structures checklist and sample collection logs) documenting the SI sampling activities are included in **Appendices H** and **I**, respectively. Photographs of the sampling activities are included in **Appendix J**.

6.3.1 Field Methods

Composite soil samples were collected via a 3.25 inch diameter, nickel plated, alloy steel hand auger from the top 2 feet of native soil at the shallow soil sampling locations at PTA and KMR. Several borings at PTA were not able to be advanced to 2 feet bgs due to refusal; instead, the soil sample was collected from soil present at the surface to the depth of refusal. In general, sampling points were positioned in the center, downgradient, and/or cross gradient of a suspected release area. Soil collected with the hand auger was transferred to a stainless-steel bowl where it was mixed for homogenization. A portion of the homogenized soil was then placed in the sample container and packed with ice in a cooler to meet the

preservation temperature requirements. Nitrile gloves were worn during sample collection to prevent PFAS cross-contamination. Soil lithological descriptions were continuously logged and documented on field forms and coordinates for each sampling location were recorded using a handheld global positioning system device. Excess soil cuttings were used to backfill the boring location where they were generated. Decontamination water was discharged to the boring location where they were generated.

For the AOPI LZ Rob Helicopter Crash, the bulldozed lava rock LZ, soil samples were collected using a trowel from soil present at the surface to a maximum depth of 1-foot bgs.

For the AOPI Building 39: Former Fire Station, newly graded material was present at the offsite drainage area; so, a deeper, composite subsurface soil sample was collected from a sampling location from a 2-foot interval of native material located at 1 to 3 feet bgs.

For the AOPI Current and Former Fire-Fighting Training Pits, an additional deeper, composite subsurface soil sample was collected from a sampling location from a 1.5-foot interval of native material located at 2.5 to 4 feet bgs.

One sediment sample was collected at KMR from the following location: the drainage canal within the Building 59: Fire Station #19 AOPI. The sediment sampling method used was determined based on the condition of the stream/drainage canals in accordance with TGI – Sediment, Surface Water, and Stormwater Sample Collection for PFAS Analysis, provided in Appendix A to the PQAPP (Arcadis 2019). The sediment sample was collected from the upper 5 centimeters of sediment within the canal using a hand-held stainless-steel trowel. Surface water was present during the sampling event, so decanting of the sediment sample was necessary. The sediment description was documented on a field form and coordinates for the sediment sample location were recorded using a handheld global positioning system device.

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 hand tools, and field blanks for laboratory-supplied water used in the final decontamination step.

QA/QC samples were collected at the frequencies specified in the QAPP Addendum (Arcadis 2021), 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, PFBS, PFNA, and PFHxS, and TOC only. EBs were collected for media sampled for PFOS, PFOA, PFBS, PFNA, and PFHxS, at a frequency of one per piece of relevant equipment for each sampling event, as specified in the QAPP Addendum (Arcadis 2021). The decontaminated reusable equipment from which EBs were collected include the hand auger, stainless steel trowel, and stainless steel bowl. Source blanks were collected from the water used to decontaminate the hand auger, stainless-steel trowel, and stainless-steel bowl. Analytical results for blank samples are discussed in **Section 7.1.8** and **Section 7.2.4**.

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 PTA or KMR 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 (FCRs) included as **Appendix K** and are summarized below:

- FCR-PTA-01: Three soil samples (PTA-BLDG39-4-SO, PTA-BLDG39-5-SO, and PTA-BLDG39-6-SO) were moved at the Building 39: Former Fire Station AOPI due to new construction (since the PA mobilization) that obstructed the originally planned sample locations.
- FCR-PTA-02: At each soil sampling location at PTA, soil representative of the designated soil sampling interval (0 to 2 feet bgs) was placed in a PFAS-free container and composited. Soil samples were collected by subsampling the composited soil present in the PFAS-free container to obtain soil samples that were more representative of the soil sampling interval than discrete soil sample collection methods.
- FCR-PTA-03: Two soil samples (PTA-LZR-3-SO and PTA-LZR-4-SO) were moved at the LZ Rob Helicopter Crash due to surface materials not suitable or available for sampling.
- FCR-KMR-01: One soil sample (KMR-BLD59-4-SO) at the Building 59: Fire Station #19 AOPI was replaced by a sediment sample (KMR-BLDG59-4-SE) due to presence of standing water at the planned sampling location.

6.3.4 Decontamination

Non-dedicated reusable sampling equipment (e.g., stainless-steel trowel, stainless-steel bowl, and hand auger) that came into direct contact with sampling 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

Investigation-derived waste, including soil cuttings and decontamination fluids were disposed on the ground at the point of collection. Disposable equipment was collected in bags and disposed in municipal waste receptables. Equipment investigation-derived waste includes personal protective equipment and other disposable materials (e.g., nitrile gloves and plastic sheeting) that may come in contact with sampling media.

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 Eurofins Lancaster Laboratories Environmental, an ELAP-accredited laboratory for PFAS analysis, including PFOS, PFOA, PFBS, PFNA, and PFHxS, 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). Eighteen PFAS-related compounds, including PFOS, PFOA, PFBS, PFNA, and PFHxS, were analyzed for in soil and/or sediment samples using an analytical method that is ELAP-accredited and compliant with QSM 5.3 (DoD and Department of Energy 2019), Table B-15. Potable water samples were analyzed for 14 PFAS compounds, including PFOS, PFOA, PFBS, PFNA, and PFHxS, according to USEPA Method 537 Version 1.1, in accordance with Worksheet #15 of the PTA and KMR QAPP Addendum (Arcadis 2021).

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 2021) 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 L**).

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 5.3 (DoD and Department of Energy 2019). 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 L**. The Level IV analytical reports are included within **Appendix L** in the final electronic deliverable only.

6.4.3 Data Usability Assessment and Summary

A data usability assessment was completed for all analytical data associated with SI sampling at PTA and KMR. Documentation generated during the data usability assessments, which were compiled into a DUSR (**Appendix L**), 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.

Based on the final data usability assessment, the environmental data collected at PTA and KMR 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 L**), and as indicated in the full analytical tables (**Appendix M**) provided for the SI results. These data are of sufficient quality to meet the objectives and requirements of the PQAPP (Arcadis 2019) and PTA and KMR QAPP Addendum (Arcadis 2021). Data qualifiers applied to laboratory analytical results for samples collected during the SI at PTA and KMR 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 of figures.

6.5 Office of the Secretary of Defense Risk Screening Levels

The OSD risk screening levels for PFOS, PFOA, PFBS, PFNA, PFHxS, and HFPO-DA 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 6-2**.

Table 6-2 OSD Risk Screening Levels Calculated for PFOS, PFOA, PFBS, PFNA, PFHxS, and HFPO-DA 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	4	0.013	0.16
PFOA	6	0.019	0.25
PFBS	601	1.9	25
PFNA	6	0.019	0.25
PFHxS	39	0.13	1.6
HFPO-DA[3]	6	0.023	0.35

Notes:
1. Risk screening levels for tap water and soil provided by the OSD. 2022. Memorandum: Investigating Per- and Polyfluoroalkyl Substances within the Department of Defense Cleanup Program. July 06 (**Appendix A**).
2. All soil data will be screened against both the Residential Scenario and Industrial/Commercial risk screening levels (if collected from less than 2 feet bgs), regardless of the current and projected land use of the AOPI. Soil samples collected from greater than 2 feet but less than 15 feet bgs will be compared to the industrial/commercial risk screening levels only.
3 Of the six PFAS compounds presented in the 06 July 2022 OSD memorandum, HFPO-DA (commonly referred to as GenX) was not included as an analyte at the time of this SI. Based on the CSM developed during the PA and revised based on SI findings, the presence of HFPO-DA is not anticipated at PTA and KMR because HFPO-DA is generally not a component of MIL-SPEC AFFF and based on its history including distribution limitations that restricted use of HFPO-DA, it is generally not a component of other products the military used. In addition, it is unlikely that HFPO-DA would be an individual chemical of concern in the absence of other PFAS.
mg/kg = milligram per kilogram
ng/L = nanograms per liter
ppm = parts per million
ppt = parts per trillion

While the current and most likely future land uses of the AOPIs at PTA and KMR are industrial/ commercial, both residential and industrial/commercial soil risk screening levels for PFOS, PFOA, PFBS, PFNA, and PFHxS 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, PFBS, PFNA, or PFHxS 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 PTA and KMR (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 2021). The sample results discussion below focuses on the PFOS, PFOA, PFBS, PFNA, and PFHxS 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.

Table 7-1 provide a summary of the soil analytical results for PFOS, PFOA, PFBS, PFNA, and PFHxS at PTA. **Table 7-2** and **Table 7-3** provide a summary of the soil and sediment analytical results for PFOS, PFOA, PFBS, PFNA, and PFHxS at KMR. **Table 7-4** summarizes AOPIs and whether their SI results exceed the OSD risk screening levels. **Appendix M** includes the full suite of analytical results for these media, as well as for the QA/QC samples. An overview of AOPIs at PTA and KMR with OSD risk screening level exceedances is depicted on **Figure 7-1** and **Figure 7-8**, respectively. **Figures 7-2** through **7-7** show the PFOS, PFOA, PFBS, PFNA, and PFHxS analytical results in soil for each AOPI at PTA. **Figures 7-9** through **7-10** show the PFOS, PFOA, PFBS, PFNA, and PFHxS analytical results in soil and sediment for each AOPI at KMR. Non-detected results are reported as less than the LOQ. Detections of PFOS, PFOA, PFBS, PFNA, and/or PFHxS greater than the applicable OSD risk screening levels are highlighted in summary tables and on 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. Soil and sediment data are reported in mg/kg, or ppm. Soil descriptions are provided on the field forms in **Appendix I**. The results of the SI are grouped by AOPI and discussed for each medium as applicable.

Table 7-4 AOPIs and OSD Risk Screening Level Exceedances

Installation	AOPI Name	OSD Exceedances (Yes/No)
PTA	Building 39: Former Fire Station	Yes
	Building 390: Fire Station	Yes
	Current and Former Fire-Fighting Training Pits	Yes
	Former AFFF Training Area	Yes
	LZ Rob Helicopter Crash	No
	Bradshaw Army Airfield Runway	Yes
KMR	Building 43: Former Fire Station	No
	Building 59: Fire Station #19	Yes

7.1 Pohakuloa Training Area

7.1.1 Building 39: Former Fire Station

This section summarizes the soil PFOS, PFOA, PFBS, PFNA, and PFHxS analytical results associated with Building 39: Former Fire Station. The soil sampling locations are presented on **Figure 7-2**. The soil analytical results are presented in **Table 7-1**.

Six soil samples were collected via hand auger from the Building 39: Former Fire Station AOPI on 29 and 30 August 2021. Soil samples PTA-BLDG39-1-SO-082921 (0.33 to 1.2 feet bgs), PTA-BLDG39-2-SO-082921 (0.33 to 1.3 feet bgs), PTA-BLDG39-3-SO-083021 (0.33 to 1 foot bgs), and PTA-BLDG39-6-SO-3.0-083021 (1 to 3 feet bgs) were located on the west side of the former fire station. Soil samples PTA-BLDG39-4-SO-083021 (0 to 2 feet bgs) and PTA-BLDG39-5-SO-083021 (0 to 2 feet bgs) were located in a grassy area north of the former fire station. All sampling locations are shown on **Figure 7-2**.

- PFOS was detected in all six soil samples at concentrations of 1.6 mg/kg, 0.23 mg/kg, 1.1 mg/kg, 1.3 mg/kg, 1.4 mg/kg, and 1.7 mg/kg at PTA-BLDG39-1-SO-082921, PTA-BLDG39-2-SO-082921, PTA-BLDG39-3-SO-083021, PTA-BLDG39-4-SO-083021, PTA-BLDG39-5-SO-083021, PTA-BLDG39-6-SO-3.0-083021, respectively. All six detected concentrations exceed the OSD residential risk screening level (0.013 mg/kg) and the OSD industrial/commercial risk screening level (0.16 mg/kg).
- PFOA was detected in all six soil samples at concentrations of 0.095 mg/kg, 0.0078 mg/kg, 0.061 mg/kg, 0.0022 mg/kg, 0.032 mg/kg, and 0.0034 mg/kg at PTA-BLDG39-1-SO-082921, PTA-BLDG39-2-SO-082921, PTA-BLDG39-3-SO-083021, PTA-BLDG39-4-SO-083021, PTA-BLDG39-5-SO-083021, PTA-BLDG39-6-SO-3.0-083021, respectively. Three of the six detected concentrations (PTA-BLDG39-1-SO-082921, PTA-BLDG39-3-SO-083021, and PTA-BLDG39-5-SO-083021) exceed the OSD residential risk screening level (0.019 mg/kg) but not the OSD industrial/commercial risk screening level (0.25 mg/kg).
- PFBS was detected in three of the six soil samples at concentrations of 0.005 mg/kg, 0.0034 mg/kg, and 0.18 mg/kg at PTA-BLDG39-1-SO-082921, PTA-BLDG39-2-SO-082921, and PTA-BLDG39-3-SO-083021, respectively. The detected concentrations do not exceed the OSD residential risk screening level (1.9 mg/kg) or the OSD industrial/commercial risk screening level (25 mg/kg).
- PFNA was detected in five of the six soil samples at concentrations of 0.0043 mg/kg, 0.0005 J (estimated concentration) mg/kg, 0.0016 mg/kg, 0.012 mg/kg, and 0.00087 mg/kg at PTA-BLDG39-1-SO-082921, PTA-BLDG39-3-SO-083021, PTA-BLDG39-4-SO-083021, PTA-BLDG39-5-SO-083021, PTA-BLDG39-6-SO-3.0-083021, respectively. The detected concentrations do not exceed the OSD residential risk screening level (0.019 mg/kg) or the OSD industrial/commercial risk screening level (0.25 mg/kg).
- PFHxS was detected in all six soil samples at concentrations of 0.14 mg/kg, 0.11 mg/kg, 0.3 mg/kg, 0.0082 mg/kg, 0.026 mg/kg, and 0.018 mg/kg at PTA-BLDG39-1-SO-082921, PTA-BLDG39-2-SO-082921, PTA-BLDG39-3-SO-083021, PTA-BLDG39-4-SO-083021, PTA-BLDG39-5-SO-083021, PTA-BLDG39-6-SO-3.0-083021, respectively. Two of the six detected concentrations (PTA-BLDG39-1-SO-082921 and PTA-BLDG39-3-SO-083021) exceed the OSD residential risk screening level (0.13 mg/kg) but not the OSD industrial/commercial risk screening level (1.6 mg/kg).

7.1.2 Building 390: Fire Station

This section summarizes the soil PFOS, PFOA, PFBS, PFNA, and PFHxS analytical results associated with Building 390: Fire Station. The soil sampling locations are presented on **Figure 7-3**. The soil analytical results are presented in **Table 7-1**.

Four soil samples were collected via hand auger from the Building 390: Fire Station AOPI on 28 and 29 August 2021. Soil samples PTA-BLDG390-1-SO-082921 (0.3 to 2 feet bgs) and PTA-BLDG390-2-SO-082921 (0.3 to 2 feet bgs) were located on a concrete pad on the west side of the fire station. Soil samples PTA-BLDG390-3-SO-082821 (0 to 2 feet bgs) and PTA-BLDG390-4-SO-082821 (0 to 0.67 feet bgs) were collected in a grassy area west of the fire station. All sampling locations are shown on **Figure 7-3.** A field duplicate (PTA-FD-1-SO-082821) was collected and corresponds to parent sample PTA-BLDG390-3-SO-082821. The field duplicate sample results are shown in brackets below following the parent sample results.

- PFOS was detected in all four soil samples at concentrations of 0.73 mg/kg, 0.02 mg/kg, 0.054 mg/kg [0.056 mg/kg], and 0.022 mg/kg at PTA-BLDG390-1-SO-082921, PTA-BLDG390-2-SO-082921, PTA-BLDG390-3-SO-082821 [PTA-FD-1-SO-082821], and PTA-BLDG390-4-SO-082821, respectively. All four detected concentrations exceed the OSD residential risk screening level (0.013 mg/kg), while one of the four detected concentrations (PTA-BLDG390-1-SO-082921) also exceeds the OSD industrial/commercial risk screening level (0.16 mg/kg).
- PFOA was detected in all four soil samples at concentrations of 0.021 mg/kg, 0.0017 mg/kg, 0.0057 mg/kg [0.0082 mg/kg], and 0.0042 mg/kg at PTA-BLDG390-1-SO-082921, PTA-BLDG390-2-SO-082921, PTA-BLDG390-3-SO-082821 [PTA-FD-1-SO-082821], and PTA-BLDG390-4-SO-082821, respectively. One of the four detected concentrations (PTA-BLDG390-1-SO-082921) exceeds the OSD residential risk screening level (0.019 mg/kg) but not the OSD industrial/commercial risk screening level (0.25 mg/kg).
- PFBS was not detected in any of the four soil samples. Therefore, there were no exceedances of the OSD residential risk screening level (1.9 mg/kg) or the OSD industrial/commercial risk screening level (25 mg/kg).
- PFNA was detected in all four soil samples at concentrations of 0.0012 mg/kg, 0.00039 J mg/kg, 0.0024 mg/kg [0.0028 mg/kg], and 0.0017 mg/kg at PTA-BLDG390-1-SO-082921, PTA-BLDG390-2-SO-082921, PTA-BLDG390-3-SO-082821 [PTA-FD-1-SO-082821], and PTA-BLDG390-4-SO-082821, respectively. The detected concentrations do not exceed the OSD residential risk screening level (0.019 mg/kg) or the OSD industrial/commercial risk screening level (0.25 mg/kg).
- PFHxS was detected in all four soil samples at concentrations of 0.067 mg/kg, 0.0012 mg/kg, 0.0098 mg/kg [0.014 mg/kg], and 0.0016 mg/kg at PTA-BLDG390-1-SO-082921, PTA-BLDG390-2-SO-082921, PTA-BLDG390-3-SO-082821 [PTA-FD-1-SO-082821], and PTA-BLDG390-4-SO-082821, respectively. The detected concentrations do not exceed the OSD residential risk screening level (0.13 mg/kg) or the OSD industrial/commercial risk screening level (1.6 mg/kg).

7.1.3 Current and Former Fire-Fighting Training Pits

This section summarizes the soil PFOS, PFOA, PFBS, PFNA, and PFHxS analytical results associated with Current and Former Fire-Fighting Training Pits. The soil sampling locations are presented on **Figure 7-4**. The soil analytical results are presented in **Table 7-1**.

Six soil samples were collected via hand auger from the Current and Former Fire-Fighting Training Pits AOPI on 28 and 30 August 2021. Soil samples PTA-FFTP-1-SO-082821 (0 to 2 feet bgs) and PTA-FFTP-2-SO-082821 (0 to 2 feet bgs) were located on the north side of the training pits. Soil samples PTA-FFTP-4-SO-082821 (0 to 2 feet bgs), PTA-FFTP-5-SO-082821 (0 to 2 feet bgs), and PTA-FFTP-5-SO-4.0-083021 (2.5 to 4 feet bgs) were located on the south side of the training pits. Soil sample PTA-FFTP-3-SO-0.75-082821 (0 to 0.75 feet bgs) was located in the central area of the training pits. All sampling locations are shown on **Figure 7-4**.

- PFOS was detected in all six soil samples at concentrations of 0.067 mg/kg, 0.16 mg/kg, 0.025 mg/kg, 0.5 mg/kg, 0.3 mg/kg, and 0.13 mg/kg at PTA-FFTP-1-SO-082821, PTA-FFTP-2-SO-082821, PTA-FFTP-3-SO-0.75-082821, PTA-FFTP-4-SO-082821, PTA-FFTP-5-SO-082821, and PTA-FFTP-5-SO-4.0-083021, respectively. All six detected concentrations exceed the OSD residential risk screening level (0.013 mg/kg), while two of the six detected concentrations (PTA-FFTP-4-SO-082821 and PTA-FFTP-5-SO-082821) also exceed the OSD industrial/commercial risk screening level (0.16 mg/kg).
- PFOA was detected in all six soil samples at concentrations of 0.014 mg/kg, 0.011 mg/kg, 0.0056 mg/kg, 0.03 mg/kg, 0.011 mg/kg, and 0.0034 mg/kg at PTA-FFTP-1-SO-082821, PTA-FFTP-2-SO-082821, PTA-FFTP-3-SO-0.75-082821, PTA-FFTP-4-SO-082821, PTA-FFTP-5-SO-082821, and PTA-FFTP-5-SO-4.0-083021, respectively. One detected concentration (PTA-FFTP-4-SO-082821) exceeds the OSD residential risk screening level (0.019 mg/kg) but not the OSD industrial/commercial risk screening level (0.25 mg/kg).
- PFBS was not detected in the any of the six soil samples. Therefore, there were no exceedances of the OSD residential risk screening level (1.9 mg/kg) or the OSD industrial/commercial risk screening level (25 mg/kg).
- PFNA was detected in all six soil samples at concentrations of 0.0056 mg/kg, 0.013 mg/kg, 0.0015 mg/kg, 0.0088 mg/kg, 0.066 mg/kg, and 0.023 mg/kg at PTA-FFTP-1-SO-082821, PTA-FFTP-2-SO-082821, PTA-FFTP-3-SO-0.75-082821, PTA-FFTP-4-SO-082821, PTA-FFTP-5-SO-082821, and PTA-FFTP-5-SO-4.0-083021, respectively. The detected concentrations do not exceed the OSD residential risk screening level (0.019 mg/kg) or the OSD industrial/commercial risk screening level (0.25 mg/kg).
- PFHxS was detected in all six soil samples at concentrations of 0.0049 mg/kg, 0.0013 mg/kg, 0.0059 mg/kg, 0.076 mg/kg, 0.011 mg/kg, and 0.018 mg/kg at PTA-FFTP-1-SO-082821, PTA-FFTP-2-SO-082821, PTA-FFTP-3-SO-0.75-082821, PTA-FFTP-4-SO-082821, PTA-FFTP-5-SO-082821, and PTA-FFTP-5-SO-4.0-083021, respectively. The detected concentrations do not exceed the OSD residential risk screening level (0.13 mg/kg) or the OSD industrial/commercial risk screening level (1.6 mg/kg).

7.1.4 Former AFFF Training Area

This section summarizes the soil PFOS, PFOA, PFBS, PFNA, and PFHxS analytical results associated with Former AFFF Training Area. The soil sampling locations are presented on **Figure 7-5**. The soil analytical results are presented in **Table 7-1**.

Four soil samples were collected via hand auger from the Former AFFF Training Area AOPI on 27 August 2021. Soil samples PTA-AFFFTA-3-SO-082721 (0 to 2 feet bgs) and PTA-AFFFTA-4-SO-082721 (0 to 2 feet bgs) were located in the northwest section of the AOPI. Soil samples PTA-AFFFTA-1-SO-082721 (0 to 2 feet bgs) and PTA-AFFFTA-2-SO-082721 (0 to 2 feet bgs) were located in the northeast and central sections of the AOPI, respectively. All sampling locations are shown on **Figure 7-5**.

- PFOS was detected in all four soil samples at concentrations of 0.16 mg/kg, 0.21 mg/kg, 1.1 mg/kg, and 1.4 mg/kg at PTA-AFFFTA-1-SO-082721, PTA-AFFFTA-2-SO-082721, PTA-AFFFTA-3-SO-082721, and PTA-AFFFTA-4-SO-082721, respectively. All four detected concentrations exceed the OSD residential risk screening level (0.013 mg/kg), while three of the four detected concentrations (PTA-AFFFTA-1-SO-082721, PTA-AFFFTA-3-SO-082721, and PTA-AFFFTA-4-SO-082721) also exceed the OSD industrial industrial/commercial risk screening level (0.16 mg/kg).
- PFOA was detected in all four soil samples at concentrations of 0.012 mg/kg, 0.0026 mg/kg, 0.0065 mg/kg, and 0.013 mg/kg at PTA-AFFFTA-1-SO-082721, PTA-AFFFTA-2-SO-082721, PTA-AFFFTA-3-SO-082721, and PTA-AFFFTA-4-SO-082721, respectively. The detected concentrations do not exceed the OSD residential risk screening level (0.019 mg/kg) or the OSD industrial/commercial risk screening level (0.25 mg/kg).
- PFBS was not detected in the any of the four soil samples. Therefore, there were no exceedances of the OSD residential risk screening level (1.9 mg/kg) or the OSD industrial/commercial risk screening level (25 mg/kg).
- PFNA was detected in all four soil samples at concentrations of 0.0064 mg/kg, 0.0016 mg/kg, 0.0031 mg/kg, and 0.0037 mg/kg at PTA-AFFFTA-1-SO-082721, PTA-AFFFTA-2-SO-082721, PTA-AFFFTA-3-SO-082721, and PTA-AFFFTA-4-SO-082721, respectively. The detected concentrations do not exceed the OSD residential risk screening level (0.019 mg/kg) or the OSD industrial/commercial risk screening level (0.25 mg/kg).
- PFHxS was detected in all four soil samples at concentrations of 0.0056 mg/kg, 0.0026 mg/kg, 0.011 mg/kg, and 0.05 mg/kg at PTA-AFFFTA-1-SO-082721, PTA-AFFFTA-2-SO-082721, PTA-AFFFTA-3-SO-082721, and PTA-AFFFTA-4-SO-082721, respectively. The detected concentrations do not exceed the OSD residential risk screening level (0.13 mg/kg) or the OSD industrial/commercial risk screening level (1.6 mg/kg).

7.1.5 LZ Rob Helicopter Crash

This section summarizes the soil PFOS, PFOA, PFBS, PFNA, and PFHxS analytical results associated with LZ Rob Helicopter Crash. The soil sampling locations are presented on **Figure 7-6**. The soil analytical results are presented in **Table 7-1**.

Four soil samples were collected via stainless-steel trowel within the bulldozed lava rock landing zone at the LZ Rob Helicopter Crash AOPI on 31 August 2021. Due to the nature of the surface material present, the soil sample was unable to be collected via the hand auger. Soil samples PTA-LZR-1-SO-083121 (circular area 1.5 feet in diameter; 0 to 0.25 feet bgs), PTA-LZR-2-SO-083121 (circular area 1 foot in diameter; 0 to 0.5 feet bgs), PTA-LZR-3-SO-083121 (circular area 1.5 feet in diameter; 0 to 1 foot bgs), and PTA-LZR-4-SO-083121 (circular area 2 feet in diameter; 0 to 0.5 feet bgs) were located in the northeast, southeast, northwest, and southwest areas of the AOPI, respectively. All sampling locations are shown on **Figure 7-6**.

- PFOS was not detected in any of the four soil samples. Therefore, there were no exceedances of the OSD residential risk screening level (0.013 mg/kg) or the OSD industrial/commercial risk screening level (0.16 mg/kg).
- PFOA was not detected in any of the four soil samples. Therefore, there were no exceedances of the OSD residential risk screening level (0.019 mg/kg) or the OSD industrial/commercial risk screening level (0.25 mg/kg).
- PFBS was not detected in any of the four soil samples. Therefore, there were no exceedances of the OSD residential risk screening level (1.9 mg/kg) or the OSD industrial/commercial risk screening level (25 mg/kg).
- PFNA was not detected in any of the four soil samples. Therefore, there were no exceedances of the OSD residential risk screening level (0.019 mg/kg) or the OSD industrial/commercial risk screening level (0.25 mg/kg).
- PFHxS was not detected in any of the four soil samples. Therefore, there were no exceedances of the OSD residential risk screening level (0.13 mg/kg) or the OSD industrial/commercial risk screening level (1.6 mg/kg).

7.1.6 Bradshaw Army Airfield Runway

This section summarizes the soil PFOS, PFOA, PFBS, PFNA, and PFHxS analytical results associated with Bradshaw Army Airfield Runway. The soil sampling locations are presented on **Figure 7-7**. The soil analytical results are presented in **Table 7-1**.

Six soil samples were collected via hand auger from the Bradshaw Army Airfield Runway AOPI on 31 August 2021. Soil samples PTA-BAAFR-1-SO-083121 (0 to 1.5 feet bgs), PTA-BAAFR-2-SO-083121 (0 to 1.7 feet bgs), and PTA-BAAFR-3-SO-083121 (0 to 1.4 feet bgs) were located off the west end of the runway. Soil samples PTA-BAAFR-4-SO-083121 (0 to 2 feet bgs), PTA-BAAFR-5-SO-083121 (0 to 2 feet), and PTA-BAAFR-6-SO-083121 (0 to 1.5 feet bgs) were located off the east end of the runway. A field duplicate (PTA-FD-2-083121) was collected and corresponds to parent sample PTA-BAAFR-4-SO-083121. All sampling locations are shown on **Figure 7-7**.

- PFOS was detected in all six soil samples at concentrations of 0.0073 mg/kg, 0.0097 mg/kg, 0.015 mg/kg, 0.00075 mg/kg [0.0011 mg/kg], 0.00095 mg/kg, and 0.0051 mg/kg at PTA-BAAFR-1-SO-083121, PTA-BAAFR-2-SO-083121, PTA-BAAFR-3-SO-083121, PTA-BAAFR-4-SO-083121 [PTA-FD-2-SO-083121], PTA-BAAFR-5-SO-083121, and PTA-BAAFR-6-SO-083121, respectively. One of the six detected concentrations (PTA-BAAFR-3-SO-083121) exceeds the OSD residential risk

screening level (0.013 mg/kg) but not the OSD industrial/commercial risk screening level (0.16 mg/kg).

- PFOA was detected in all six soil samples at concentrations of 0.0065 mg/kg, 0.025 mg/kg, 0.041 mg/kg, 0.00059 mg/kg [0.00088 mg/kg], 0.00061 mg/kg, and 0.0022 mg/kg at PTA-BAAFR-1-SO-083121, PTA-BAAFR-2-SO-083121, PTA-BAAFR-3-SO-083121, PTA-BAAFR-4-SO-083121 [PTA-FD-2-SO-083121], PTA-BAAFR-5-SO-083121, and PTA-BAAFR-6-SO-083121, respectively. Two of the six detected concentrations (PTA-BAAFR-2-SO-083121 and PTA-BAAFR-3-SO-083121) exceed the OSD residential risk screening level (0.019 mg/kg) but not the OSD industrial/commercial risk screening level (0.25 mg/kg).
- PFBS was not detected in any of the six soil samples. Therefore, there were no exceedances of the OSD residential risk screening level (1.9 mg/kg) or the OSD industrial/commercial risk screening level (25 mg/kg).
- PFNA was detected in five (including duplicate sample) of the six soil samples at concentrations of 0.0074 mg/kg, 0.0053 mg/kg, 0.0049 mg/kg, and 0.00046 J mg/kg at PTA-BAAFR-1-SO-083121, PTA-BAAFR-2-SO-083121, PTA-BAAFR-3-SO-083121, and PTA-BAAFR-6-SO-083121, respectively. PFNA was also detected in the field duplicate (PTA-FD-2-SO-083121) at a concentration of 0.00044 J mg/kg, while the parent sample (PTA-BAAFR-4-SO-083121) was non-detect. The detected concentrations do not exceed the OSD residential risk screening level (0.019 mg/kg) or the OSD industrial/commercial risk screening level (0.25 mg/kg).
- PFHxS was detected in three of the six soil samples at concentrations of 0.00052 J mg/kg, 0.0017 mg/kg, and 0.0016 mg/kg at PTA-BAAFR-2-SO-083121, PTA-BAAFR-3-SO-083121, and PTA-BAAFR-6-SO-083121, respectively. The detected concentrations do not exceed the OSD residential risk screening level (0.13 mg/kg) or the OSD industrial/commercial risk screening level (1.6 mg/kg).

7.1.7 TOC, pH, and Grain Size

In addition to sampling soil for PFOS, PFOA, PFBS, PFNA, and PFHxS, 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. Ranges for five AOPIs (Building 39: Former Fire Station, Building 390: Fire Station, Current and Former Fire-Fighting Training Pits, Former AFFF Training Area, and Bradshaw Army Airfield Runway) were grouped together while one AOPI (LZ Rob Helicopter Crash) is presented separately. Samples at the LZ Rob Helicopter Crash AOPI were made up primarily of rock (gravels and coarse/medium sand) while samples at the other five AOPIs consisted of soils.

7.1.7.1 Building 39: Former Fire Station, Building 390: Fire Station, Current and Former Fire-Fighting Training Pits, Former AFFF Training Area, and Bradshaw Army Airfield Runway

The TOC in the soil samples ranged from 1,220 J- (estimated quantity; biased low) to 6,810 J- mg/kg. The combined percentage of fines (i.e., silt and clay) in soils at PTA ranged from 13.9 to 21.9% with an average of 17.18%. In general, PFAS constituents tend to be more mobile in soils with less than 20% fines (silt and clay) and a lower TOC than typically observed in topsoil (5,000 to 3,000 mg/kg). The

percent moisture of the soil at PTA ranged from 2 to 22.4% with an average of 6.18% which was typical for sandy soil (0 to 10%). The pH of the soil ranged from 7.7 J to 8.4 J standard units with an average of 7.96 standard units, which was typical for neutral to slightly alkaline soils. Based on these geochemical and physical soil characteristics (i.e., low percentage of fines and TOC) observed underlying the installation during the SI, PFAS constituents are expected to be relatively more mobile in these AOPIs at PTA than in soils with greater percentages of fines and TOC. The full analytical results from samples collected during the SI are included in **Appendix M**.

7.1.7.2 LZ Rob Helicopter Crash

The TOC in the analyzed sample was returned as non-detect (337 UJ [The analyte was analyzed for but was not detected. The LOQ is approximate and may be inaccurate or imprecise]). The combined percentage of fines (i.e., silt and clay) in the analyzed sample was 1%. In general, PFAS constituents tend to be more mobile in soils with less than 20% fines (silt and clay) and lower TOC. The percent moisture of the samples at this AOPI ranged from 0 to 0.2% with an average of 0.05%. The pH for the analyzed sample was 6.8 J standard units. Based on these geochemical and physical characteristics (i.e., low percentage of fines and TOC) observed underlying the installation during the SI, PFAS constituents are expected to be relatively more mobile in this AOPI at PTA than in soils with greater percentages of fines and TOC.

7.1.8 Blank Samples

Detections of PFOS, PFOA, PFBS, PFNA, and PFHxS constituents are summarized below for blank samples collected at PTA. Other than those noted below, concentrations of PFOS, PFOA, PFBS, PFNA, and PFHxS in all other blank samples were not detected.

PFOS, PFOA, PFBS, PFNA, and/or PFHxS were detected in the following samples:

- The EB sample (PTA-EB-1-083021), associated with the hand auger, exhibited detections of PFOS and PFOA at a concentration of 30 ng/L and 1.2 J ng/L, respectively.
- The EB sample (PTA-EB-2-083021), associated with the stainless-steel trowel, exhibited a detection of PFOS at a concentration of 1.7 ng/L.
- The EB sample (PTA-EB-3-083021), associated with the stainless-steel bowl, exhibited a detection of PFOS at a concentration of 1.0 J ng/L.

A blank action limit of five times the concentration of a detected compound in an associated blank is calculated for QA blanks containing concentrations greater than the detection limits. The blank action limit is compared to the associated sample results to determine the appropriate qualification of the sample results, if needed. The final rinse, followed by collection of the EBs measures the potential for contamination of samples during field operations. As stated above, compounds were detected in the associated QA blanks; however, the associated sample results were greater than the blank action limit and/or were non-detect. Therefore, no qualification of the associated sample results was required. The full analytical results for blank samples collected during the SI are included in **Appendix M**.

7.2 Kilauea Military Reservation

At the time of the SI, KMR was referred to as Kilauea Military Camp (KMC); as such, the sample IDs in the sub sections below, as well as the applicable tables, figures, and appendices, retain the "KMC" acronym to be consistent with the analytical reports. It was later requested by USAEC that the installation name be updated to Kilauea Military Reservation (KMR) to be consistent with already existing documents in HQAES.

7.2.1 Building 43: Former Fire Station

This section summarizes the soil PFOS, PFOA, PFBS, PFNA, and PFHxS analytical results associated with Building 43: Former Fire Station. The soil sampling locations are presented on **Figure 7-9**. The soil analytical results are presented in **Table 7-2**.

Three soil samples were collected via hand auger at the Building 43: Former Fire Station AOPI on 12 and 13 December 2022. Soil samples KMC-BLD43-1-SO-121222 (0 to 2 feet bgs), KMC-BLD43-2-SO-121322 (0.2 to 2 feet bgs), and KMC-BLD43-3-SO-121222 (0 to 2 feet bgs) were located off the edge of the driveway apron, within the driveway apron, and south of the driveway apron, west of the former fire station, respectively. Sampling locations are shown on **Figure 7-9**.

- PFOS was detected in all three soil samples at concentrations of 0.002 mg/kg, 0.0052 mg/kg, and 0.012 mg/kg at KMC-BLD43-1-SO-121222, KMC-BLD43-2-SO-121322, and KMC-BLD43-3-SO-121222, respectively. None of the detected concentrations exceeded the OSD residential risk screening level (0.013 mg/kg) or the OSD industrial/commercial risk screening level (0.16 mg/kg).
- PFOA was detected in all three soil samples at concentrations of 0.00011 J mg/kg, 0.00025 J mg/kg, and 0.00054 mg/kg, at KMC-BLD43-1-SO-121222, KMC-BLD43-2-SO-121322, and KMC-BLD43-3-SO-121222, respectively. None of the detected concentrations exceed the OSD residential risk screening level (0.019 mg/kg) or the OSD industrial/commercial risk screening level (0.25 mg/kg).
- PFBS was not detected in any of the three soil samples. Therefore, there were no exceedances of the OSD residential risk screening level (1.9 mg/kg) or the OSD industrial/commercial risk screening level (25 mg/kg).
- PFNA was detected in all three soil samples at concentrations of 0.00027 mg/kg, 0.00012 J mg/kg, and 0.00011 J mg/kg at KMC-BLD43-1-SO-121222, KMC-BLD43-2-SO-121322, and KMC-BLD43-3-SO-121222, respectively. None of the detected concentrations exceeded the OSD residential risk screening level (0.019 mg/kg) or the OSD industrial/commercial risk screening level (0.25 mg/kg).
- PFHxS was detected in all three soil samples at concentrations of 0.00014 J mg/kg, 0.00046 mg/kg, and 0.00094 mg/kg at KMC-BLD43-1-SO-121222, KMC-BLD43-2-SO-121322, and KMC-BLD43-3-SO-121222, respectively. None of the detected concentrations exceeded the OSD residential risk screening level (0.13 mg/kg) or the OSD industrial/commercial risk screening level (1.6 mg/kg).

7.2.2 Building 59: Fire Station #19

This section summarizes the soil and sediment PFOS, PFOA, PFBS, PFNA, and PFHxS analytical results associated with Building 59: Fire Station #19. The soil and sediment sampling locations are presented on

Figure 7-10. The soil and sediment analytical results are presented in **Table 7-2** and **Table 7-3**, respectively.

7.2.2.1 Soil

Three soil samples were collected via hand auger at the Building 59: Fire Station #19 AOPI on 12 and 13 December 2022. Soil samples KMC-BLD59-1-SO-121322 (0.2 to 2 feet bgs) and KMC-BLD59-2-SO-121322 (0.2 to 2 feet bgs) were located within the apron south of the fire station shown on **Figure 7-10**. Soil sample KMC-BLD59-3-SO-121222 (0 to 2 feet bgs) was located southwest of the fire station (downgradient from stormwater flow) adjacent to the covered drain in a grassy area shown on **Figure 7-10**. A field duplicate (KMC-FD-1-SO-121222) was collected and corresponds to parent sample KMC-BLD59-2-SO-121322. The field duplicate sample results are shown in brackets below following the parent sample results.

- PFOS was detected in two of the three soil samples at concentrations of 0.02 mg/kg and 0.051 mg/kg [0.057 mg/kg] at KMC-BLD59-1-SO-121322 and KMC-BLD59-2-SO-121322 [KMC-FD-1-SO-121222], respectively. Both of the detected concentrations exceed the OSD residential risk screening level (0.013 mg/kg) but not the OSD industrial/commercial risk screening level (0.16 mg/kg).
- PFOA was detected in all three soil samples at concentrations of 0.00079 mg/kg, 0.0016 mg/kg [0.0018 mg/kg], and 0.00015 J mg/kg at KMC-BLD59-1-SO-121322, KMC-BLD59-2-SO-121322 [KMC-FD-1-SO-121222], and KMC-BLD59-3-SO-121222, respectively. None of the detected concentrations exceed the OSD residential risk screening level (0.019 mg/kg) or the OSD industrial/commercial risk screening level (0.25 mg/kg).
- PFBS was detected in one of the three soil samples (KMC-BLD59-2-SO-121322) at a concentration of 0.000053 J mg/kg. The field duplicate associated with this sample [KMC-FD-1-SO-121222] was reported as non-detect. The detected concentration does not exceed the OSD residential risk screening level (1.9 mg/kg) or the OSD industrial/commercial risk screening level (25 mg/kg).
- PFNA was detected in all three soil samples at concentrations of 0.0006 mg/kg, 0.001 mg/kg [0.0011 mg/kg], and 0.000074 J mg/kg at KMC-BLD59-1-SO-121322, KMC-BLD59-2-SO-121322 [KMC-FD-1-SO-121222], and KMC-BLD59-3-SO-121222, respectively. The detected concentrations do not exceed the OSD residential risk screening level (0.019 mg/kg) or the OSD industrial/commercial risk screening level (0.25 mg/kg).
- PFHxS was detected in all three soil samples at concentrations of 0.00033 mg/kg, 0.00061 mg/kg [0.00057 mg/kg], and 0.000072 J mg/kg at KMC-BLD59-1-SO-121322, KMC-BLD59-2-SO-121322 [KMC-FD-1-SO-121222], and KMC-BLD59-3-SO-121222, respectively. The detected concentrations do not exceed the OSD residential risk screening level (0.13 mg/kg) or the OSD industrial/commercial risk screening level (1.6 mg/kg).

7.2.2.2 Sediment

One sediment sample was collected from the upper 5 centimeters via stainless-steel trowel at the Building 59: Fire Station #19 AOPI on 12 December 2022. Sediment sample KMC-BLD59-4-SE-121322 was located southwest of the fire station, at the mouth of the covered drain shown on **Figure 7-10**. A field

duplicate (KMC-FD-1-SE-121322) was collected and corresponds to parent sample KMC-BLD59-4-SE-121322. The field duplicate sample results are shown in brackets below following the parent sample results.

- PFOS was not detected in the parent or duplicate sediment sample. Therefore, there were no exceedances of the OSD residential risk screening level (0.013 mg/kg) or the OSD industrial/commercial risk screening level (0.16 mg/kg).
- PFOA was detected at a concentration of 0.00028 J mg/kg in the parent sample, and in the duplicate sample no concentration was detected. The parent sample concentration does not exceed the OSD residential risk screening level (0.019 mg/kg) or the OSD industrial/commercial risk screening level (0.25 mg/kg).
- PFBS was not detected in the parent or duplicate sediment sample. Therefore, there were no exceedances of the OSD residential risk screening level (1.9 mg/kg) or the OSD industrial/commercial risk screening level (25 mg/kg).
- PFNA was detected at a concentration of 0.00019 J mg/kg [0.000084 J mg/kg]. The parent and duplicate sample concentrations do not exceed the OSD residential risk screening level (0.019 mg/kg) or the OSD industrial/commercial risk screening level (0.25 mg/kg).
- PFHxS was not detected in the parent or duplicate sediment sample. Therefore, there were no exceedances of the OSD residential risk screening level (0.13 mg/kg) or the OSD industrial/commercial risk screening level (1.6 mg/kg).

7.2.3 TOC, pH, and Grain Size

In addition to sampling soil for PFOS, PFOA, PFBS, PFNA, and PFHxS, 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 TOC in the soil samples from both AOPIs were 2,230 J- mg/kg and 4,440 J mg/kg. The combined percentage of fines (i.e., silt and clay) in soils at KMR was 28.4% and 35.6% with an average of 32%. In general, PFAS constituents tend to be more mobile in soils with less than 20% fines (silt and clay) and lower TOC. The percent moisture of the soil at KMR ranged from 7.5 to 24.1% with an average of 13.66% which was typical for sandy soil with an elevated percentage of fines. The pH of the soil at both AOPIs was 8 J standard units, which was typical for slightly alkaline soils. While PFAS constituents are relatively less mobile in soils with high percentages of fines, depleted TOC may allow for enhanced mobility of the constituents in soil.

7.2.4 Blank Samples

PFOS, PFOA, PFBS, PFNA, and PFHxS 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 M**.

7.3 Conceptual Site Models

The preliminary human health CSMs presented in the QAPP Addendum (Arcadis 2021) were re-evaluated and updated, if necessary, based on the SI sampling results. The CSMs for PTA presented on **Figures 7-11** through **7-13,** for KMR presented on **Figures 7-14** and **7-15**, 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 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, PFBS, PFNA, and PFHxS are each negatively charged at environmentally-relevant pH. The media potentially affected by PFOS, PFOA, PFBS, PFNA, and PFHxS 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 use, storage, and/or disposal of PFAS-containing materials at the AOPIs, affected media are likely to consist of soil and groundwater and 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, groundwater recharge, and, if a drainage area is present, adsorption/desorption between intermittent 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, PFBS, PFNA, and PFHxS may be evaluated at a future date if those pathways warrant further consideration.

CSMs were developed for each individual AOPI and were combined where source media, potential migration pathways and exposure media, and human exposure pathway determinations are congruent.

The following exposure pathway determinations apply to all CSMs at PTA (**Figures 7-11** through **7-13**):

- Groundwater was not sampled during the SI at PTA. PTA purchases drinking water from the Hawaii County Water System, which sources raw water from Waimea, about 30 miles north of the site. Two

existing wells located northeast of the installation identified under the name PTA are presumed to be inactive and are unlikely to be impacted by groundwater underlying the AOPIs. Therefore, the groundwater exposure pathways (via drinking water ingestion and dermal contact) for on-installation site workers and residents are considered to be incomplete. Recreational users are not likely to contact groundwater; therefore, the groundwater exposure pathway for on-installation recreational users is also considered to be incomplete.

Additional exposure pathway descriptions for the AOPIs at PTA are listed below by figure.

Figure 7-11 shows the CSM for the Building 39: Former Fire Station and Former AFFF Training Area AOPIs at PTA. PFAS-containing material was released to soil and/or paved surfaces during PFAS-containing materials storage, truck maintenance, and firefighter training activities.

- PFOS, PFOA, PFBS, PFNA, and/or PFHxS were detected in soil at the AOPIs, 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.
- The AOPIs are not likely to be regularly accessed by on-installation residents and recreational users, or by off-installation receptors. Therefore, the soil exposure pathways for these receptors are incomplete.
- Groundwater originating at the AOPIs likely flows southwest downgradient toward the sea and discharges at or near the coast (PRC 1997). However, there is limited information regarding the direction of groundwater flow at PTA. Due to the absence of land use controls that prevent potable use of off-post groundwater, the groundwater exposure pathway for off-installation drinking water receptors is considered to be potentially complete.
- Intermittent stormwater runoff from these AOPIs flows to downgradient drainage ditches. While unlikely, on-installation site workers or recreational users could contact constituents in the drainage ditches through incidental ingestion and dermal contact; therefore, the surface water and sediment/soil exposure pathways for these receptors are considered to be potentially complete.
- The drainage ditches are not connected to any perennial water bodies that flow off-installation. There are intermittent water bodies present at PTA, however any nearby intermittent water bodies are upgradient of all AOPIs at PTA and none are directly connected with AOPIs at PTA. Due to the depth to groundwater, shallow groundwater is unlikely to discharge to off-installation surface water bodies. Therefore, the surface water and sediment/soil exposure pathways for off-installation receptors are considered to be incomplete.

Figure 7-12 shows the CSM for Building 390: Fire Station, Current and Former Fire-Fighting Training Pits, and Bradshaw Army Airfield Runway AOPIs at PTA. PFAS-containing materials were or may have been released to soil and/or paved surfaces during PFAS-containing materials storage, truck maintenance, and firefighter training activities.

- PFOS, PFOA, PFBS, PFNA, and/or PFHxS were detected in soil at the AOPIs, 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.

- The AOPIs are not likely to be regularly accessed by on-installation residents and recreational users, or by off-installation receptors. Therefore, the soil exposure pathways for these receptors are incomplete.
- Groundwater originating at the AOPIs likely flows southwest downgradient toward the sea and discharges at or near the coast (PRC 1997). However, there is limited information regarding the direction of groundwater flow at PTA. Due to the absence of land use controls that prevent potable use of off-post groundwater, the groundwater exposure pathway for off-installation drinking water receptors is considered to be potentially complete.
- Due to the high permeability of the soils and underlying bedrock, stormwater runoff likely quickly recharges groundwater at, or near, these AOPIs. There are no perennial waterbodies at PTA, and it is unlikely that PFOS, PFOA, PFBS, PFNA, and/or PFHxS would be transported to off-installation surface water bodies. Therefore, surface water and sediment are not potential exposure media in the CSM for these AOPIs.

Figure 7-13 shows the CSM for AOPI LZ Rob Helicopter Crash at PTA. PFAS-containing material was released to soil and/or basalt rock during emergency response efforts at the helicopter crash site.

- PFOS, PFOA, PFBS, PFNA, and PFHxS were not detected in soil at the AOPI; therefore, the soil exposure pathways for all receptors are incomplete.
- Based on the non-detect soil sample results, the groundwater exposure pathway for off-installation drinking water receptors is also considered to be incomplete.

The following exposure pathway determinations apply to all CSMs at KMR (**Figures 7-14** and **7-15**):

- The AOPIs are not likely to be regularly accessed by on-installation residents or recreational users, or by off-installation receptors. Therefore, the soil exposure pathways for these receptors are considered to be incomplete.
- There are no drinking water wells at KMR. Drinking water is obtained via a rainwater catchment system, which is supplemented with potable water from the City of Hilo. Due to the rapid increase in temperature with depth, water that infiltrates the subsurface turns to steam at KMR. Therefore, the groundwater exposure pathways (via drinking water ingestion and dermal contact) for on-installation site workers and residents are considered to be incomplete. Recreational users are not likely to contact groundwater; therefore, the groundwater exposure pathway for on-installation recreational users is considered to be incomplete.
- Although available information indicates there is no groundwater at KMR, database records indicate there are wells (i.e., listed as catchment systems, abandoned-sealed wells, observation wells, and/or U.S. Geological Survey wells) located within 5 miles of KMR. Therefore, in the absence of additional information and given the evidence that infiltrated water becomes steam in the subsurface with rapid increase in temperature with depth, the groundwater exposure pathway for off-installation receptors is considered to be incomplete.

Additional exposure pathway descriptions for the AOPIs at KMR are listed below by figure.

Figure 7-14 shows the CSM for Building 43: Former Fire Station AOPI at KMR. PFAS-containing material was released to soil and/or paved surfaces during PFAS-containing materials storage, truck maintenance, and firefighter training activities.

- PFOS, PFOA, PFBS, PFNA, and/or PFHxS were detected in soil at the AOPIs, 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 potentially complete.
- There are no surface water bodies at KMR. Additionally, stormwater runoff from the Building 43: Former Fire Station AOPI is limited by the porous nature of the ground surface, making it unlikely that PFOS, PFOA, PFBS, PFNA, and/or PFHxS detected in soil would be transported to off-installation surface water bodies. Therefore, surface water and sediment are not potential exposure media in the CSM for this AOPI.

Figure 7-15 shows the CSM for Building 59: Fire Station #19 AOPI at KMR. PFAS-containing materials were or may have been released to soil and/or paved surfaces during PFAS-containing materials storage, truck maintenance, and firefighter training activities.

- PFOS, PFOA, PFBS, PFNA, and/or PFHxS were detected in soil at the AOPIs, 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.
- There is a trench drain on the station apron that discharges stormwater to a grassy area southwest of the station. One sediment sample was collected at the mouth of the covered drain. PFOA and PFNA were detected in the sediment sample. In the event of maintenance activities, on-installation site workers could contact constituents in the drain sediment through incidental ingestion and dermal contact; therefore, the sediment exposure pathway is complete.
- Due to the porous nature of the ground surface, it is likely stormwater runoff quickly infiltrates groundwater, which then likely turns to steam. Therefore, it is unlikely that human receptors would contact intermittent stormwater on post or surface water and sediment off post, and these exposure pathways are considered to be incomplete.

Following the SI sampling, five out of the six AOPIs at PTA and all the AOPIs at KMR 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, PFBS, PFNA, and PFHxS to the OSD risk screening levels (**Table 6-2**).

8 CONCLUSIONS AND RECOMMENDATIONS

The PFAS PA/SI included two distinct efforts. The PA identified AOPIs at PTA and KMR 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 soil and sediment sampling at AOPIs to determine whether or not a release of PFOS, PFOA, PFBS, PFNA, and PFHxS to the environment occurred.

OSD provided residential risk screening levels based on the USEPA oral reference dose for PFOS, PFOA, PFBS, PFNA, and PFHxS in soil and groundwater (tap water) and industrial/commercial risk screening levels for PFOS, PFOA, PFBS, PFNA, and PFHxS 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, PFBS, PFNA, and PFHxS use, storage, and/or disposal at PTA and KMR. Following the evaluation, six AOPIs were identified at PTA and two AOPIs were identified at KMR.

Drinking water samples were collected from PTA on 18 October 2016 for PFAS analysis (including PFBS, PFOS, and PFOA) using USEPA Method 537 (Department of the Army 2016). None of the PFAS analytes were detected above the method reporting limit of 2.0 ng/L (0.002 micrograms per liter) in the drinking water samples.

Of the six PFAS compounds presented in the 06 July 2022 OSD memorandum, HFPO-DA (commonly referred to as GenX) was not included as an analyte at the time of this SI. Based on the CSM developed during the PA and revised based on SI findings, the presence of HFPO-DA is not anticipated at PTA and KMR because HFPO-DA is generally not a component of MIL-SPEC AFFF and based on its history including distribution limitations that restricted use of HFPO-DA, it is generally not a component of other products the military used. In addition, it is unlikely that HFPO-DA would be an individual chemical of concern in the absence of other PFAS.

Six AOPIs were sampled during the SI at PTA to identify presence or absence of PFOS, PFOA, PFBS, PFNA, and PFHxS at each AOPI. The SI scope of work was completed in accordance with the Final PQAPP (Arcadis 2019) and the PTA and KMR QAPP Addendum (Arcadis 2021). Five AOPIs had detections of PFOS, PFOA, PFBS, PFNA, and PFHxS in soil and all five AOPIs exceeded OSD risk screening levels.

Two AOPIs were sampled during the SI at KMR to identify presence or absence of PFOS, PFOA, PFBS, PFNA, and PFHxS at each AOPI. The SI scope of work was completed in accordance with the Final PQAPP (Arcadis 2019) and the PTA and KMR QAPP Addendum (Arcadis 2021). Both AOPIs had detections of PFOS, PFOA, PFBS, PFNA, and PFHxS in soil and one AOPI exceeded OSD risk screening levels. Following the SI sampling at PTA, five out of the six AOPIs at PTA were considered to have complete or potentially complete exposure pathways. Soil exposure pathways for on-installation site workers are complete and the groundwater exposure pathways for off-installation drinking water receptors are potentially complete at five AOPIs (Building 39: Former Fire Station, Former AFFF Training Area, Building 390: Fire Station, Current and Former Fire-Fighting Training Pits, and Bradshaw Army Airfield Runway). The surface water and sediment exposure pathways for on-installation site workers and recreational users are potentially complete at two AOPIs (Building 39: Former Fire Station and Former AFFF Training Area).

Following the SI sampling at KMR, one AOPI at KMR was considered to have complete or potentially complete exposure pathways. The soil exposure pathways for on-installation site workers are complete at the Building 59: Fire Station #19 AOPI. Additionally, the exposure pathway for trench drain sediment is complete for on-installation site workers at Building 59: Fire Station #19.

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, PFBS, PFNA, and PFHxS to the OSD risk screening levels (**Table 6-2**). **Table 8-1** below summarizes the AOPIs identified at PTA and KMR, PFOS, PFOA, PFBS, PFNA, and PFHxS sampling and recommendations for each AOPI; further investigation is warranted at PTA and KMR. 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, PFBS, PFNA, and PFHxS Sampling at PTA and KMR, and Recommendations

Installation Name	AOPI Name	PFOS, PFOA, PFBS, PFNA, and/or PFHxS detected greater than OSD Risk Screening Levels? (Yes/No/ND/NS)		Recommendation
		SO	GW	
PTA	Building 39: Former Fire Station	Yes	NS[1]	Further study in a remedial investigation
	Building 390: Fire Station	Yes	NS[1]	Further study in a remedial investigation
	Current and Former Fire-Training Pits	Yes	NS[1]	Further study in a remedial investigation
	Former Aqueous Film-Forming Foam Training Area	Yes	NS[1]	Further study in a remedial investigation
	Landing Zone Rob Helicopter Crash	ND	NS[1]	No action at this time
	Bradshaw Army Airfield Runway	Yes	NS[1]	Further study in a remedial investigation
KMR	Building 43: Former Fire Station	No	NS[2]	No action at this time
	Building 59: Fire Station #19	Yes	NS[2]	Further study in a remedial investigation

Notes:
1 = Historical reports indicate groundwater at PTA has been identified several hundred to more than 1,000 feet bgs. The significant depth to groundwater precludes collection of groundwater samples as part of this SI; instead, soil samples were collected to verify the presence of PFAS at PTA.
2 = KMR is underlain with accumulated surface lava flows of the Keamoku lava flow from Mauna Loa's southeastern flank and the Puna volcanic series and the intrusive rocks of Kilauea's dike-complex. There is no groundwater development in the area, nor is groundwater connected to a water source. Additionally, due to the rapid increase in temperature with depth, water that infiltrates the subsurface turns to steam, which precluded the collection of groundwater samples as part of this SI; instead, soil samples were collected to verify the presence of PFAS at KMR.

Light gray shading – detection greater than the OSD risk screening level
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, PFBS, PFNA, and PFHxS at PTA and KMR are discussed below.

Data limitations were encountered during the PA process for PTA and KMR. There is limited information regarding the direction of groundwater flow at PTA. In general, groundwater moves southwest downgradient toward the sea and discharges at or near the coast (PRC 1997). There is no groundwater development at KMR, nor is groundwater connected to a water source. Additionally, due to the rapid increase in temperature with depth, water that infiltrates the subsurface turns to steam at KMR. Presence or absence of PFOS, PFOA, PFBS, PFNA, and PFHxS in groundwater at PTA and KMR AOPIs has not been determined and is not included in the scope of this SI, however, may be in the future. For this PA/SI report, CSM evaluations only include elements applicable to the potential PFAS (i.e., PFOS, PFOA, PFBS, PFNA, and PFHxS) source and human receptors. The potential for ecological exposure to PFAS (i.e., PFOS, PFOA, PFBS, PFNA, and PFHxS) may be evaluated at a future date if it is determined that those pathways warrant further consideration.

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, PFBS, PFNA, and PFHxS 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 C**).

The searches for ecological receptors and off-post PFOS, PFOA, PFBS, PFNA, and PFHxS 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, PFBS, PFNA, and PFHxS analytical data is limited to results from on-post soil and sediment sampling locations. Available data, including PFOS, PFOA, PFBS, PFNA, and PFHxS, is listed in **Appendix M**, which were analyzed per the selected analytical method. HFPO-DA was not in the suite of PFAS compounds analyzed during the SI at PTA and KMR because it was not considered to be a constituent of concern at the time; therefore, there are no HFPO-DA SI analytical results to screen against the 2022 OSD risk screening levels.

Results from this PA/SI indicate further study in a remedial investigation is warranted at PTA and KMR in accordance with the guidance provided by the OSD.

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10 ACRONYMS

%	percent
ADERP	Army Defense Environmental Restoration Program
AFFF	aqueous film-forming foam
amsl	above mean sea level
AOPI	area of potential interest
Arcadis	Arcadis U.S., Inc.
Army	United States Army
bgs	below ground surface
C	candidate for listing
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
FARP	Forward Aircraft Refueling Point
FCR	field change report
G1	species critically imperiled globally (typically 1 to 5 occurrences)
G2	species imperiled globally (typically 6 to 20 occurrences)
G5	species possibly extinct
GIS	geographic information system
GW	groundwater
HFPO-DA	hexafluoropropylene oxide dimer acid
HQAES	Headquarters Army Environmental System
IARI	International Archaeological Research Institute, Inc.
IMCOM	Installation Management Command
installation	United States Army or Reserve installation

IRP	Installation Restoration Program
KMC	Kilauea Military Camp
KMR	Kilauea Military Reservation
LE	listed endangered
LOD	limit of detection
LOQ	limit of quantitation
LZ	landing zone
mg/kg	milligrams per kilogram (parts per million)
MIL-SPEC	military specification
ng/L	nanograms per liter (parts per trillion)
OSD	Office of the Secretary of Defense
PA	preliminary assessment
PFAS	per- and polyfluoroalkyl substances
PFBS	perfluorobutanesulfonic acid
PFHxS	perfluorohexane sulfonate
PFNA	perfluorononanoic 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
PRC	PRC Environmental Management, Inc.
PTA	Pohakuloa Training Area
QA	quality assurance
QAPP	Quality Assurance Project Plan
QC	quality control
QSM	Quality Systems Manual
RSL	Regional Screening Level
SI	site inspection
SOP	standard operating procedure

SSHP	Site Safety and Health Plan
T1	subspecies or variety critically imperiled globally (typically 1 to 5 occurrences)
TGI	technical guidance instruction
TLI	TLI Solutions, Inc.
TOC	total organic carbon
U.S.	United States
UCMR3	third Unregulated Contaminant Monitoring Rule
USACE	United States Army Corps of Engineers
USAEC	United States Army Environmental Command
USAG-HI	United States Army Garrison, Hawaii
USEPA	United States Environmental Protection Agency

TABLES

Table 7-1 Soil PFOS, PFOA, PFBS, PFNA, and PFHxS Analytical Results
USAEC PFAS Preliminary Assessment/Site Inspection
Pohakuloa Training Area, Hawaii

Location	Sample/ Parent ID	Sample Date	Analyte	PFOS (mg/kg)		PFOA (mg/kg)		PFHxS (mg/kg)		PFBS (mg/kg)		PFNA (mg/kg)	
			OSD Industrial/Commercial Risk Screening Level	*0.16*		0.25		1.6		25		0.25	
			OSD Residential Risk Screening Level	0.013		0.019		0.13		1.9		0.019	
			Sample Type	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual
PTA-AFFFTA-1-SO	PTA-AFFFTA-1-SO-082721	08/27/2021	N	***0.21***		**0.012**		**0.0056**		0.002	U	**0.0064**	
PTA-AFFFTA-2-SO	PTA-AFFFTA-2-SO-082721	08/27/2021	N	**0.16**		**0.0026**		**0.0026**		0.0021	U	**0.0016**	
PTA-AFFFTA-3-SO	PTA-AFFFTA-3-SO-082721	08/27/2021	N	***1.4***		**0.0065**		**0.011**		0.0026	U	**0.0031**	
PTA-AFFFTA-4-SO	PTA-AFFFTA-4-SO-082721	08/27/2021	N	***1.1***		**0.013**		**0.05**		0.002	U	**0.0037**	
PTA-BLDG39-1-SO	PTA-BLDG39-1-SO-082921	08/29/2021	N	***1.6***		**0.095**		**0.14**		**0.005**		**0.0043**	
PTA-BLDG39-2-SO	PTA-BLDG39-2-SO-082921	08/29/2021	N	***0.23***		**0.0078**		**0.11**		**0.0034**		0.00065	U
PTA-BLDG39-3-SO	PTA-BLDG39-3-SO-083021	08/30/2021	N	***1.1***		**0.061**		**0.3**		**0.18**		**0.0005**	J
PTA-BLDG39-4-SO	PTA-BLDG39-4-SO-083021	08/30/2021	N	***1.3***		**0.0022**		**0.0082**		0.002	U	**0.0016**	
PTA-BLDG39-5-SO	PTA-BLDG39-5-SO-083021	08/30/2021	N	***1.4***		**0.032**		**0.026**		0.002	U	**0.012**	
PTA-BLDG39-6-SO	PTA-BLDG39-6-SO-3.0-083021	08/30/2021	N	***1.7***		**0.0034**		**0.018**		0.0022	U	**0.00087**	
PTA-BLDG390-1-SO	PTA-BLDG390-1-SO-082921	08/29/2021	N	***0.73***		**0.021**		**0.067**		0.0022	U	**0.0012**	
PTA-BLDG390-2-SO	PTA-BLDG390-2-SO-082921	08/29/2021	N	**0.02**		**0.0017**		**0.0012**		0.002	U	**0.00039**	J
PTA-BLDG390-3-SO	PTA-BLDG390-3-SO-082821	08/28/2021	N	**0.054**		**0.0057**		**0.0098**		0.002	U	**0.0024**	
PTA-BLDG390-4-SO	PTA-BLDG390-4-SO-082821	08/28/2021	N	**0.022**		**0.0042**		**0.0016**		0.0021	U	**0.0017**	
	PTA-FD-1-SO-082821 / PTA-BLDG390-4-SO-082821	08/28/2021	FD	**0.056**		**0.0082**		**0.014**		0.0021	U	**0.0028**	
PTA-BAAFR-1-SO	PTA-BAAFR-1-SO-083121	08/31/2021	N	**0.0073**		**0.0065**		0.00057	U	0.0019	U	**0.0074**	
PTA-BAAFR-2-SO	PTA-BAAFR-2-SO-083121	08/31/2021	N	**0.0097**		**0.025**		**0.00052**	J	0.0021	U	**0.0053**	
PTA-BAAFR-3-SO	PTA-BAAFR-3-SO-083121	08/31/2021	N	**0.015**		**0.041**		**0.0017**		0.002	U	**0.0049**	
PTA-BAAFR-4-SO	PTA-BAAFR-4-SO-083121	08/31/2021	N	**0.00075**		**0.00059**		0.00058	U	0.0021	U	0.00058	U
	PTA-FD-2-SO-083121 / PTA-BAAFR-4-SO-083121	08/31/2021	FD	**0.0011**		**0.00088**		0.00059	U	0.002	U	**0.00044**	J
PTA-BAAFR-5-SO	PTA-BAAFR-5-SO-083121	08/31/2021	N	**0.00095**		**0.00061**		0.0006	U	0.002	U	0.0006	U
PTA-BAAFR-6-SO	PTA-BAAFR-6-SO-083121	08/31/2021	N	**0.0051**		**0.0022**		**0.0016**		0.0019	U	**0.00046**	J
PTA-FFTP-1-SO	PTA-FFTP-1-SO-082821	08/28/2021	N	**0.067**		**0.014**		**0.0049**		0.0021	U	**0.0056**	
PTA-FFTP-2-SO	PTA-FFTP-2-SO-082821	08/28/2021	N	**0.16**		**0.011**		**0.0013**		0.0021	U	**0.013**	
PTA-FFTP-3-SO	PTA-FFTP-3-SO-0.75-082821	08/28/2021	N	**0.025**		**0.0056**		**0.0059**		0.002	U	**0.0015**	
PTA-FFTP-4-SO	PTA-FFTP-4-SO-082821	08/28/2021	N	***0.5***		**0.03**		**0.076**		0.002	U	**0.0088**	
PTA-FFTP-5-SO	PTA-FFTP-5-SO-082821	08/28/2021	N	***0.3***		**0.011**		**0.011**		0.002	U	**0.0066**	
	PTA-FFTP-5-SO-4.0-083021	08/30/2021	N	**0.13**		**0.0034**		**0.018**		0.0021	U	**0.0023**	
PTA-LZR-1-SO	PTA-LZR-1-SO-083121	08/31/2021	N	0.00059	U	0.00059	U	0.00059	U	0.002	U	0.00059	U
PTA-LZR-2-SO	PTA-LZR-2-SO-083121	08/31/2021	N	0.00055	U	0.00055	U	0.00055	U	0.0018	U	0.00055	U
PTA-LZR-3-SO	PTA-LZR-3-SO-083121	08/31/2021	N	0.00055	U	0.00055	U	0.00055	U	0.0018	U	0.00055	U
PTA-LZR-4-SO	PTA-LZR-4-SO-083121	08/31/2021	N	0.00058	U	0.00058	U	0.00058	U	0.0019	U	0.00058	U

Table 7-1 Soil PFOS, PFOA, PFBS, PFNA, and PFHxS Analytical Results
USAEC PFAS Preliminary Assessment/Site Inspection
Pohakuloa Training Area, Hawaii

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. 2022. Memorandum: Investigating Per- and Polyfluoroalkyl Substances within the Department of Defense Cleanup Program. July).
3. Gray shaded values indicate the result was detected greater than the residential scenario risk screening levels (OSD 2022).
4. Gray shaded and italicized values indicate the result was detected greater than the industrial/commercial scenario (i.e., and therefore greater than the residential scenario) risk screening levels (OSD 2022).

Acronyms/Abbreviations:
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
PFNA = perfluorononanoic acid
PFHxS = perfluorohexane sulfonate
Qual = qualifier

Qualifiers:

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 thelimit of quantitation (LOQ).

Table 7-2 Soil PFOS, PFOA, PFBS, PFNA, and PFHxS Analytical Results
USAEC PFAS Preliminary Assessment/Site Inspection
Kilauea Military Resevation, Hawaii

Location	Sample/ Duplicate ID	Sample Date	Analyte	PFOS (mg/kg)		PFOA (mg/kg)		PFBS (mg/kg)		PFNA (mg/kg)		PFHxS (mg/kg)	
			OSD Industrial/Commercial Risk Screening Level	0.16		0.25		25		0.25		1.6	
			OSD Residential Risk Screening Level	0.013		0.019		1.9		0.019		0.13	
			Sample Type	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual
KMC-BLD43-1-SO	KMC-BLD43-1-SO-121222	12/12/2022	N	**0.002**		**0.00011**	J	0.00024	U	**0.00027**		**0.00014**	J
KMC-BLD43-2-SO	KMC-BLD43-2-SO-121322	12/13/2022	N	**0.0052**		**0.00025**	J	0.00026	U	**0.00012**	J	**0.00046**	
KMC-BLD43-3-SO	KMC-BLD43-3-SO-121222	12/12/2022	N	**0.012**		**0.00054**		0.00021	U	**0.00011**	J	**0.00094**	
KMC-BLD59-1-SO	KMC-BLD59-1-SO-121322	12/13/2022	N	**0.02**		**0.00079**		0.00023	U	**0.0006**		**0.00033**	
KMC-BLD59-2-SO	KMC-BLD59-2-SO-121322 / KMC-FD-1-SO-121322	12/13/2022	N	**0.051**		**0.0016**		**0.000053**	J	**0.001**		**0.00061**	
		12/13/2022	FD	**0.057**		**0.0018**		0.0002	U	**0.0011**		**0.00057**	
KMC-BLD59-3-SO	KMC-BLD59-3-SO-121222	12/12/2022	N	0.00033	U	**0.00015**	J	0.00022	U	**0.000074**	J	**0.000072**	J

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. 2022. Memorandum: Investigating Per- and Polyfluoroalkyl Substances within the Department of Defense Cleanup Program. July).
3. Gray shaded values indicate the result was detected greater than the residential scenario risk screening levels (OSD 2022).
4. At the time of the SI, KMR was referred to as Kilauea Military Camp (KMC); as such, the sample IDs from the SI retain the “KMC” acronym to be consistent with the analytical reports. It was later requested by USAEC that the installation name be updated to Kilauea Military Reservation (KMR) to be consistent with already existing documents in HQAES.

Acronyms/Abbreviations:
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
PFNA = perfluorononanoic acid
PFHxS = perfluorohexane sulfonate
Qual = qualifier

Qualifiers:
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 thelimit of quantitation (LOQ).

Table 7-3 Sediment PFOS, PFOA, PFBS, PFNA, and PFHxS Analytical Results
USAEC PFAS Preliminary Assessment/Site Inspection
Kilauea Military Reservation, Hawaii

Location	Sample/ Duplicate ID	Sample Date	Analyte	PFOS (mg/kg)		PFOA (mg/kg)		PFBS (mg/kg)		PFNA (mg/kg)		PFHxS (mg/kg)	
			OSD Industrial/Commercial Risk Screening Level	0.16		0.25		25		0.25		1.6	
			OSD Residential Risk Screening Level	0.013		0.019		1.9		0.019		0.13	
			Sample Type	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual
KMC-BLD59-4-SE	KMC-BLD59-4-SE-121322 / KMC-FD-1-SE-121322	12/13/2022	N	0.0014	U	**0.00028**	J	0.00096	U	**0.00019**	J	0.00096	U
		12/13/2022	FD	0.00072	U	0.00072	U	0.00048	U	**0.000084**	J	0.00048	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. 2022. Memorandum: Investigating Per- and Polyfluoroalkyl Substances within the Department of Defense Cleanup Program. July).
3. At the time of the SI, KMR was referred to as Kilauea Military Camp (KMC); as such, the sample IDs from the SI retain the “KMC” acronym to be consistent with the analytical reports. It was later requested by USAEC that the installation name be updated to Kilauea Military Reservation (KMR) to be consistent with already existing documents in HQAES

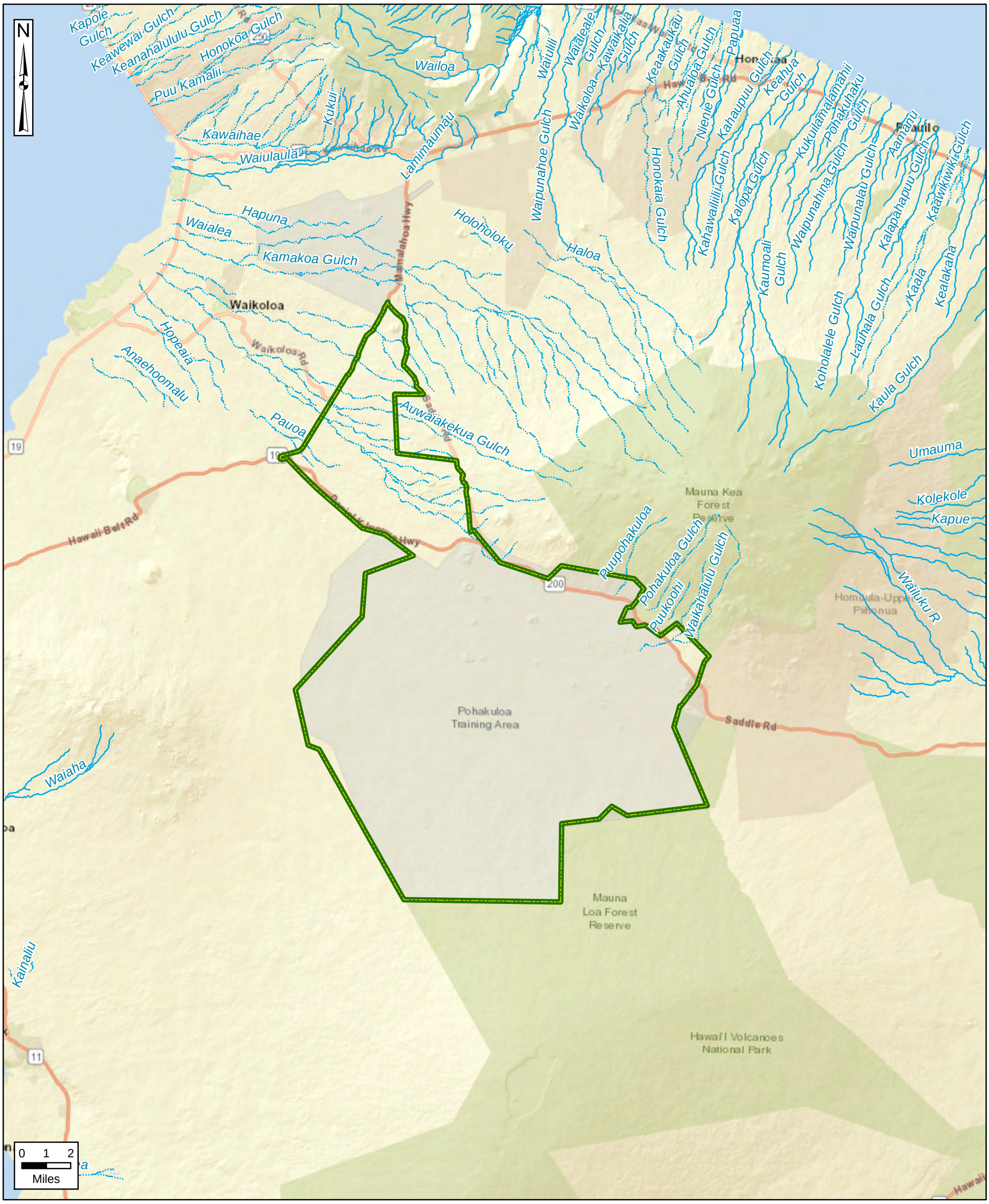
Acronyms/Abbreviations:
FD = field duplicate sample
ID = identification
mg/kg = milligrams per kilogram (parts per million)
N = primary sample
PFAS = per- and polyfluoroalkyl substances
PFBS = perfluorobutanesulfonic acid
PFOA = perfluorooctanoic acid
PFOS = perfluorooctane sulfonate
PFNA = perfluorononanoic acid
PFHxS = perfluorohexane sulfonate
Qual = qualifier

Qualifiers:
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
Pohakuloa Training Area and Kilauea Military Reservation, Hawaii

Figure 2-1
PTA Site Location



Installation Boundary

River/Stream (Perennial)

Stream (Intermittent)

PTA = Pohakuloa Training Area

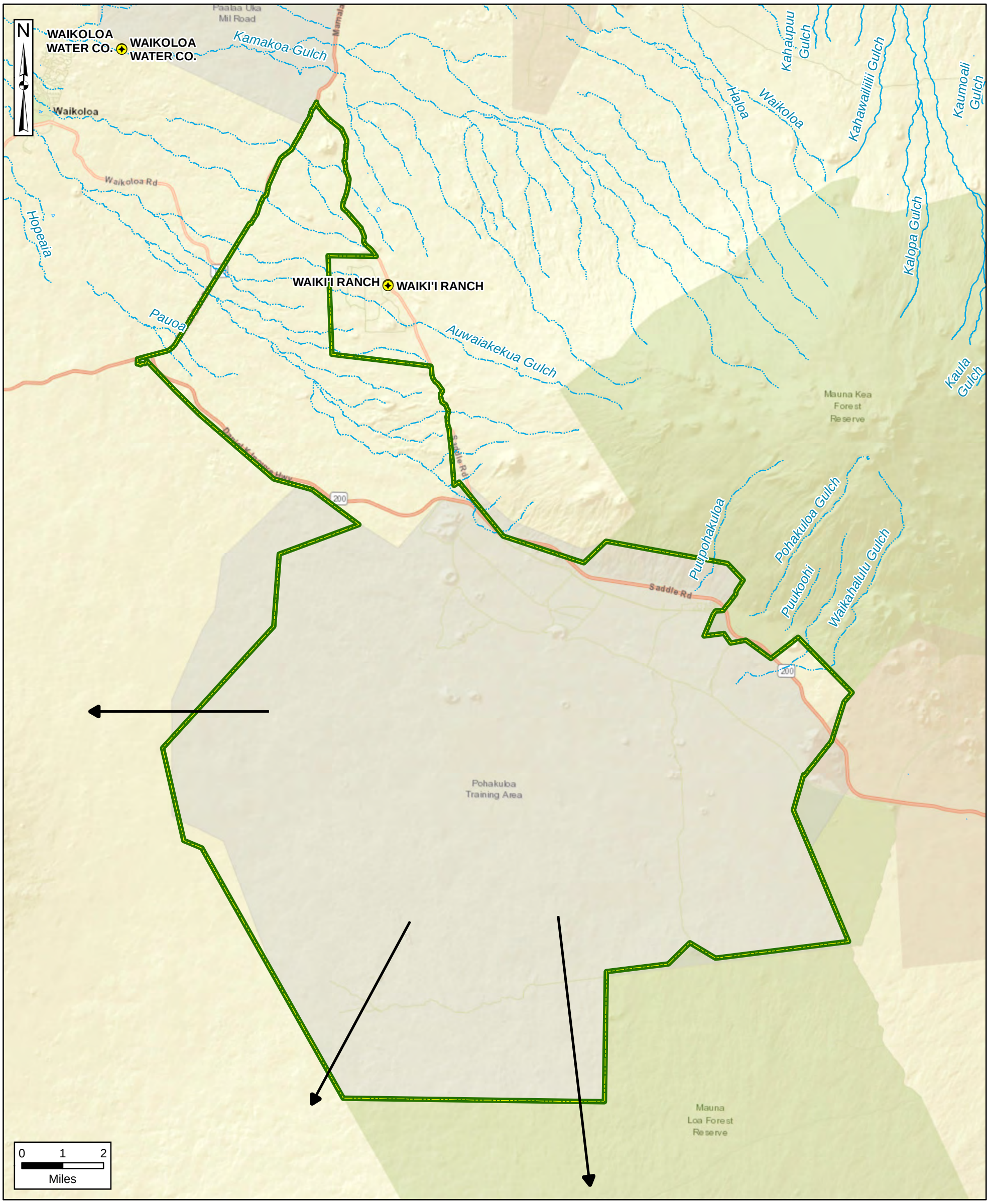
Data Sources:
HI State GIS, Rivers/Streams, 2018
ESRI, ArcGIS Online, StreetMap Data

Coordinate System:
WGS 1984, UTM Zone 5 North

USAEC PFAS Preliminary Assessment / Site Inspection
Pohakuloa Training Area and Kilauea Military Reservation, Hawaii

ARCADIS

Figure 2-2
PTA Site Layout



Installation Boundary
River/Stream (Perennial)
Stream (Intermittent)
Assumed Groundwater Flow Direction
Public Water Supply System Well

PTA = Pohakuloa Training Area

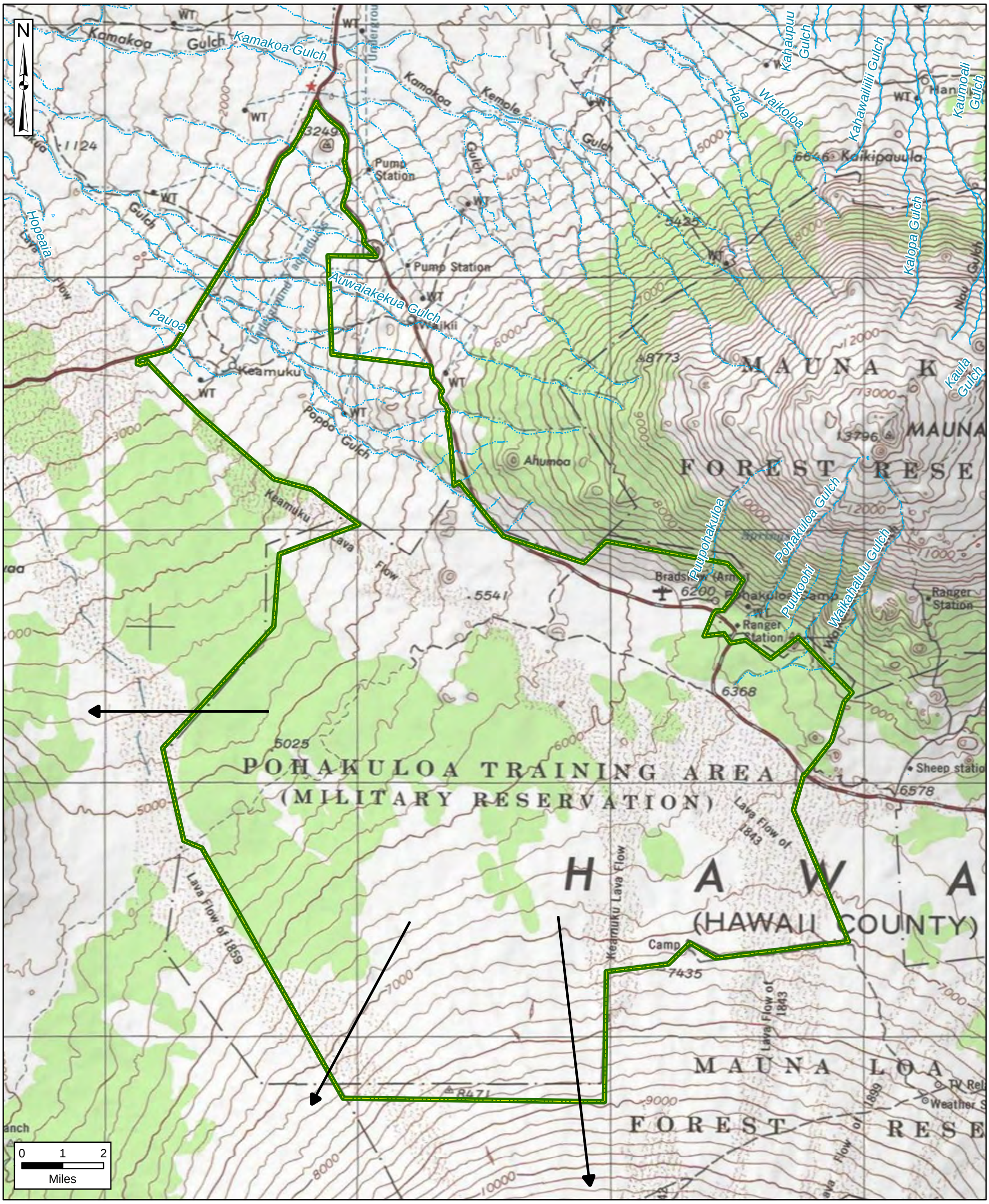
Data Sources:
HI State GIS, Rivers/Streams, 2018
EDR, Well Data, 2019
ESRI, ArcGIS Online, StreetMap Data

Coordinate System:
WGS 1984, UTM Zone 5 North

USAEC PFAS Preliminary Assessment / Site Inspection
Pohakuloa Training Area and Kilauea Military Reservation, Hawaii

ARCADIS

Figure 2-3
PTA Topographic Map



Installation Boundary
River/Stream (Perennial)
Stream (Intermittent)
Assumed Groundwater Flow Direction

Notes:
1) Contour labels are in feet.
2) There is limited information regarding the direction of groundwater flow at PTA. In general, groundwater moves southwest downgradient toward the sea and discharges at or near the coast (PRC Environmental Management, 1997).

PTA = Pohakuloa Training Area

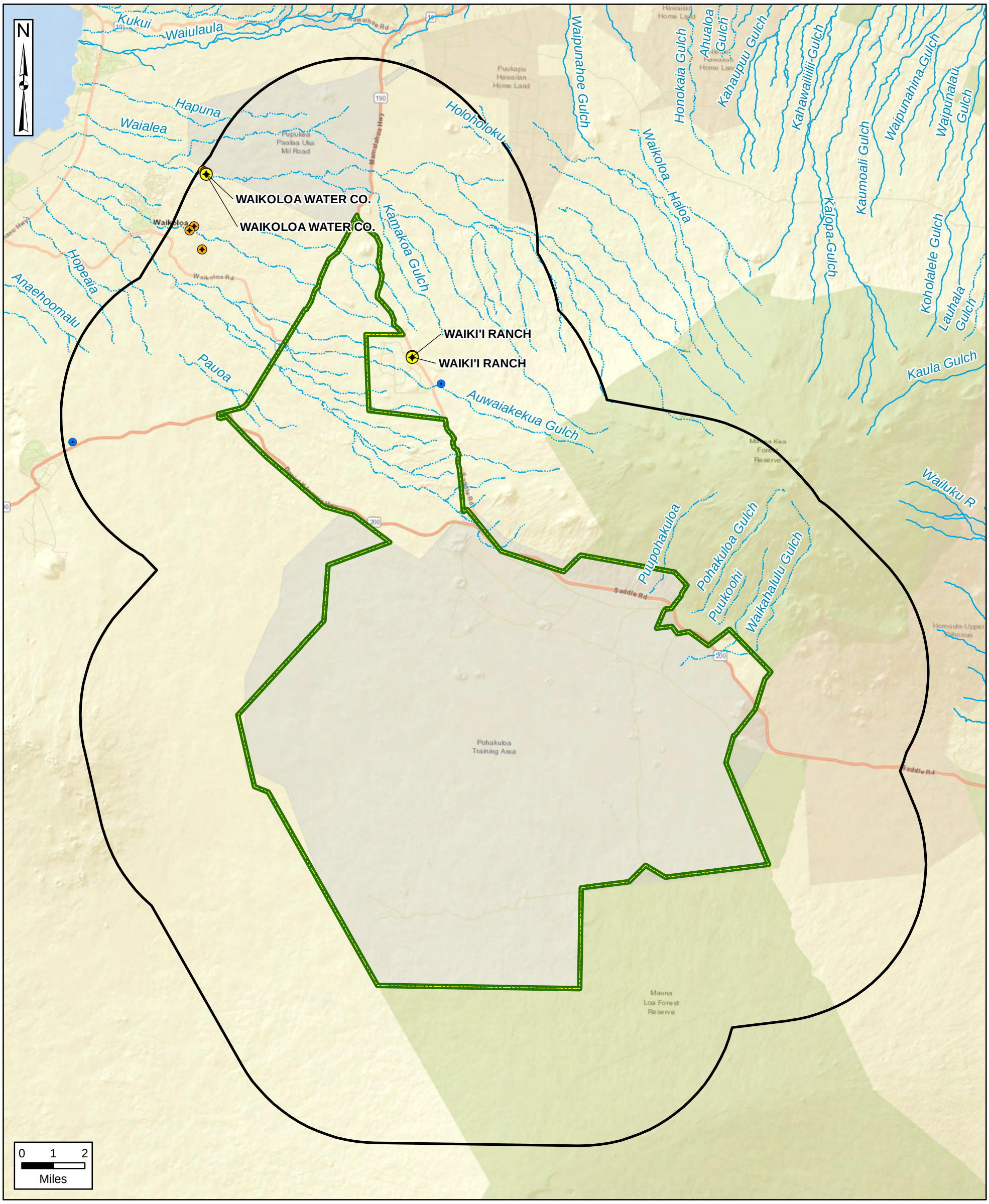
Data Sources:
HI State GIS, Rivers/Streams, 2018
ESRI, ArcGIS Online, USA Topo Maps

Coordinate System:
WGS 1984, UTM Zone 5 North

USAEC PFAS Preliminary Assessment / Site Inspection
Pohakuloa Training Area and Kilauea Military Reservation, Hawaii

ARCADIS

Figure 2-4
PTA Off-Post Potable Supply Wells



Installation Boundary
5-Mile Radius
River/Stream (Perennial)
Stream (Intermittent)

Public Water Supply System Well
Other Public Supply Well
Other Designated Use Water Well

Note: Public Water Supply System Well data from the Federal Reporting Data System and includes water systems that provide water to at least 25 people for at least 60 days annually. Other Designated Use Water Wells includes irrigation wells and wells of unknown use.

PTA = Pohakuloa Training Area

Data Sources:
EDR, Well Data, 2018
HI State GIS, Rivers/Streams, 2018
ESRI, ArcGIS Online, StreetMap Data

Coordinate System:
WGS 1984, UTM Zone 5 North

USAEC PFAS Preliminary Assessment / Site Inspection
Pohakuloa Training Area and Kilauea Military Reservation, Hawaii

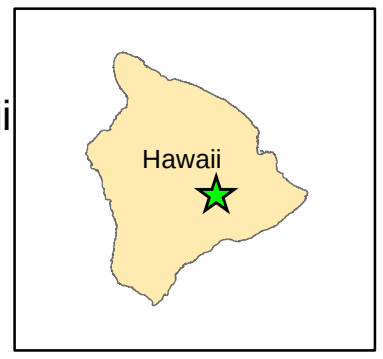
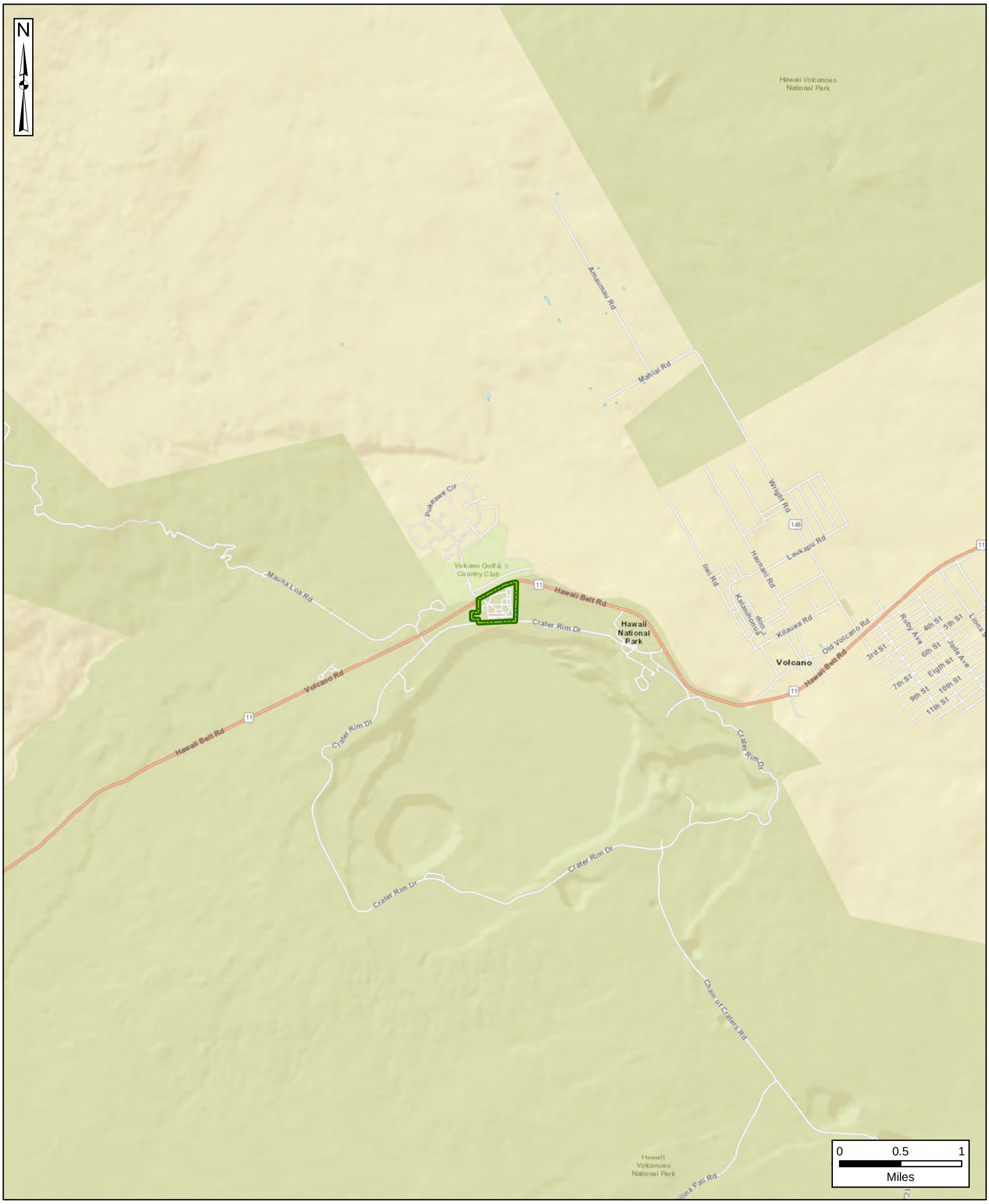


Figure 2-5
KMR Site Location



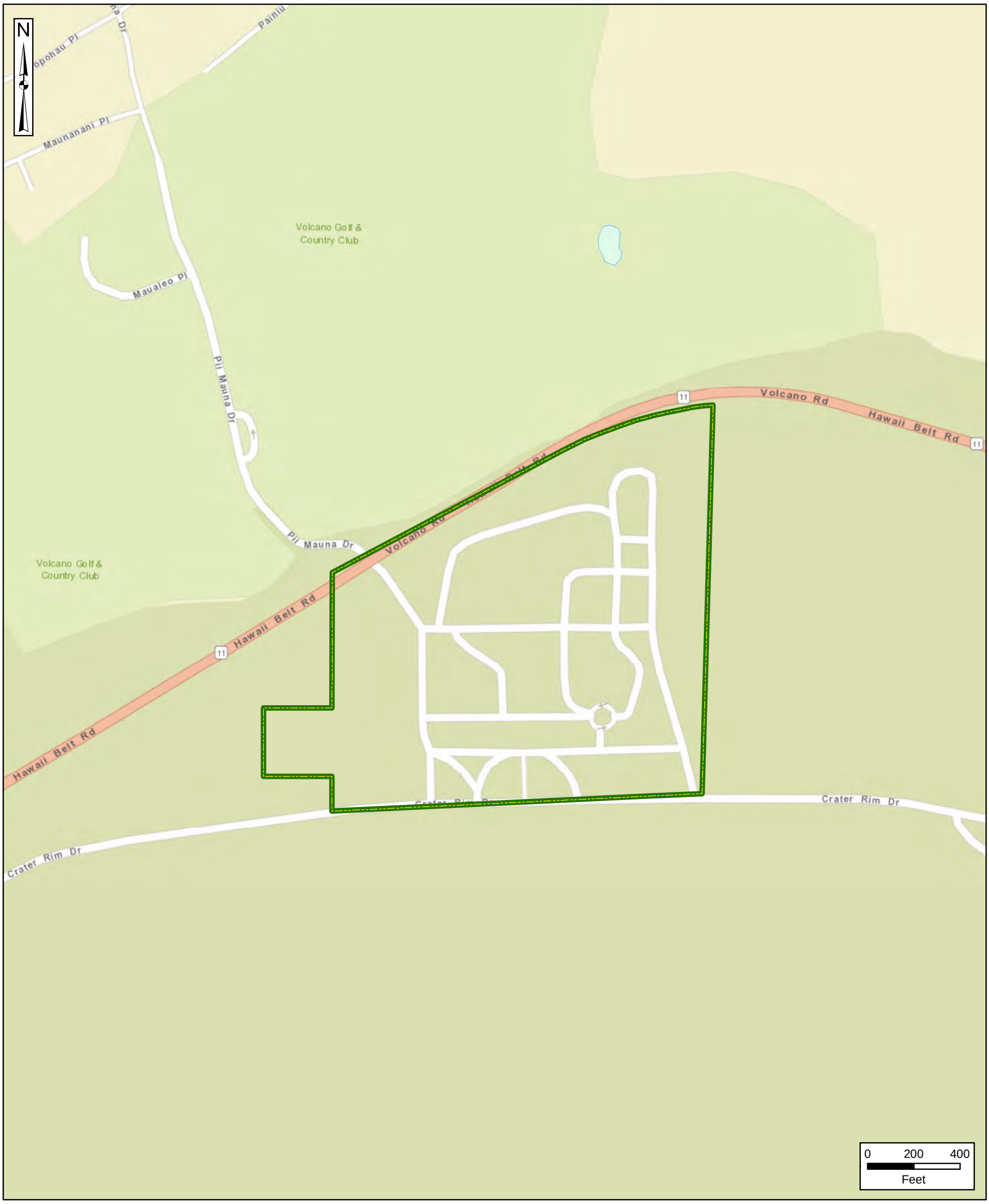
Installation Boundary

KMR = Kilauea Military Reservation

Data Sources:
ESRI, ArcGIS Online, StreetMap Data

Coordinate System:
WGS 1984, UTM Zone 5 North

Figure 2-6
KMR Site Layout



Installation Boundary

Water Body

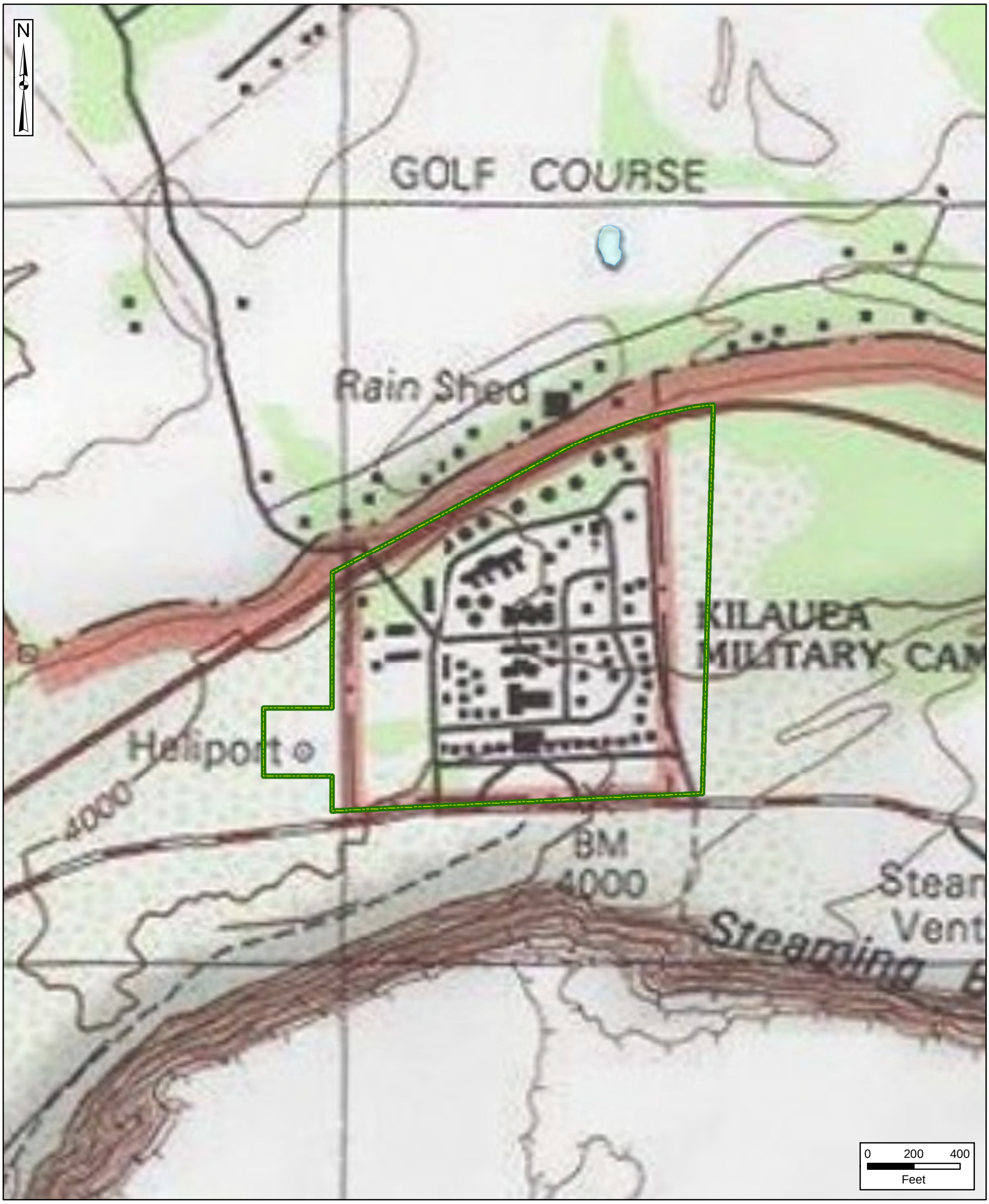
KMR = Kilauea Military Reservation

Data Sources:
ESRI, ArcGIS Online, StreetMap Data

Coordinate System:
WGS 1984, UTM Zone 5 North

ARCADIS

Figure 2-7
KMR Topographic Map



Installation Boundary

Water Body

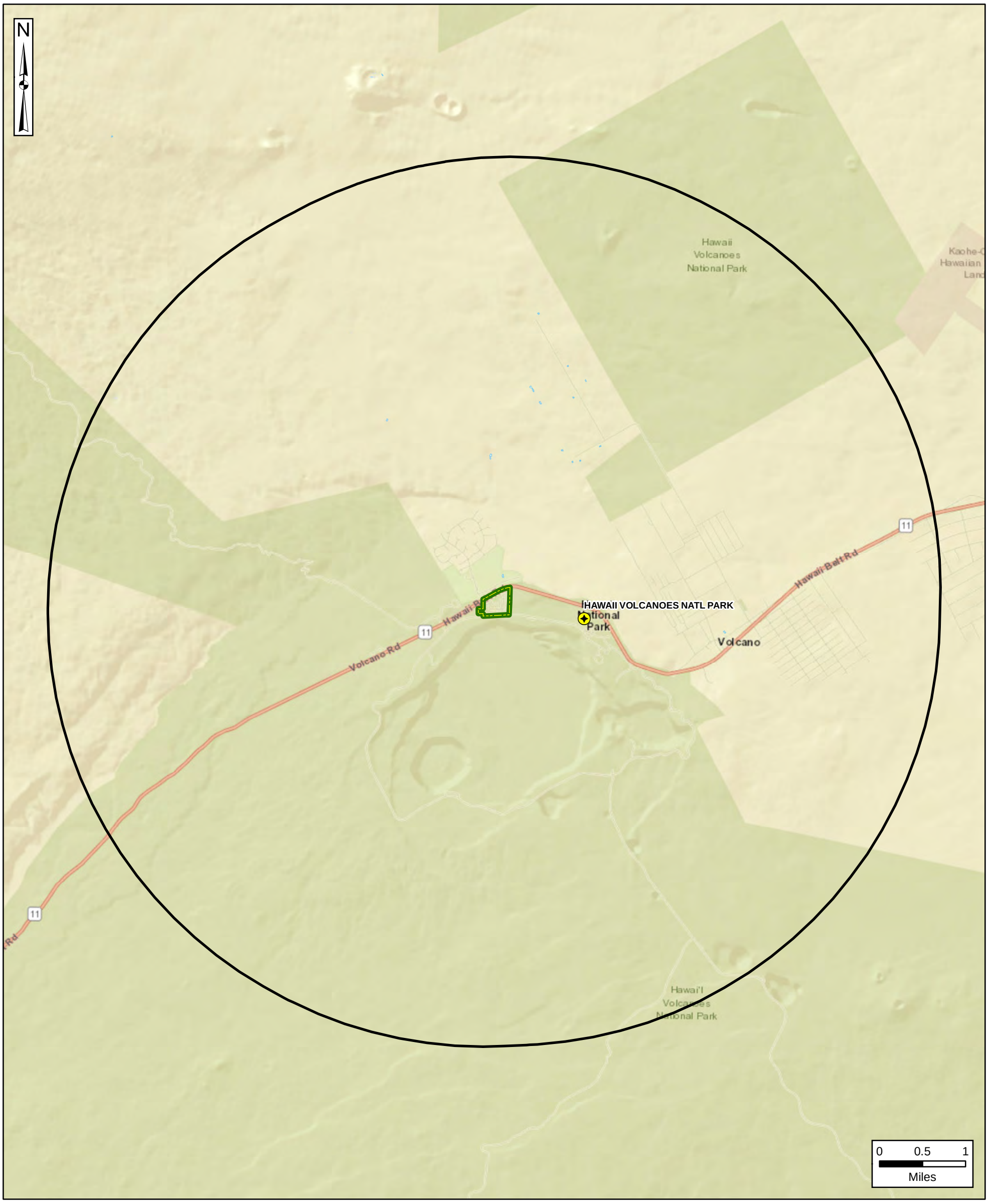
KMR = Kilauea Military Reservation

Data Sources:
ESRI, ArcGIS Online, USA Topo Maps

Note: Contour labels are in feet.

Coordinate System:
WGS 1984, UTM Zone 5 North

Figure 2-8
KMR Off-Post Potable Supply Wells



Installation Boundary

Public Water Supply System Well

Note: Public Water Supply System Well data from the Federal Reporting Data System and includes water systems that provide water to at least 25 people for at least 60 days annually.

KMR = Kilauea Military Reservation

Data Sources:
EDR, Well Data, 2018
ESRI, ArcGIS Online, StreetMap Data

Coordinate System:
WGS 1984, UTM Zone 5 North

USAEC PFAS Preliminary Assessment / Site Inspection
Pohakuloa Training Area and Kilauea Military Reservation, Hawaii

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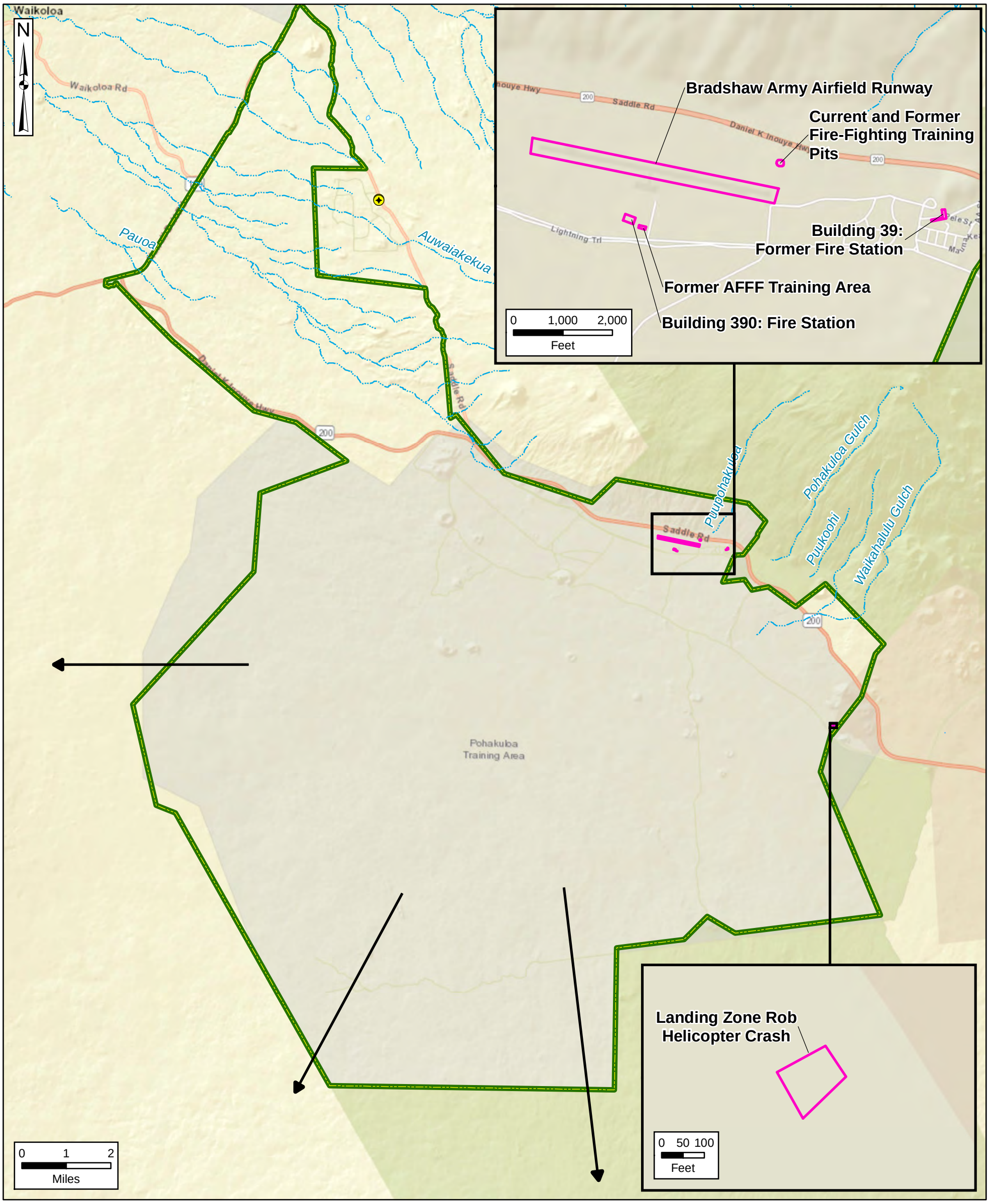
Figure 5-2
PTA AOPI Locations



Installation Boundary
AOPI
Stream (Intermittent)
Assumed Groundwater Flow Direction
Public Water Supply System Well

AFFF = aqueous film-forming foam
AOPI = area of potential interest
PTA = Pohakuloa Training Area

Data Sources:
HI State GIS, Rivers/Streams, 2018
EDR, Well Data, 2019
ESRI, ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 5 North

USAEC PFAS Preliminary Assessment / Site Inspection
Pohakuloa Training Area and Kilauea Military Reservation, Hawaii

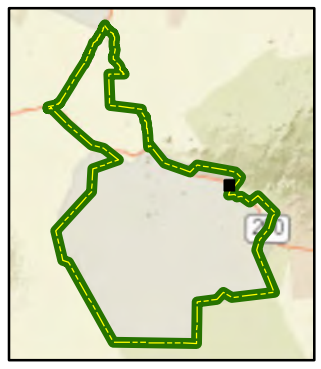
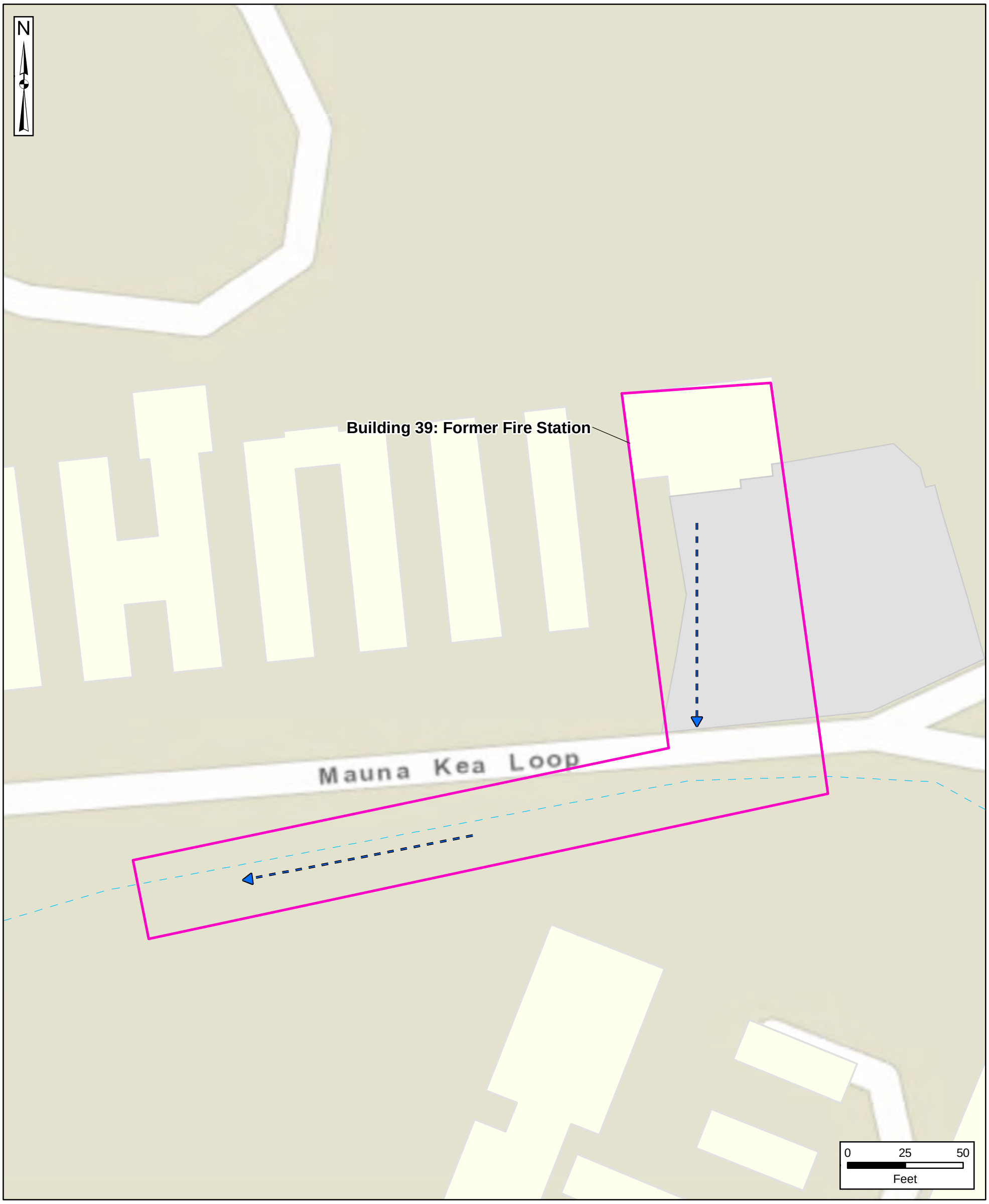


Figure 5-3
Building 39: Former Fire Station



Installation Boundary
AOPI
Stormwater/Surface Runoff Flow Direction
Drainage Ditch

AOPI = area of potential interest

Data Sources:
ESRI, ArcGIS Online, StreetMap Data

Coordinate System:
WGS 1984, UTM Zone 5 North

USAEC PFAS Preliminary Assessment / Site Inspection
Pohakuloa Training Area and Kilauea Military Reservation, Hawaii

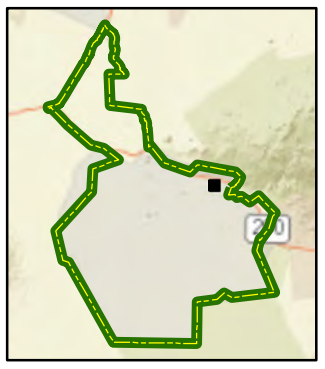


Figure 5-4
Building 390: Fire Station

Installation Boundary

AOPI

Drainage Ditch

Stormwater/Surface Runoff Flow Direction

AOPI = area of potential interest

Data Sources:
ESRI, ArcGIS Online, StreetMap Data

Coordinate System:
WGS 1984, UTM Zone 5 North

USAEC PFAS Preliminary Assessment / Site Inspection
Pohakuloa Training Area and Kilauea Military Reservation, Hawaii

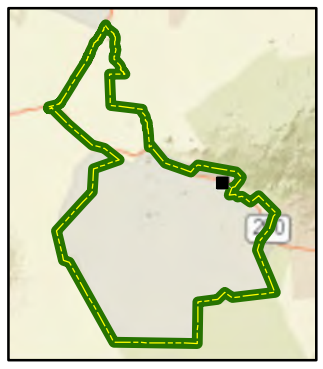
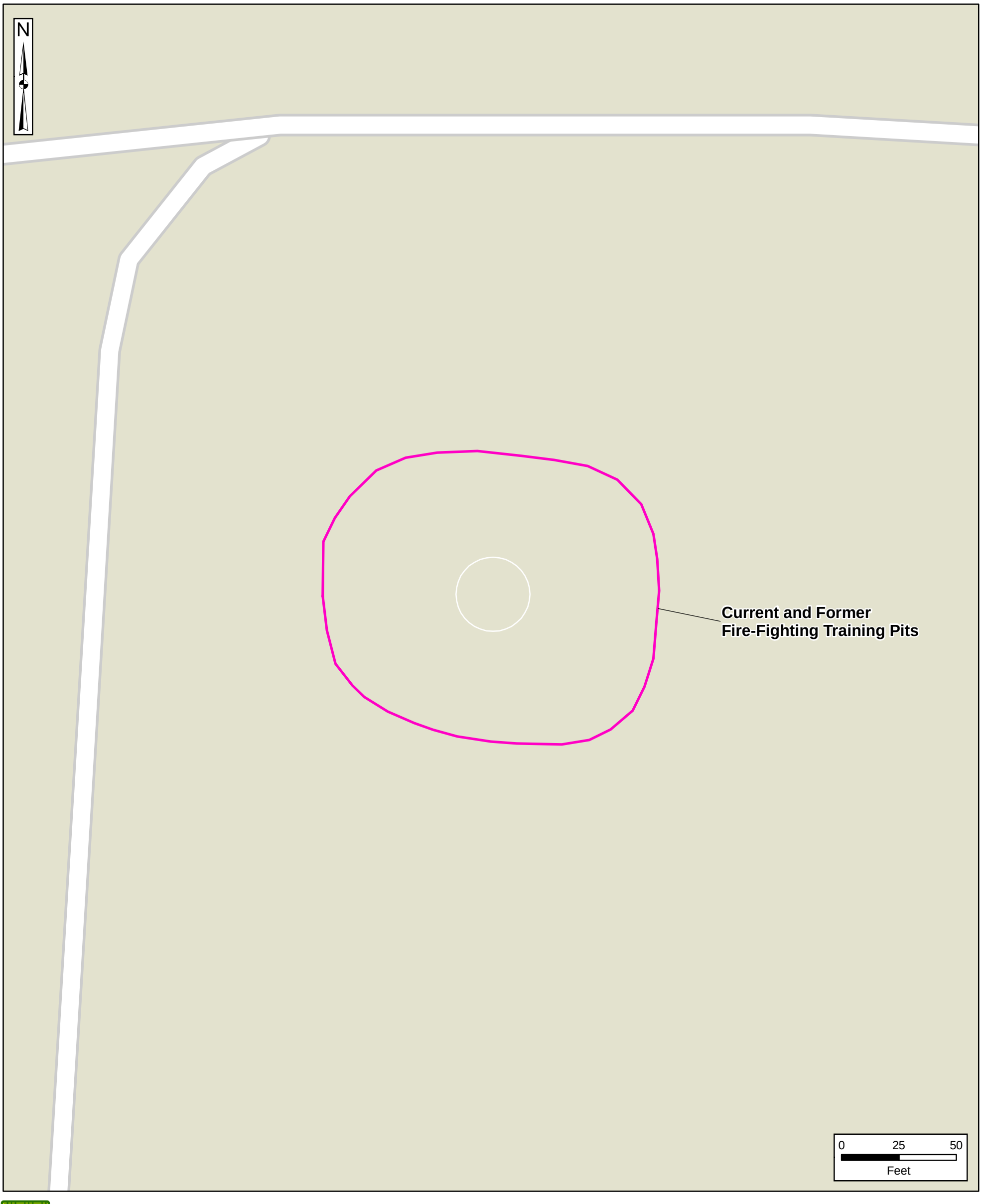


Figure 5-5
Current and Former Fire-Fighting Training Pits



Installation Boundary

AOPI

AOPI = area of potential interest

Data Sources:
ESRI, ArcGIS Online, StreetMap Data

Coordinate System:
WGS 1984, UTM Zone 5 North

USAEC PFAS Preliminary Assessment / Site Inspection
Pohakuloa Training Area and Kilauea Military Reservation, Hawaii

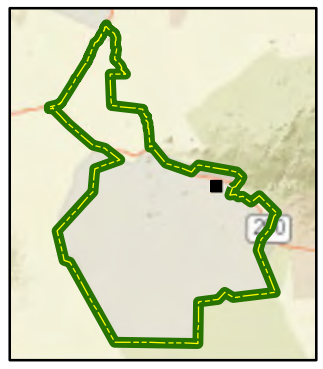


Figure 5-6
Former AFFF Training Area

Installation Boundary
AOPI
Drainage Ditch
Stormwater/Surface Runoff Flow Direction

AFFF = aqueous film-forming foam
AOPI = area of potential interest

Data Sources:
ESRI, ArcGIS Online, StreetMap Data

Coordinate System:
WGS 1984, UTM Zone 5 North

USAEC PFAS Preliminary Assessment / Site Inspection
Pohakuloa Training Area and Kilauea Military Reservation, Hawaii

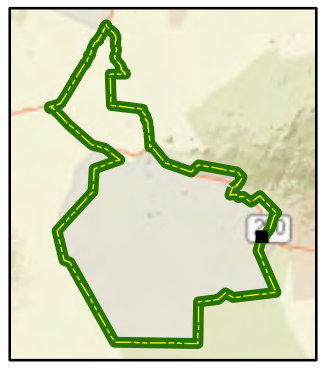


Figure 5-7
Landing Zone Rob Helicopter Crash

Installation Boundary

AOPI

AOPI = area of potential interest

Data Sources:
ESRI, ArcGIS Online, StreetMap Data

Coordinate System:
WGS 1984, UTM Zone 5 North

USAEC PFAS Preliminary Assessment / Site Inspection
Pohakuloa Training Area and Kilauea Military Reservation, Hawaii

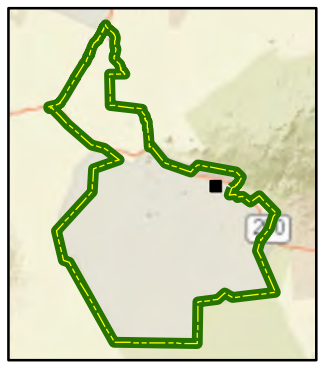


Figure 5-8
Bradshaw Army Airfield Runway

Installation Boundary

AOPI

Stormwater/Surface Runoff Flow Direction

AOPI = area of potential interest

Data Sources:
ESRI, ArcGIS Online, StreetMap Data

Coordinate System:
WGS 1984, UTM Zone 5 North

Figure 5-9
KMR AOPI Locations

Installation Boundary

AOPI

Water Body

AOPI = area of potential interest
KMR = Kilauea Military Reservation

Data Sources:
EDR, Well Data, 2018
ESRI, ArcGIS Online, StreetMap Data

Coordinate System:
WGS 1984, UTM Zone 5 North

USAEC PFAS Preliminary Assessment / Site Inspection
Pohakuloa Training Area and Kilauea Military Reservation, Hawaii

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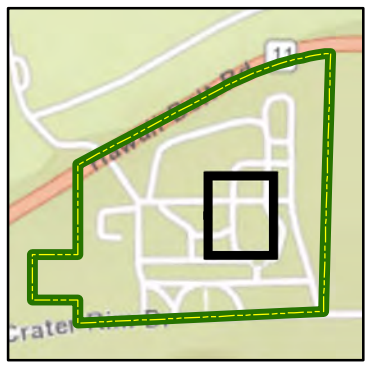
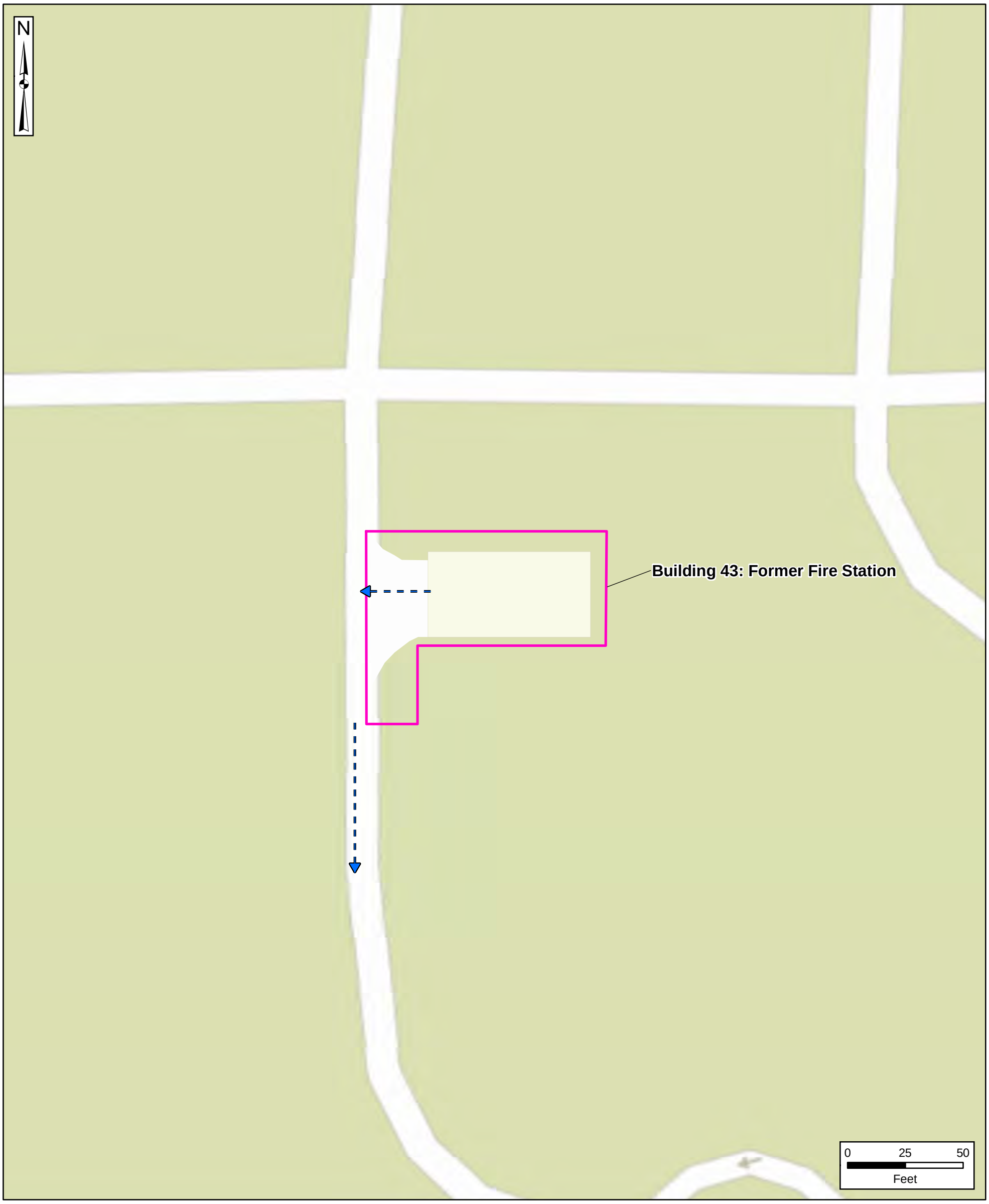


Figure 5-10
Building 43: Former Fire Station



Installation Boundary

AOPI

Stormwater/Surface Runoff Flow Direction

AOPI = area of potential interest

Data Sources:
ESRI, ArcGIS Online, StreetMap Data

Coordinate System:
WGS 1984, UTM Zone 5 North

USAEC PFAS Preliminary Assessment / Site Inspection
Pohakuloa Training Area and Kilauea Military Reservation, Hawaii

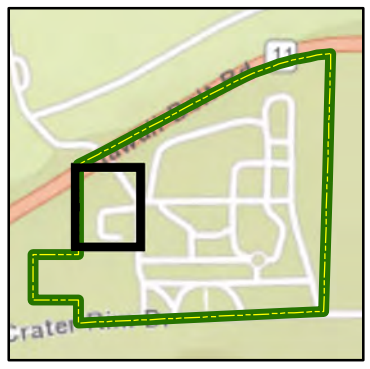
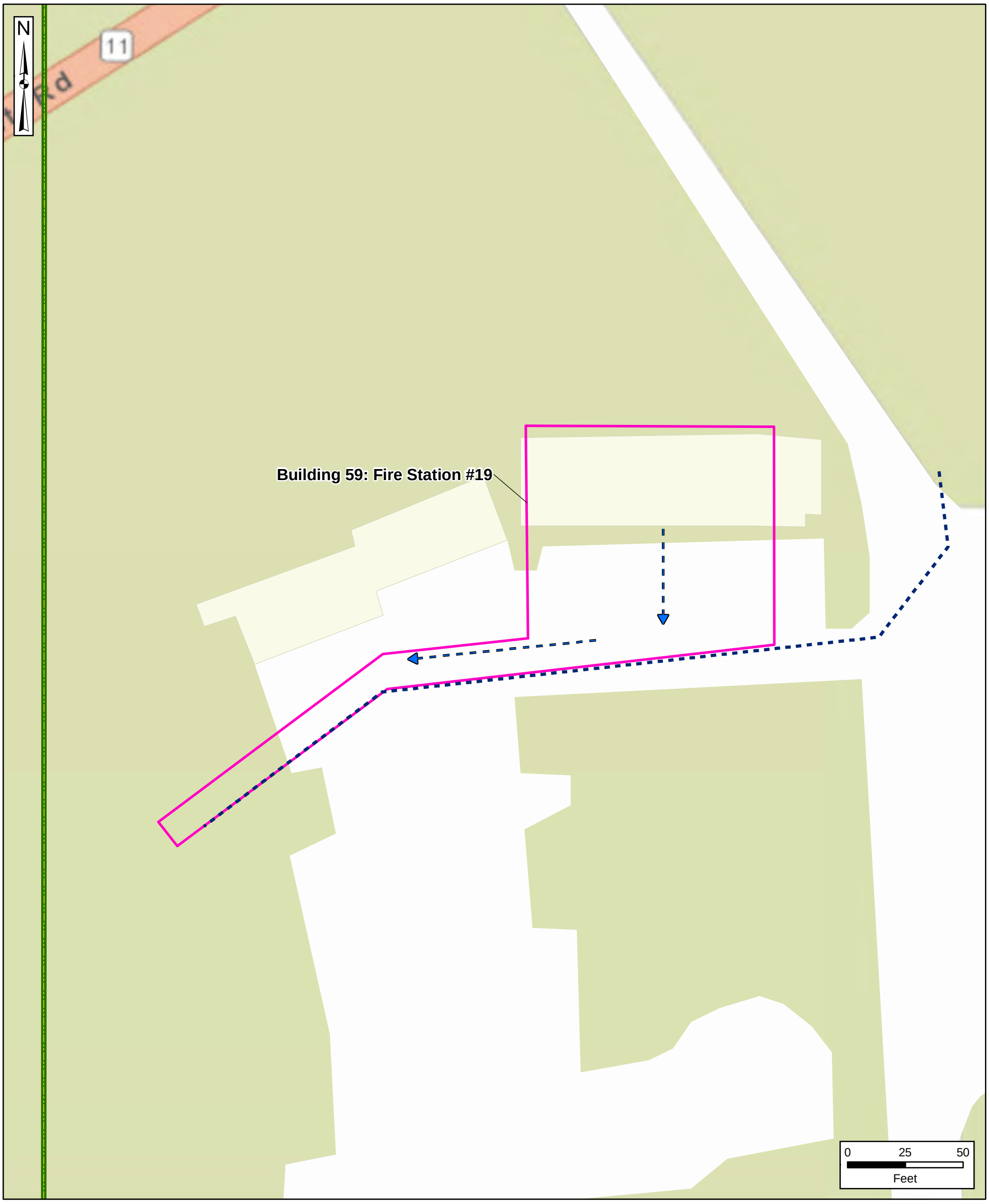


Figure 5-11
Building 59: Fire Station #19



Installation Boundary
AOPI
Covered Drain
Stormwater Flow Direction

AOPI = area of potential interest

Data Sources:
ESRI, ArcGIS Online, StreetMap Data

Coordinate System:
WGS 1984, UTM Zone 5 North

USAEC PFAS Preliminary Assessment / Site Inspection
Pohakuloa Training Area and Kilauea Military Reservation, Hawaii

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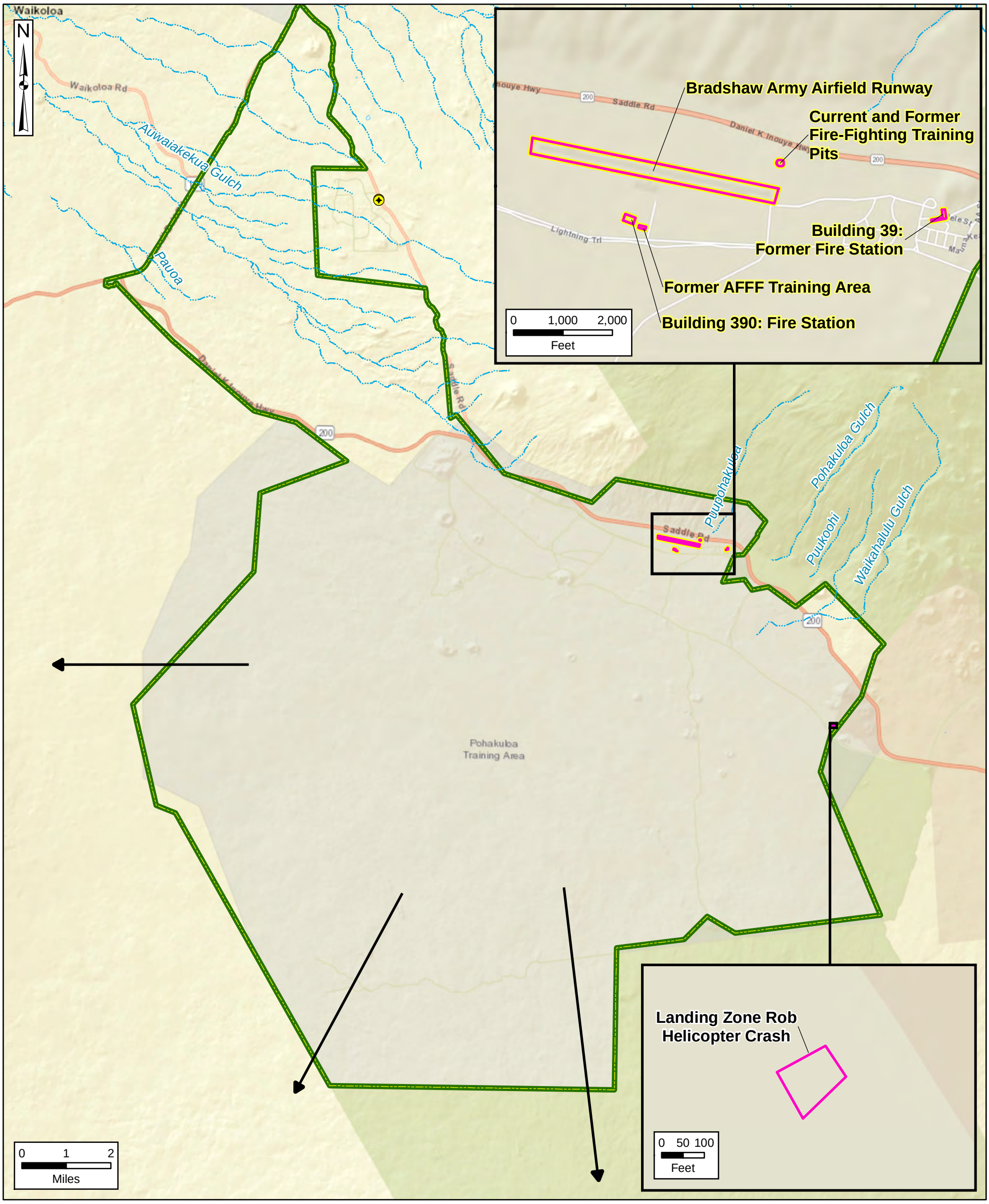
Figure 7-1
PTA AOPI Locations and
OSD Risk Screening Level Exceedances



Installation Boundary
AOPI
AOPI with OSD Risk Screening Level Exceedance
Stream (Intermittent)
Assumed Groundwater Flow Direction
Public Water Supply System Well

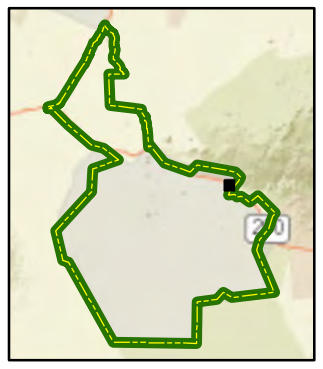
AFFF = aqueous film-forming foam
AOPI = area of potential interest
OSD = Office of the Secretary or Defense
PTA = Pohakuloa Training Area

Data Sources:
HI State GIS, Rivers/Streams, 2018
EDR, Well Data, 2019
ESRI, ArcGIS Online, StreetMap Data

Coordinate System:
WGS 1984, UTM Zone 5 North

USAEC PFAS Preliminary Assessment / Site Inspection
Pohakuloa Training Area and Kilauea Military Reservation, Hawaii

Figure 7-2
Building 39: Former Fire Station
PFOS, PFOA, PFBS, PFNA, and PFHxS Analytical Results



Chemical	Residential Scenario Risk Screening Level	Industrial/Commercial Scenario Risk Screening Level
	Soil (mg/kg)	Soil (mg/kg)
PFOS	0.013	0.16
PFOA	0.019	0.25
PFBS	1.9	25
PFNA	0.019	0.25
PFHxS	0.13	1.6

PTA-BLDG39-1-SO	
Date	8/29/2021
Depth	0.33-1.2 ft
PFOS	***1.6***
PFOA	**0.095**
PFBS	**0.0050**
PFNA	**0.0043**
PFHxS	**0.14**

PTA-BLDG39-5-SO	
Date	8/30/2021
Depth	0-2 ft
PFOS	***1.4***
PFOA	**0.032**
PFBS	0.0020 U
PFNA	**0.012**
PFHxS	**0.026**

Building 39: Former Fire Station

PTA-BLDG39-2-SO	
Date	8/29/2021
Depth	0.33-1.3 ft
PFOS	***0.23***
PFOA	**0.0078**
PFBS	**0.0034**
PFNA	0.00065 U
PFHxS	**0.11**

PTA-BLDG39-4-SO	
Date	8/30/2021
Depth	0-2 ft
PFOS	***1.3***
PFOA	**0.0022**
PFBS	0.0020 U
PFNA	**0.0016**
PFHxS	**0.0082**

PTA-BLDG39-3-SO	
Date	8/30/2021
Depth	0.33-1 ft
PFOS	***1.1***
PFOA	**0.061**
PFBS	**0.18**
PFNA	**0.00050 J**
PFHxS	**0.3**

PTA-BLDG39-6-SO	
Date	8/30/2021
Depth	1-3 ft
PFOS	***1.7***
PFOA	**0.0034**
PFBS	0.0022 U
PFNA	**0.00087**
PFHxS	**0.018**

Mauna Kea Loop

Notes:
1. Soil results are reported in milligrams per kilogram (mg/kg), or parts per million.
2. Bolded values indicate detections.
3. Results that exceed Office of the Secretary of Defense (OSD) residential scenario risk screening levels (OSD 2022) are highlighted gray.
4. Results that exceed the OSD industrial/commercial scenario risk screening levels (OSD 2022) are highlighted gray and italicized.

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 25 50
Feet

Installation Boundary
AOPI
Drainage Ditch
Stormwater/Surface Runoff Flow Direction
Soil Sampling Location

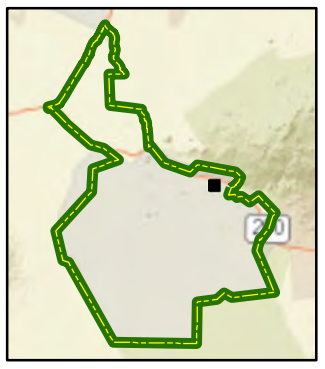
AOPI = area of potential interest
ft = feet
PFBS = perfluorobutanesulfonic acid
PFHxS = perfluorohexane sulfonate
PFNA = perfluorononanoic acid
PFOA = perfluorooctanoic acid
PFOS = perfluorooctane sulfonate
SO = soil

Data Sources:
ESRI, ArcGIS Online, StreetMap Data

Coordinate System:
WGS 1984, UTM Zone 5 North

USAEC PFAS Preliminary Assessment / Site Inspection
Pohakuloa Training Area and Kilauea Military Reservation, Hawaii

Figure 7-3
Building 390: Fire Station
PFOS, PFOA, PFBS, PFNA, and PFHxS Analytical Results



Chemical	Residential Scenario Risk Screening Level	Industrial/Commercial Scenario Risk Screening Level
	Soil (mg/kg)	Soil (mg/kg)
PFOS	0.013	0.16
PFOA	0.019	0.25
PFBS	1.9	25
PFNA	0.019	0.25
PFHxS	0.13	1.6

PTA-BLDG390-1-SO	
Date	8/29/2021
Depth	0.3-2 ft
PFOS	***0.73***
PFOA	**0.021**
PFBS	0.0022 U
PFNA	**0.0012**
PFHxS	**0.067**

PTA-BLDG390-3-SO	
Date	8/28/2021
Depth	0-2 ft
PFOS	**0.054 [0.056]**
PFOA	**0.0057 [0.0082]**
PFBS	0.0020 U [0.0021 U]
PFNA	**0.0024 [0.0028]**
PFHxS	**0.0098 [0.014]**

Building 390: Fire Station

PTA-BLDG390-4-SO	
Date	8/28/2021
Depth	0-0.67 ft
PFOS	**0.022**
PFOA	**0.0042**
PFBS	0.0021 U
PFNA	**0.0017**
PFHxS	**0.0016**

PTA-BLDG390-2-SO	
Date	8/29/2021
Depth	0.3-2 ft
PFOS	**0.020**
PFOA	**0.0017**
PFBS	0.0020 U
PFNA	**0.00039 J**
PFHxS	**0.0012**

Notes:
1. Soil results are reported in milligrams per kilogram (mg/kg), or parts per million.
2. Duplicate sample results are shown in brackets.
3. Bolded values indicate detections.
4. Results that exceed Office of the Secretary of Defense (OSD) residential scenario risk screening levels (OSD 2022) are highlighted gray.
5. Results that exceed the OSD industrial/commercial scenario risk screening levels (OSD 2022) are highlighted gray and italicized.

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 25 50
Feet

Installation Boundary
AOPI
Drainage Ditch
Stormwater/Surface Runoff Flow Direction
Soil Sampling Location

AOPI = area of potential interest
ft = feet
PFBS = perfluorobutanesulfonic acid
PFHxS = perfluorohexane sulfonate
PFNA = perfluorononanoic acid
PFOA = perfluorooctanoic acid
PFOS = perfluorooctane sulfonate
SO = soil

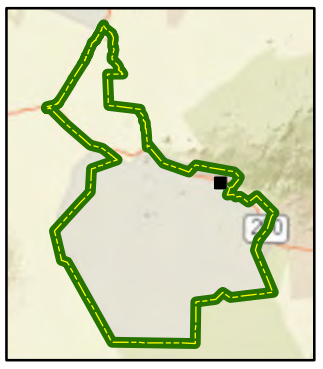
Data Sources:
ESRI, ArcGIS Online, StreetMap Data

Coordinate System:
WGS 1984, UTM Zone 5 North

USAEC PFAS Preliminary Assessment / Site Inspection
Pohakuloa Training Area and Kilauea Military Reservation, Hawaii

ARCADIS

Figure 7-4
Current and Former Fire-Fighting Training Pits
PFOS, PFOA, PFBS, PFNA, and PFHxS Analytical Results



Chemical	Residential Scenario Risk Screening Level	Industrial/Commercial Scenario Risk Screening Level
	Soil (mg/kg)	Soil (mg/kg)
PFOS	0.013	0.16
PFOA	0.019	0.25
PFBS	1.9	25
PFNA	0.019	0.25
PFHxS	0.13	1.6

PTA-FFTP-1-SO	
Date	8/28/2021
Depth	0-2 ft
PFOS	**0.067**
PFOA	**0.014**
PFBS	0.0021 U
PFNA	**0.0056**
PFHxS	**0.0049**

PTA-FFTP-2-SO	
Date	8/28/2021
Depth	0-2 ft
PFOS	**0.16**
PFOA	**0.011**
PFBS	0.0021 U
PFNA	**0.013**
PFHxS	**0.0013**

PTA-FFTP-3-SO	
Date	8/28/2021
Depth	0-0.75 ft
PFOS	**0.025**
PFOA	**0.0056**
PFBS	0.0020 U
PFNA	**0.0015**
PFHxS	**0.0059**

Current and Former Fire-Fighting Training Pits

PTA-FFTP-4-SO	
Date	8/28/2021
Depth	0-2 ft
PFOS	***0.5***
PFOA	**0.03**
PFBS	0.0020 U
PFNA	**0.0088**
PFHxS	**0.076**

PTA-FFTP-5-SO		
Date	8/28/2021	8/30/2021
Depth	0-2 ft	2.5-4 ft
PFOS	***0.3***	**0.13**
PFOA	**0.011**	**0.0034**
PFBS	0.0020 U	0.0021 U
PFNA	**0.0066**	**0.0023**
PFHxS	**0.011**	**0.018**

Notes:
1. Soil results are reported in milligrams per kilogram (mg/kg), or parts per million.
2. Bolded values indicate detections.
3. Results that exceed Office of the Secretary of Defense (OSD) residential scenario risk screening levels (OSD 2022) are highlighted gray.
4. Results that exceed the OSD industrial scenario risk screening levels (OSD 2022) are highlighted gray and italicized.

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

0 25 50
Feet

Installation Boundary
AOPI
Soil Sampling Location (Shallow)
Soil Sampling Location (Shallow and Deep)

AOPI = area of potential interest
ft = feet
PFBS = perfluorobutanesulfonic acid
PFHxS = perfluorohexane sulfonate
PFNA = perfluorononanoic acid
PFOA = perfluorooctanoic acid
PFOS = perfluorooctane sulfonate
SO = soil

Data Sources:
ESRI, ArcGIS Online, StreetMap Data

Coordinate System:
WGS 1984, UTM Zone 5 North

USAEC PFAS Preliminary Assessment / Site Inspection
Pohakuloa Training Area and Kilauea Military Reservation, Hawaii

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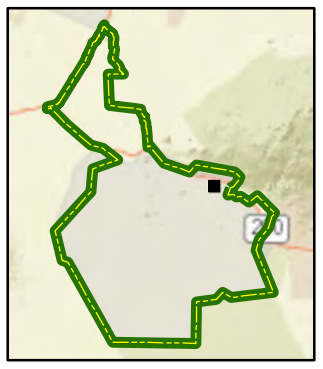
Figure 7-5
Former AFFF Training Area
PFOS, PFOA, PFBS, PFNA, and PFHxS Analytical Results



Chemical	Residential Scenario Risk Screening Level	Industrial/Commercial Scenario Risk Screening Level
	Soil (mg/kg)	Soil (mg/kg)
PFOS	0.013	0.16
PFOA	0.019	0.25
PFBS	1.9	25
PFNA	0.019	0.25
PFHxS	0.13	1.6

PTA-AFFFTA-4-SO	
Date	8/27/2021
Depth	0-2 ft
PFOS	***1.1***
PFOA	**0.013**
PFBS	0.0020 U
PFNA	**0.0037**
PFHxS	**0.050**

PTA-AFFFTA-3-SO	
Date	8/27/2021
Depth	0-2 ft
PFOS	***1.4***
PFOA	**0.0065**
PFBS	0.0026 U
PFNA	**0.0031**
PFHxS	**0.011**

PTA-AFFFTA-1-SO	
Date	8/27/2021
Depth	0-2 ft
PFOS	***0.21***
PFOA	**0.012**
PFBS	0.0020 U
PFNA	**0.0064**
PFHxS	**0.0056**

PTA-AFFFTA-2-SO	
Date	8/27/2021
Depth	0-2 ft
PFOS	**0.16**
PFOA	**0.0026**
PFBS	0.0021 U
PFNA	**0.0016**
PFHxS	**0.0026**

Former AFFF Training Area

Bradshaw

Notes:
1. Soil results are reported in milligrams per kilogram (mg/kg), or parts per million.
2. Bolded values indicate detections.
3. Results that exceed Office of the Secretary of Defense (OSD) residential scenario risk screening levels (OSD 2022) are highlighted gray.
4. Results that exceed the OSD industrial scenario risk screening levels (OSD 2022) are highlighted gray and italicized.

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

0 25 50
Feet

Installation Boundary
AOPI
Drainage Ditch
Stormwater/Surface Runoff Flow Direction
Soil Sampling Location

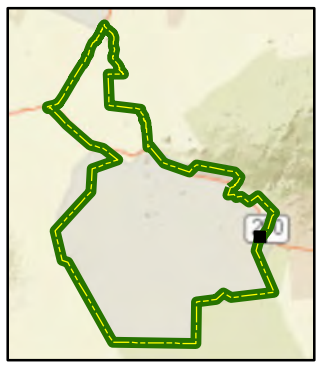
AFFF= aqueous film-forming foam
AOPI = area of potential interest
ft = feet
PFBS = perfluorobutanesulfonic acid
PFHxS = perfluorohexane sulfonate
PFNA = perfluorononanoic acid
PFOA = perfluorooctanoic acid
PFOS = perfluorooctane sulfonate
SO = soil

Data Sources:
ESRI, ArcGIS Online, StreetMap Data

Coordinate System:
WGS 1984, UTM Zone 5 North

USAEC PFAS Preliminary Assessment / Site Inspection
Pohakuloa Training Area and Kilauea Military Reservation, Hawaii

Figure 7-6
Landing Zone Rob Helicopter Crash
PFOS, PFOA, PFBS, PFNA, and PFHxS Analytical Results



Chemical	Residential Scenario Risk Screening Level	Industrial/Commercial Scenario Risk Screening Level
	Soil (mg/kg)	Soil (mg/kg)
PFOS	0.013	0.16
PFOA	0.019	0.25
PFBS	1.9	25
PFNA	0.019	0.25
PFHxS	0.13	1.6

N

Landing Zone Rob Helicopter Crash

PTA-LZR-1-SO	
Date	8/31/2021
Depth	0-0.25 ft
PFOS	0.00059 U
PFOA	0.00059 U
PFBS	0.0020 U
PFNA	0.00059 U
PFHxS	0.00059 U

PTA-LZR-3-SO	
Date	8/31/2021
Depth	0-1 ft
PFOS	0.00055 U
PFOA	0.00055 U
PFBS	0.0018 U
PFNA	0.00055 U
PFHxS	0.00055 U

PTA-LZR-2-SO	
Date	8/31/2021
Depth	0-0.5 ft
PFOS	0.00055 U
PFOA	0.00055 U
PFBS	0.0018 U
PFNA	0.00055 U
PFHxS	0.00055 U

PTA-LZR-4-SO	
Date	8/31/2021
Depth	0-0.5 ft
PFOS	0.00058 U
PFOA	0.00058 U
PFBS	0.0019 U
PFNA	0.00058 U
PFHxS	0.00058 U

Notes:
1. Soil results are reported 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 25 50
Feet

Installation Boundary
AOPI
Soil Sampling Location

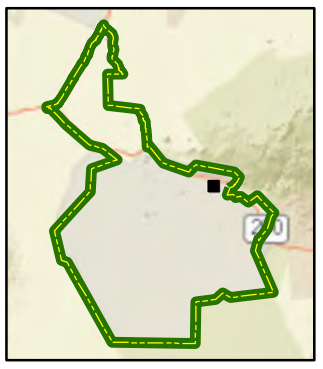
AOPI = area of potential interest
ft = feet
PFBS = perfluorobutanesulfonic acid
PFHxS = perfluorohexane sulfonate
PFNA = perfluorononanoic acid
PFOA = perfluorooctanoic acid
PFOS = perfluorooctane sulfonate
SO = soil

Data Sources:
ESRI, ArcGIS Online, StreetMap Data

Coordinate System:
WGS 1984, UTM Zone 5 North

USAEC PFAS Preliminary Assessment / Site Inspection
Pohakuloa Training Area and Kilauea Military Reservation, Hawaii

Figure 7-7
Bradshaw Army Airfield Runway
PFOS, PFOA, PFBS, PFNA, and PFHxS Analytical Results



Chemical	Residential Scenario Risk Screening Level	Industrial/Commercial Scenario Risk Screening Level
	Soil (mg/kg)	Soil (mg/kg)
PFOS	0.013	0.16
PFOA	0.019	0.25
PFBS	1.9	25
PFNA	0.019	0.25
PFHxS	0.13	1.6

PTA-BAAFR-5-SO	
Date	8/31/2021
Depth	0-2 ft
PFOS	**0.00095**
PFOA	**0.00061**
PFBS	0.0020 U
PFNA	0.00060 U
PFHxS	0.00060 U

PTA-BAAFR-6-SO	
Date	8/31/2021
Depth	0-1.5 ft
PFOS	**0.0051**
PFOA	**0.0022**
PFBS	0.0019 U
PFNA	**0.00046 J**
PFHxS	**0.0016**

PTA-BAAFR-4-SO	
Date	8/31/2021
Depth	0-2 ft
PFOS	**0.00075 [0.0011]**
PFOA	**0.00059 [0.00088]**
PFBS	0.0021 U [0.0020 U]
PFNA	0.00058 U **[0.00044 J]**
PFHxS	0.00058 U [0.00059 U]

Bradshaw Army Airfield Runway

PTA-BAAFR-3-SO	
Date	8/31/2021
Depth	0-1.4 ft
PFOS	**0.015**
PFOA	**0.041**
PFBS	0.0020 U
PFNA	**0.0049**
PFHxS	**0.0017**

PTA-BAAFR-1-SO	
Date	8/31/2021
Depth	0-1.5 ft
PFOS	**0.0073**
PFOA	**0.0065**
PFBS	0.0019 U
PFNA	**0.0074**
PFHxS	0.00057 U

PTA-BAAFR-2-SO	
Date	8/31/2021
Depth	0-1.7 ft
PFOS	**0.0097**
PFOA	**0.025**
PFBS	0.0021 U
PFNA	**0.0053**
PFHxS	**0.00052 J**

0 25 50 Feet

0 250 500 Feet

Notes:
1. Soil results are reported in milligrams per kilogram (mg/kg), or parts per million.
2. Duplicate sample results are shown in brackets.
3. Bolded values indicate detections.
4. Results that exceed Office of the Secretary of Defense (OSD) residential scenario risk screening levels (OSD 2022) are highlighted gray.

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
AOPI
Stormwater/Surface Runoff Flow Direction
Soil Sampling Location

AOPI = area of potential interest
ft = feet
PFBS = perfluorobutanesulfonic acid
PFHxS = perfluorohexane sulfonate
PFNA = perfluorononanoic acid
PFOA = perfluorooctanoic acid
PFOS = perfluorooctane sulfonate
SO = soil

Data Sources:
ESRI, ArcGIS Online, StreetMap Data

Coordinate System:
WGS 1984, UTM Zone 5 North

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Figure 7-8
KMR AOPI Locations and
OSD Risk Screening Level Exceedances

Installation Boundary

AOPI

AOPI with OSD Risk Screening Level Exceedance

Water Body

AOPI = area of potential interest
KMR = Kilauea Military Reservation
OSD = Office of the Secretary of Defense

Data Sources:
ESRI, ArcGIS Online, StreetMap Data

Coordinate System:
WGS 1984, UTM Zone 5 North

USAEC PFAS Preliminary Assessment / Site Inspection
Pohakuloa Training Area and Kilauea Military Reservation, Hawaii

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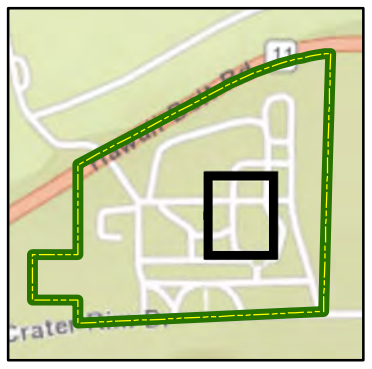
Figure 7-9
Building 43: Former Fire Station
PFOS, PFOA, PFBS, PFNA, and PFHxS Analytical Results



N

Chemical	Residential Scenario Risk Screening Level	Industrial/Commercial Scenario Risk Screening Level
	Soil (mg/kg)	Soil (mg/kg)
PFOS	0.013	0.16
PFOA	0.019	0.25
PFBS	1.9	25
PFNA	0.019	0.25
PFHxS	0.13	1.6

KMC-BLD43-1-SO	
Date	12/12/2022
Depth	0-2 ft
PFOS	**0.0020**
PFOA	**0.00011 J**
PFBS	0.00024 U
PFNA	**0.00027**
PFHxS	**0.00014 J**

Building 43: Former Fire Station

KMC-BLD43-2-SO	
Date	12/13/2022
Depth	0.2-2 ft
PFOS	**0.0052**
PFOA	**0.00025 J**
PFBS	0.00026 U
PFNA	**0.00012 J**
PFHxS	**0.00046**

KMC-BLD43-3-SO	
Date	12/12/2022
Depth	0-2 ft
PFOS	**0.012**
PFOA	**0.00054**
PFBS	0.00021 U
PFNA	**0.00011 J**
PFHxS	**0.00094**

Notes:
1. Soil results are reported in milligrams per kilogram (mg/kg).
2. Bolded values indicate detections.
3. At the time of the SI, KMR was referred to as Kilauea Military Camp (KMC); as such, the sample IDs from the SI retain the "KMC" acronym to be consistent with the analytical reports. It was later requested by USAEC that the installation name be updated to Kilauea Military Reservation (KMR) to be consistent with already existing documents in HQAES.

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 25 50
Feet

Installation Boundary
AOPI
Stormwater/Surface Runoff Flow Direction
Soil Sampling Location

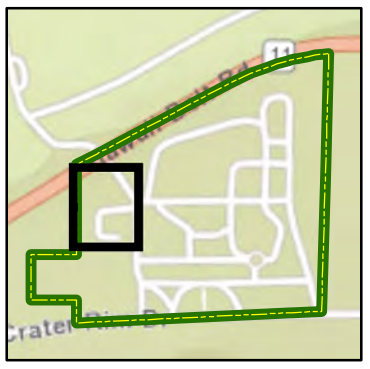
AOPI = area of potential interest
ft = feet
PFBS = perfluorobutanesulfonic acid
PFHxS = perfluorohexane sulfonate
PFNA = perfluorononanoic acid
PFOA = perfluorooctanoic acid
PFOS = perfluorooctane sulfonate
SO = soil

Data Sources:
ESRI, ArcGIS Online, StreetMap Data

Coordinate System:
WGS 1984, UTM Zone 5 North

USAEC PFAS Preliminary Assessment / Site Inspection
Pohakuloa Training Area and Kilauea Military Reservation, Hawaii

Figure 7-10
Building 59: Fire Station #19
PFOS, PFOA, PFBS, PFNA, and PFHxS Analytical Results



Chemical	Residential Scenario Risk Screening Level	Industrial/Commercial Scenario Risk Screening Level
	Soil (mg/kg)	Soil (mg/kg)
PFOS	0.013	0.16
PFOA	0.019	0.25
PFBS	1.9	25
PFNA	0.019	0.25
PFHxS	0.13	1.6

KMC-BLD59-2-SO	
Date	12/13/2022
Depth	0.2-2 ft
PFOS	**0.051 [0.057]**
PFOA	**0.0016 [0.0018]**
PFBS	**0.000053 J** [0.00020 U]
PFNA	**0.0010 [0.0011]**
PFHxS	**0.00061 [0.00057]**

KMC-BLD59-1-SO	
Date	12/13/2022
Depth	0.2-2 ft
PFOS	**0.020**
PFOA	**0.00079**
PFBS	0.00023 U
PFNA	**0.00060**
PFHxS	**0.00033**

Building 59: Fire Station #19

KMC-BLD59-3-SO	
Date	12/12/2022
Depth	0-2 ft
PFOS	0.00033 U
PFOA	**0.00015 J**
PFBS	0.00022 U
PFNA	**0.000074 J**
PFHxS	**0.000072 J**

KMC-BLD59-4-SE	
Date	12/13/2022
PFOS	0.0014 U [0.00072 U]
PFOA	**0.00028 J** [0.00072 U]
PFBS	0.00096 U [0.00048 U]
PFNA	**0.00019 J [0.000084 J]**
PFHxS	0.00096 U [0.00048 U]

Notes:
1. Soil results are reported in milligrams per kilogram (mg/kg).
2. Duplicate sample results are shown in brackets.
3. Bolded values indicate detections.
4. Results that exceed Office of the Secretary of Defense (OSD) residential scenario risk screening levels (OSD 2022) are highlighted gray.
3. At the time of the SI, KMR was referred to as Kilauea Military Camp (KMC); as such, the sample IDs from the SI retain the "KMC" acronym to be consistent with the analytical reports. It was later requested by USAEC that the installation name be updated to Kilauea Military Reservation (KMR) to be consistent with already existing documents in HQAES.

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 25 50
Feet

Installation Boundary
AOPI
Covered Drain
Stormwater Flow Direction
Soil Sampling Location
Sediment Sampling Location

AOPI = area of potential interest
ft = feet
PFBS = perfluorobutanesulfonic acid
PFHxS = perfluorohexane sulfonate
PFNA = perfluorononanoic acid
PFOA = perfluorooctanoic acid
PFOS = perfluorooctane sulfonate
SE = sediment
SO = soil

Data Sources:
ESRI, ArcGIS Online, StreetMap Data

Coordinate System:
WGS 1984, UTM Zone 5 North

Source Medium	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]
Aqueous Film-Forming Foam (AFFF) Releases to Soil and/or Paved Surfaces				Soil	Ingestion	●	○	○	○
					Dermal Contact	●	○	○	○
					Inhalation (dust)	●	○	○	○
	Desorption / Dissolution	Groundwater		Groundwater	Ingestion	○	○	○	◐
					Dermal Contact	○	○	○	◐
			Recharge						
	Surface Runoff / Dissolution / Adsorption	Stormwater		Intermittent Surface Water in Drainage Ditch [1]	Ingestion	◐	○	◐	○
					Dermal Contact	◐	○	◐	○
			Adsorption / Desorption	Sediment / Soil in Drainage Ditch	Ingestion	◐	○	◐	○
					Dermal Contact	◐	○	◐	○

Legend:

● = Complete Exposure Pathway

◐ = Potentially Complete Exposure Pathway

○ = Incomplete Exposure Pathway

Notes:
[1] Surface water is not considered a drinking water resource, however, the exposure pathway for Site Workers, Residents, or Recreational Users describes an incidental ingestion or dermal contact scenario.
[2] All types of off-installation human receptors include drinking water receptors and recreational users.

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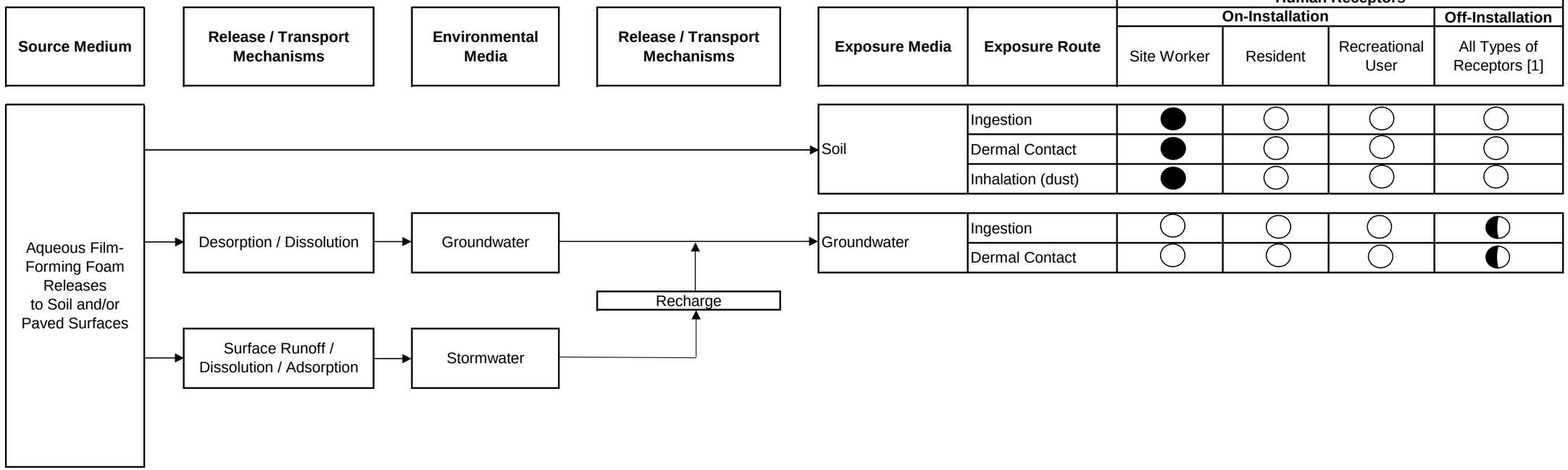
Conceptual Site Model for PTA AOPIs - Building 39: Former Fire Station and Former AFFF Training Area
USAEC PFAS Preliminary Assessment / Site Inspection
Pohakuloa Training Area, Hawaii

Figure 7-11



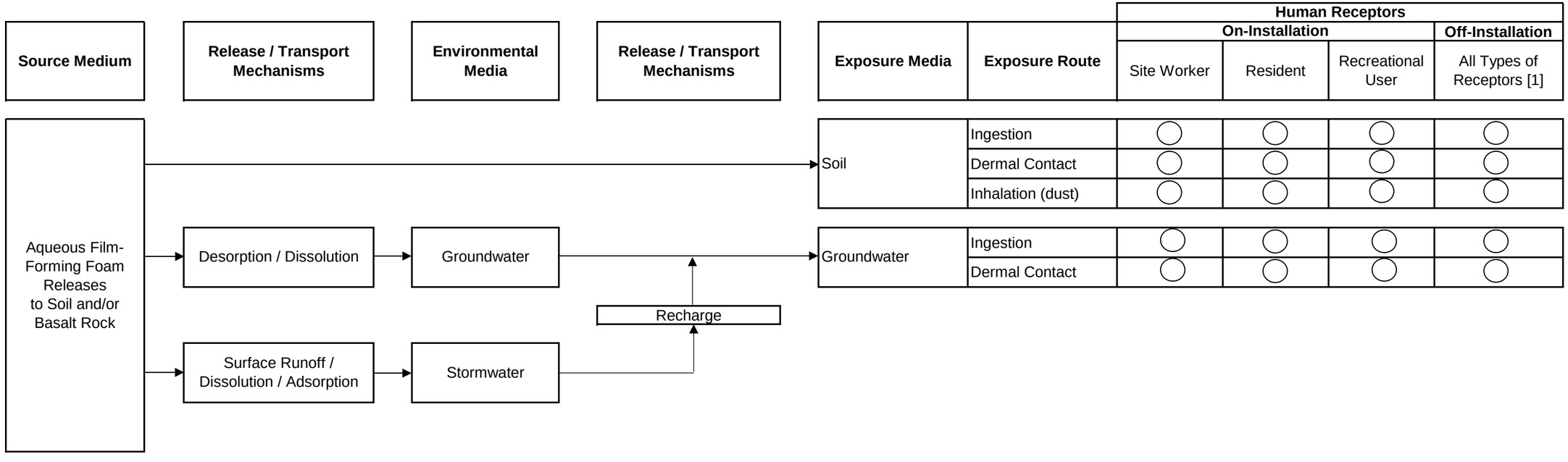
Legend:

- = Complete Exposure Pathway
- = Potentially Complete Exposure Pathway
- = Incomplete Exposure Pathway

Notes:
[1] All types of off-installation human receptors include drinking water receptors and recreational users.

Conceptual Site Model for PTA AOPIs - Building 390: Fire Station, Current and Former Fire-Fighting Training Pits, and Bradshaw Army Airfield Runway
USAEC PFAS Preliminary Assessment / Site Inspection

Figure 7-12



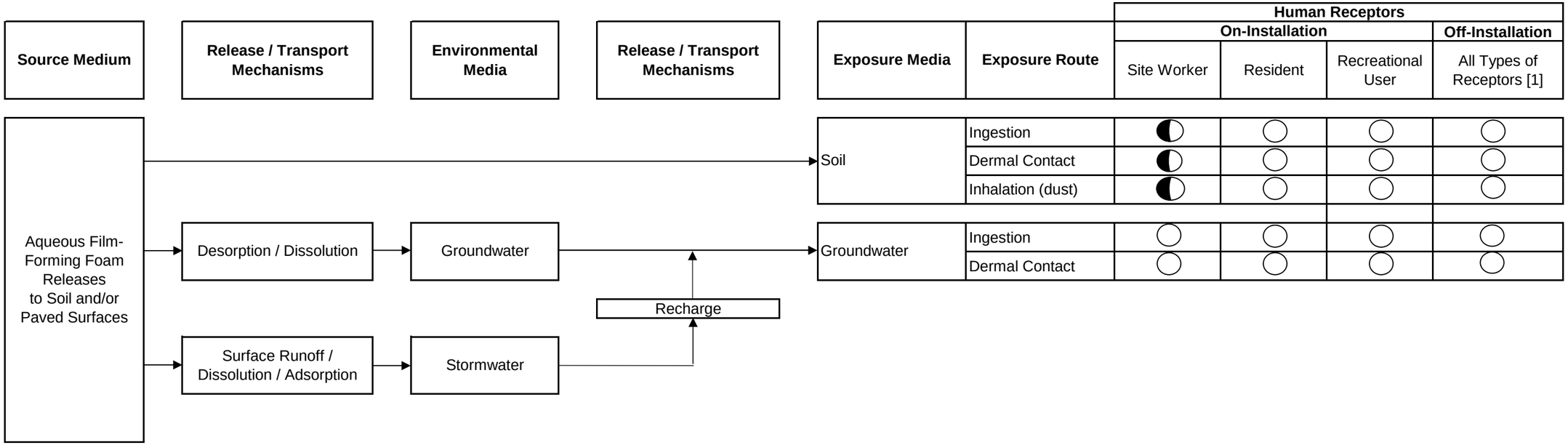
Legend:

- = Complete Exposure Pathway
- = Potentially Complete Exposure Pathway
- = Incomplete Exposure Pathway

Notes:
[1] All types of off-installation human receptors include drinking water receptors and recreational users.

Conceptual Site Model for PTA AOPI - LZ Rob Helicopter Crash
USAEC PFAS Preliminary Assessment / Site Inspection
Pohakuloa Training Area, Hawaii

Figure 7-13



Legend:

- = Complete Exposure Pathway
- = Potentially Complete Exposure Pathway
- = Incomplete Exposure Pathway

Notes:
[1] All types of off-installation human receptors include drinking water receptors and recreational users.

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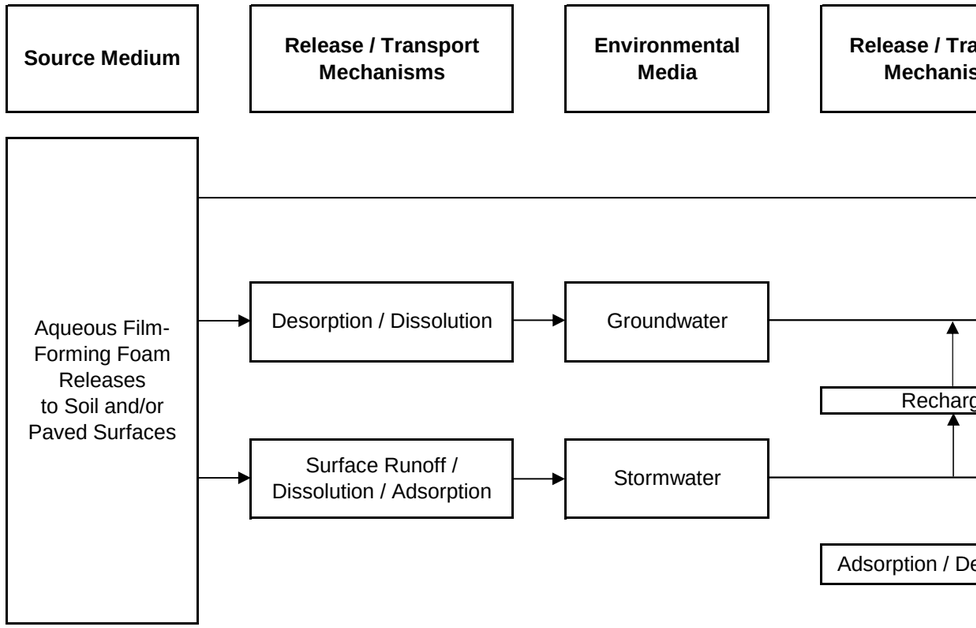
Conceptual Site Model for KMR AOPI - Building 43: Former Fire Station
USAEC PFAS Preliminary Assessment / Site Inspection
Kilauea Military Reservation, Hawaii

Figure 7-14



Source Medium	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]
Aqueous Film-Forming Foam Releases to Soil and/or Paved Surfaces				Soil	Ingestion	●	○	○	○
					Dermal Contact	●	○	○	○
					Inhalation (dust)	●	○	○	○
	Desorption / Dissolution	Groundwater		Groundwater	Ingestion	○	○	○	○
					Dermal Contact	○	○	○	○
	Surface Runoff / Dissolution / Adsorption	Stormwater		Intermittent Surface Water in Drainage Area [1]	Ingestion	○	○	○	○
					Dermal Contact	○	○	○	○
			Adsorption / Desorption	Sediment / Soil in Drainage Area	Ingestion	●	○	○	○
					Dermal Contact	●	○	○	○

Legend:

● = Complete Exposure Pathway

◐ = Potentially Complete Exposure Pathway

○ = Incomplete Exposure Pathway

Notes:
[1] Surface water exposure pathway for Site Workers and Residents describes a drinking water scenario, and for Recreational Users describes an outdoor recreational scenario.
[2] All types of off-installation human receptors include drinking water receptors and recreational users.

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Conceptual Site Model for KMR AOPI - Building 59: Fire Station #19
USAEC PFAS Preliminary Assessment / Site Inspection
Kilauea Military Reservation, Hawaii

Figure 7-15