FINAL
Site Inspection Report
Waiawa Gulch Training Site and Unit Training and Equipment Site
O‘ahu, Hawai‘i

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

May 2023

Prepared for:

Army National Guard Bureau
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Acronyms and Abbreviations

%	percent
°C	degrees Celsius
°F	degrees Fahrenheit
µg/kg	micrograms per kilogram
AECOM	AECOM Technical Services, Inc.
AFFF	aqueous film-forming foam
amsl	above mean sea level
AOI	Area of Interest
ARNG	Army National Guard
bgs	below ground surface
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CoC	chain of custody
CSM	conceptual site model
CWRM	Commission on Water Resource Management
DA	Department of the Army
DoD	Department of Defense
DO	dissolved oxygen
DON	Department of the Navy
DOT	Department of Transportation
DPT	direct push technology
DQO	data quality objective
DUA	data usability assessment
EA	EA Engineering, Science, and Technology, Inc.
EDR™	Environmental Data Resources, Inc.™
ELAP	Environmental Laboratory Accreditation Program
EM	Engineer Manual
FedEx	Federal Express
GPRS	Ground Penetrating Radar Systems
HDOH	Hawai‘i Department of Health
HDPE	high-density polyethylene
HEER	Hazard Evaluation and Emergency Response Office
HFPO-DA	hexafluoropropylene oxide dimer acid
HIARNG	Hawai‘i Army National Guard
IDW	investigation-derived waste
ISM	Incremental Sample Methodology
ITRC	Interstate Technology Regulatory Council
kg	kilogram
LC/MS/MS	liquid chromatography with tandem mass spectrometry
MIL-SPEC	military specification
NELAP	National Environmental Laboratory Accreditation Program
ng/L	nanograms per liter
NOAA	National Oceanic and Atmospheric Administration
NTU	nephelometric turbidity units

ORP	oxidation-reduction potential
OSD	Office of the Secretary of Defense
PA	Preliminary Assessment
PFAS	per- and polyfluoroalkyl substances
PFBS	perfluorobutanesulfonic acid
PFHxS	perfluorohexanesulfonic acid
PFNA	perfluorononanoic acid
PFOA	perfluorooctanoic acid
PFOS	perfluorooctanesulfonic acid
PID	photoionization detector
PQAPP	Programmatic UFP-QAPP
PVC	polyvinyl chloride
QA	quality assurance
QAPP	Quality Assurance Project Plan
QC	quality control
QSM	Quality Systems Manual
RI	Remedial Investigation
SI	Site Inspection
SL	screening level
SOP	standard operating procedure
TGM	Technical Guidance Manual
TOC	total organic carbon
TPP	Technical Project Planning
UFP	Uniform Federal Policy
US	United States
USACE	United States Army Corps of Engineers
USCS	Unified Soil Classification System
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service
UTES	Unit Training and Equipment Site

Executive Summary

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

The PA identified two Areas of Interest (AOIs) where PFAS-containing materials may have been used, stored, disposed, or released historically (see **Table ES-2** for AOI locations). The objective of the SI is to identify whether there has been a release to the environment from the AOIs identified in the PA and determine whether further investigation is warranted, a removal action is required to address immediate threats, or no further action is required based on SLs for relevant compounds. This SI was completed at the Waiawa Gulch Training Site and Unit Training and Equipment Site (UTES) in O‘ahu, Hawai‘i and determined further evaluation under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) is warranted for AOI 1 and AOI 2. The Waiawa Gulch Training Site and UTES will also be referred to as the “facility” throughout this document.

The Waiawa Gulch Training Site and UTES facility is located north of Pearl Harbor, on the island of O‘ahu. The facility falls 0.75 miles northeast of the H1-H2 freeway merge. The facility is bordered to the north and south by industrial activities and to the west by a privately operated junk yard. The Waiawa Gulch Training Site and UTES facility comprise approximately 20 acres.

The PA identified two AOIs for investigation during the SI phase. SI sampling results from the two AOIs were compared to OSD SLs. **Table ES-2** summarizes the SI results for each AOI. Based on the results of this SI, further evaluation under CERCLA is warranted in a Remedial Investigation (RI) for AOI 1 and AOI 2.

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

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

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

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

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

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

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

AOI	Potential Release Area	Soil – Source Area	Groundwater – Source Area	Future Action
1	Firetruck Pump Test Area	◐	●	Proceed to RI
2	Firetruck Parking Area, Vehicle Maintenance Area, and Storage Buildings	◐	●	Proceed to RI

Legend:

● = detected; exceedance of the screening levels

◐ = detected; no exceedance of the screening levels

○ = not detected

1. Introduction

1.1 Project Authorization

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

The SI project elements were performed in compliance with Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA; United States [US] Environmental Protection Agency [USEPA], 1980), as amended, the National Oil and Hazardous Substances Pollution Contingency Plan (40 Code of Federal Regulations Part 300; USEPA, 1994), and in compliance with US Department of the Army (DA) requirements and guidance for field investigations.

1.2 SI Purpose

A PA was performed at the Waiawa Gulch Training Site and UTES (AECOM Technical Services, Inc. [AECOM], 2020) that identified two Areas of Interest (AOIs) where PFAS-containing materials may have been used, stored, disposed, or released historically. The objective of the SI is to identify whether there has been a release to the environment from the AOIs identified in the PA and determine whether further investigation is warranted, a removal action is required to address immediate threats, or no further action is required based on screening levels (SLs) for the relevant compounds.

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

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2. Facility Background

2.1 Facility Location and Description

The Waiawa Gulch Training Site and UTES facility is located north of Pearl Harbor, on the island of Oʻahu (**Figure 2-1**). The facility falls 0.75 miles northeast of the H1-H2 freeway merge. The facility is bordered to the north and south by industrial activities and to the west by a privately-operated junk yard. The Waiawa Gulch Training Site and UTES facility comprises approximately 20 acres.

Prior to Hawaiʻi ARNG (HIARNG) use, the UTES portion of the installation was owned and operated by the Navy as a military vehicle and equipment maintenance and storage facility from 1943 to 1951. When Navy operations at the facility ended, the land was transferred to the US Army. HIARNG acquired Naval Aviation Supply Depot Waiawa Gulch from the US Army in 1961.

Waiawa Gulch Training Site and UTES facility provides training and maintenance for the various units that support the Hawaiʻi (HIARNG. The Waiawa Gulch Training Site and UTES facility consists of office areas, a wash bay, maintenance shop, motor pool, and various small storage buildings. Historical aerial photography indicates that a large motor pool and storage facility were located on the northern portion of the property, prior to 2014. The US Navy historically had ownership of the facility property from 3 August 1945. On 21 July 1959, the property was transferred to the HIARNG (Argonne National Laboratory, 1993).

2.2 Facility Environmental Setting

The Waiawa Gulch Training Site and UTES facility is located approximately 1.25 miles north of Middle Loch (Pearl Harbor). Throughout Waiawa Gulch Training Site and UTES, the natural terrain slopes south towards Pearl Harbor and west towards Waiawa Stream, ranging from a maximum elevation of 90 feet above mean sea level (amsl) to 50 feet amsl (**Figure 2-2**).

2.2.1 Geology

Two major volcanic mountain ranges forming the island of Oʻahu are the Waiʻanae Range in the west and the much younger Koʻolau Range in the east. Both ranges are the eroded remnants of the large elongate Waiʻanae and Koʻolau shield volcanoes. After a long period of erosion, volcanic activity resumed with the Honolulu Volcanic Series and its eruption of vents and lava flows. The eruptions produced by these features tended to be discrete, explosive events that produced volumes of ash, which blanketed older sloping Koʻolau basalt baserock.

On the central and eastern side of Oʻahu, the underlying baserock extrusive volcanic layers are lava flows from the Koʻolau shield volcano. Layers of ´a´ā flows, pāhoehoe flows, and clinker boundaries can be found in the subsurface (Macdonald et. al, 1983). Geology beneath the facility is older alluvium.

The facility lies predominately on soil consisting of fill materials originating from dredging or hauled in from nearby areas (Argonne National Laboratory, 1993), and alluvium. This soil is composed of primarily silty clay and sandy clay. The soil along the boundaries of the facility consists of Kawaihapai stony clay loam (Department of the Navy [DON], 2016). The total thickness of the soil formation decreases from north to south, with maximum depth to bedrock at 200 feet below ground surface (bgs) (DON, 1990). **Figure 2-3** uses United State Geological Survey (USGS) data from the Geologic Map of the State of Hawaiʻi to show local geologic units at the facility (USGS, 2007).

SI soil boring depths ranged from 24.25 to 56 feet bgs. The borings primarily consisted of lean clay and sandy silt with varying concentrations of gravel. Fat clay was reported in one boring (AOI01-02) at 5 to 10 feet bgs. Many of the logs also reported fill (described as sandy silt, lean clay, and well-graded sand) at the surface. At greater depths, weathered basalt and basalt rock flour were observed interbedded with the unconsolidated alluvial clayey and silty soils. The facility observations are consistent with the understood land fill material expected. Boring logs are presented in **Appendix E**.

2.2.2 Hydrogeology

In the Waiawa Valley, an aquifer formed in the alluvium is recharged by rainfall, flood waters from Waiawa Stream, and streambed leakage. The alluvial aquifer is approximately 100 to 200 feet thick. The upper zone of the Pearl Harbor Basal aquifer lies beneath the alluvial aquifer and is separated by a layer of saturated saprolite. The low permeability of the saprolite keeps the hydraulic heads of the two aquifers distinct; however, flow from alluvial aquifer groundwater to the upper zone of the basal aquifer may occur (DON, 1990).

The Waiawa basal aquifer, which underlies the Waiawa Gulch Training Site and UTES and alluvial aquifer, is part of the Pearl Harbor Aquifer, the most productive aquifer in the state. The hydrologic and geologic classification of the Waiawa aquifer system (Hawai'i Department of Health [HDOH] Aquifer Code 3-02-02-111, Status Code 11111) at the facility describes the aquifer as a basal, unconfined aquifer in horizontally extensive flank basalt lava flows. The basal groundwater originates as rainwater falling in higher drainage basins to the north and northeast of the facility. The basal groundwater generally migrates seaward towards Pearl Harbor through zones of clinkers (Macdonald et. al, 1983). The basal aquifer can be divided into three layers: upper, middle, and lower. The upper basal aquifer consists of a mixture of rainfall recharge, irrigation return, and subsurface inflow. The middle layer consists primarily of cooler subsurface inflow from mountain recharge areas, and the lower layer is slightly warmer than the middle layer (DON, 1990). The groundwater status for the upper aquifer is classified as the following: a currently used drinking water source that is ecologically important; fresh water (salinity less than 250 milligrams per liter chloride); irreplaceable in uniqueness; and highly vulnerable to contamination (Mink and Lau, 1990). Local hydrogeological units are shown on **Figure 2-3**.

An Environmental Data Resources, Inc.™ (EDR)™ report conducted a well search for a 1-mile radius surrounding the facility, and additional online resources, such as state and local Geographic Information System databases, were used to research wells within a 4-mile radius of the facility. Numerous wells of various use exist in all directions, and multiple industrial, agricultural, irrigation, and domestic wells are located directly downgradient of the facility. Based on the position and depth of these wells, it is possible that some of the wells are screened in the alluvial aquifer. Municipal water supply wells are located both east and west of the facility, within 4 miles (**Figure 2-3**). Based on the position and depths of the municipal water supply wells, they are screened in the basal aquifer. Drinking water at Waiawa Gulch Training Site and UTES is resourced from public drinking water wells that are located cross-gradient, approximately 0.65 miles southeast of the facility. These are the Honolulu Board of Water Supply Pearl City Shaft, Pearl City 1, and Pearl City 2 wells, which range from 140 to 151 feet bgs (State of Hawai'i Commission on Water Resource Management [CWRM], 2022).

Depths to water measured in March 2022 during the SI ranged from 31.96 to 52.21 feet local mean sea level. SI borings were completed in the unconfined alluvial aquifer underlying the facility. Based on the predominant subsurface materials observed (lean clays and sandy silt), the borings did not reach the extensive flank basalt lava flows that characterize the basal aquifer. Because the basal aquifer depth at the facility is unknown, additional data are needed to evaluate the potential for a hydrogeologic connection between the groundwater encountered in the SI borings and the basal aquifer groundwater.

Groundwater elevations at AOI 1 were higher (44.32 to 52.21 feet local mean sea level) than groundwater elevations at AOI 2 (31.96 to 34.98 feet local mean sea level). The SI boring logs and drilling conditions indicate a complex hydrogeological setting at the facility. At AOI 1, the two monitoring wells were installed with well screens at similar elevations; however, based on the depths to groundwater observed, it is possible the wells are screened in discontinuous water-bearing units. Additionally, based on the boring logs for the permanent well installation at AOI01-02, the well screen interval was set below the groundwater table. As a result, groundwater elevation contours are not shown on **Figure 2-4** for the AOI 1 area. Permanent well AOI01-02 is included in the groundwater elevation contours shown to provide a comparison of elevation data between AOI 1 and AOI 2. Additional data are necessary to determine groundwater flow direction at AOI 1. The groundwater elevation at AOI01-02 compared to the groundwater elevations at AOI 2 suggests groundwater flows southwest across the greater facility area, which follows the presumed regional groundwater flow of the basal aquifer south towards Pearl Harbor.

Although groundwater across the facility presumably flows southwest, there is uncertainty surrounding groundwater flow based on the localized groundwater elevation observed at AOI 2 during the SI. In the southern portion of the facility near AOI 2, groundwater elevations indicate a convergence of flow near AOI02-02. This may be due to heterogeneous subsurface materials, such as disconnected clay lenses, or the influence of underground stormwater channels. It is also possible that surface topography influences the convergence at this location, as surface topography indicates a local depression at that point. It is unknown whether Waiawa Stream affects groundwater flow at each AOI. Groundwater elevation contours from the SI are presented on **Figure 2-4**. Depth to groundwater and groundwater elevations are discussed further and tabulated in **Sections 5.3** and **5.4**.

2.2.3 Hydrology

The facility is located within the main Pearl Harbor Watershed, which encompasses 110 square miles and comprises nine subwatersheds. The facility lies within the Waiawa subwatershed, which consists of Waiawa Stream and its tributaries (Commander, Navy Region Hawai‘i, 2011). Waiawa Stream partially borders Waiawa Gulch Training Site and UTES along the southwestern boundary (**Figure 2-5**). Waiawa Stream drains south to Middle Loch, within Pearl Harbor, approximately 1.25 miles away, and subsequently to the Pacific Ocean. Stormwater runoff at the facility is directed towards a series of storm drains and a drainage pit located in the southwest corner of the property, near the storage buildings. A dry-well system formerly existed at the facility but has been capped and is no longer functional. The drainage pit was constructed in 2019 and receives stormwater discharge from the wash rack. Facility storm drains ultimately discharge into Waiawa Stream.

2.2.4 Climate

O‘ahu is located in the tropics, with a climate characterized by mild temperatures, northeasterly trade winds year-round, and moderate humidity. Hawai‘i has two seasons: summer (between May and October) and winter (between October and April). The annual average temperature in nearby Wahiawa is 71.9 degrees Fahrenheit (°F), with temperatures decreasing at higher elevations. The coldest average temperatures are in January (68.5°F), and the warmest temperatures are in August (75.5°F) (National Oceanic and Atmospheric Administration [NOAA], 2022). Humidity on O‘ahu ranges from approximately 30 to 90 percent (%). Precipitation predominantly occurs when the island’s mountain masses capture and cool the rising, warm, moist ocean air, producing higher rainfall in the windward and mountain areas, and lower rainfall in the leeward and coastal zones. Annual rainfall ranges from 20 inches in the leeward coastal areas to 250 inches on the Ko‘olau mountain peaks (Macdonald et.al, 1983) Nearby Wahiawa has an average annual rainfall of 64.8 inches (NOAA, 2022).

2.2.5 Current and Future Land Use

Current Waiawa Gulch Training Site and UTES operations include training and maintenance for the various units that support the HIARNG. In addition to vehicle maintenance and support for HIARNG, periodic training exercises and course work for the National Guard units are conducted at the facility. The facility is staffed by both full- and part-time employees.

Portions of the northern and southern borders of Waiawa Gulch Training Site and UTES are abutted primarily by industrial land use. A junk yard abuts the northwestern boundary of the facility. Across the road of the eastern border is a small industrial park. The closest urban center is Pearl City, approximately 0.1 miles to east.

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

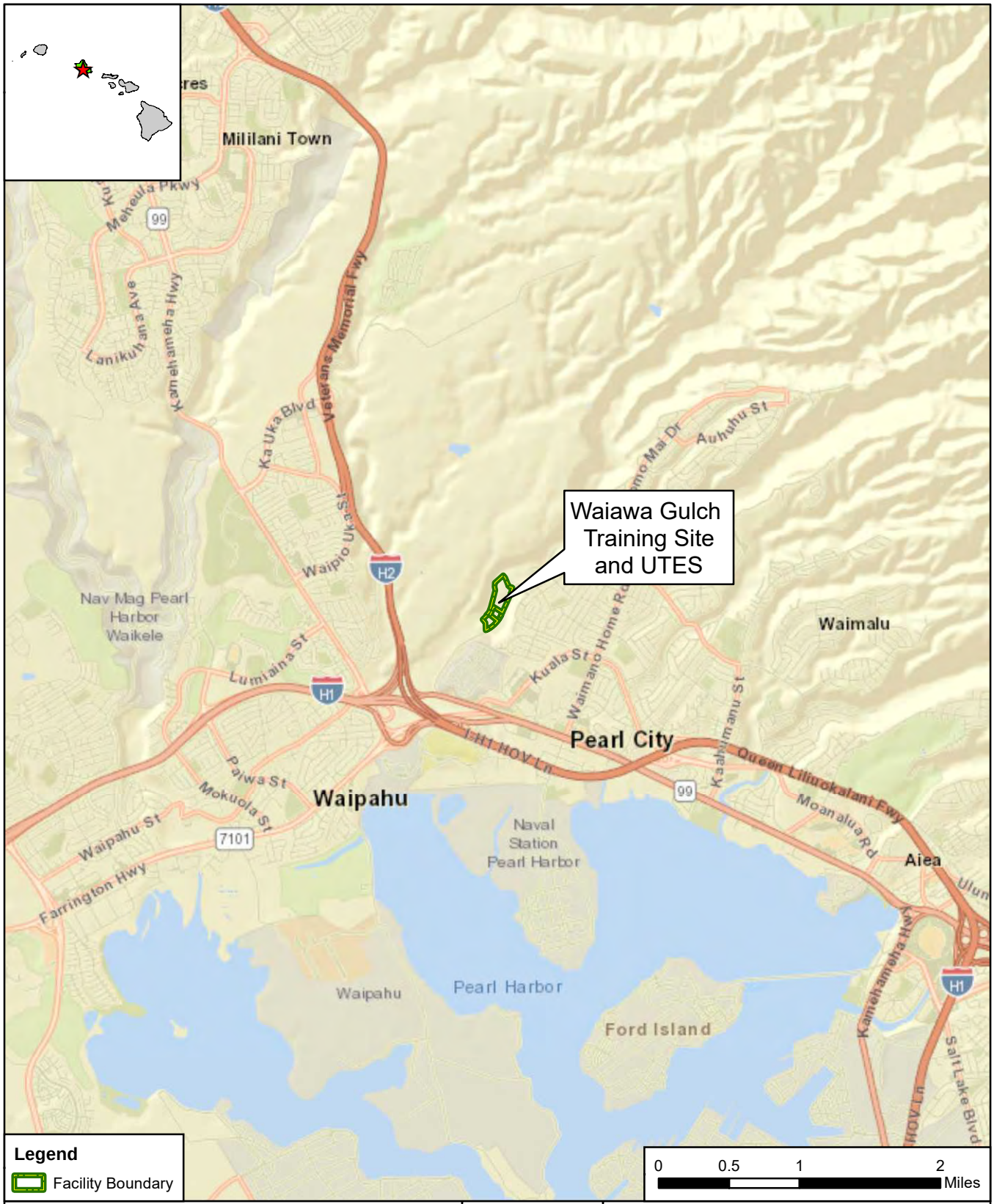
2.2.6 Sensitive Habitat and Threatened/ Endangered Species

The following birds, mammals, and plants are federally endangered, threatened, proposed, and/ or are listed as candidate species for the facility area (US Fish and Wildlife Service [USFWS], 2022).

- **Birds:** Band-rumped storm-petrel, *Oceanodroma castro* (endangered); Hawaiian Duck/Koloa, *Anas wyvilliana* (endangered); Hawaiian stilt, *Himantopus mexicanus knudseni* (endangered); Hawaiian coot, *Fulica americana alai* (endangered); Hawai‘i ‘akepa, *Loxops coccineus* (endangered); Hawaiian common gallinule, *Gallinula galeata sandvicensis (endangered);* Newell's Townsend's shearwater, *Puffinus auricularis newelli (threatened)*
- **Mammals**: Hawaiian hoary bat, *Lasiurus cinereus semotus* (endangered)
- **Flowering plants:** ‘aiea, *Nothocestrum latifolium* (endangered); ‘akoko, *Euphorbia celastroides var. kaenana* (endangered); ‘akoko, *Euphorbia kuwaleana* (endangered); ‘ena‘ana, *Pseudognaphalium sandicensium var. molokaiense* (endangered); Carter’s Panicgrass, *Panicum fauriel var. carteri* (endangered); ‘Ihi, *Portalaca villosa* (endangered); ‘Ohai, *Sesbania tomentosa* (endangered); Pu‘uka‘a, *Cyperus trachysanthos* (endangered); *Spermolepsis hawaiiensis* (no common name, endangered); *Vigna o-wahuensis* (no common name, endangered)
- **Ferns and Allies:** Ihi‘ihi, *Marsilea villosa* (endangered)

2.3 History of PFAS Use

Two potential release areas were identified at the Waiawa Gulch Training Site and UTES during the PA where aqueous film-forming foam (AFFF) may have been used or released historically (AECOM, 2020). The Waiawa Gulch Training Site and UTES includes a Firetruck Pump Test Area as well as a Vehicle Maintenance Area, Firetruck Parking Area, and Storage Buildings potentially impacted by AFFF use or storage. The Firetruck Pump Test Area in the northern portion of the facility is a grassy area used for vehicle storage and for pump testing of a firetruck. Because there is little knowledge regarding historical pump testing activities, AFFF may have been released within the grassy area where testing occurred. The Firetruck Pump Test Area is considered AOI 1. The southern portion of the facility includes the vehicle maintenance area and surrounding areas where AFFF was discharged from the facility firetruck in the early 2000s, the grassy firetruck parking area, and the storage buildings on the edge of the grassy area where AFFF has been stored. These areas comprise AOI 2. Descriptions of AOI 1 and AOI 2 are presented in **Section 3**.



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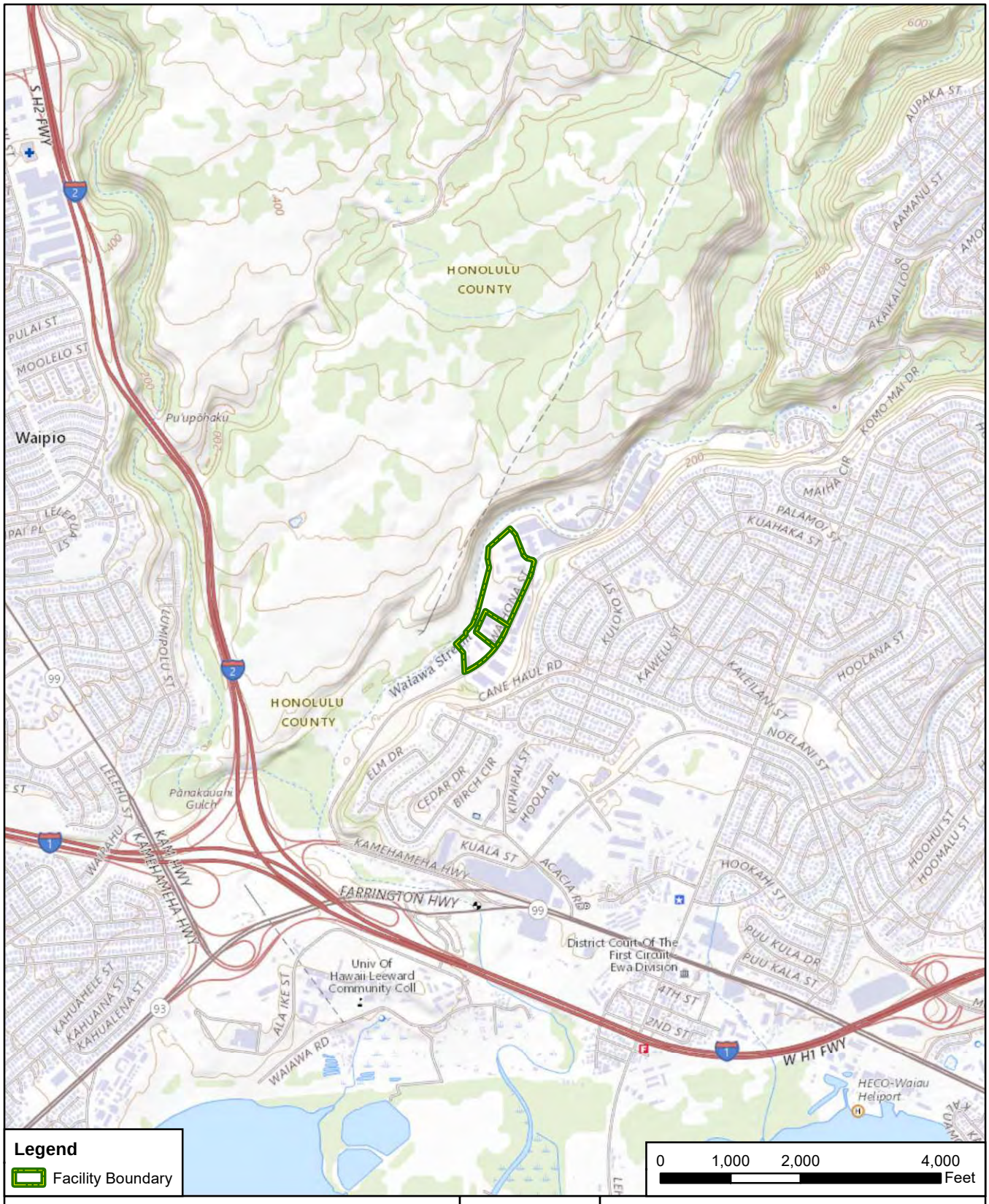
Base Map: Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI,		PM	CM	10/25/2022

Facility Location

AECOM
12420 Milestone Center Drive
Germantown, MD 20876

Figure 2-1



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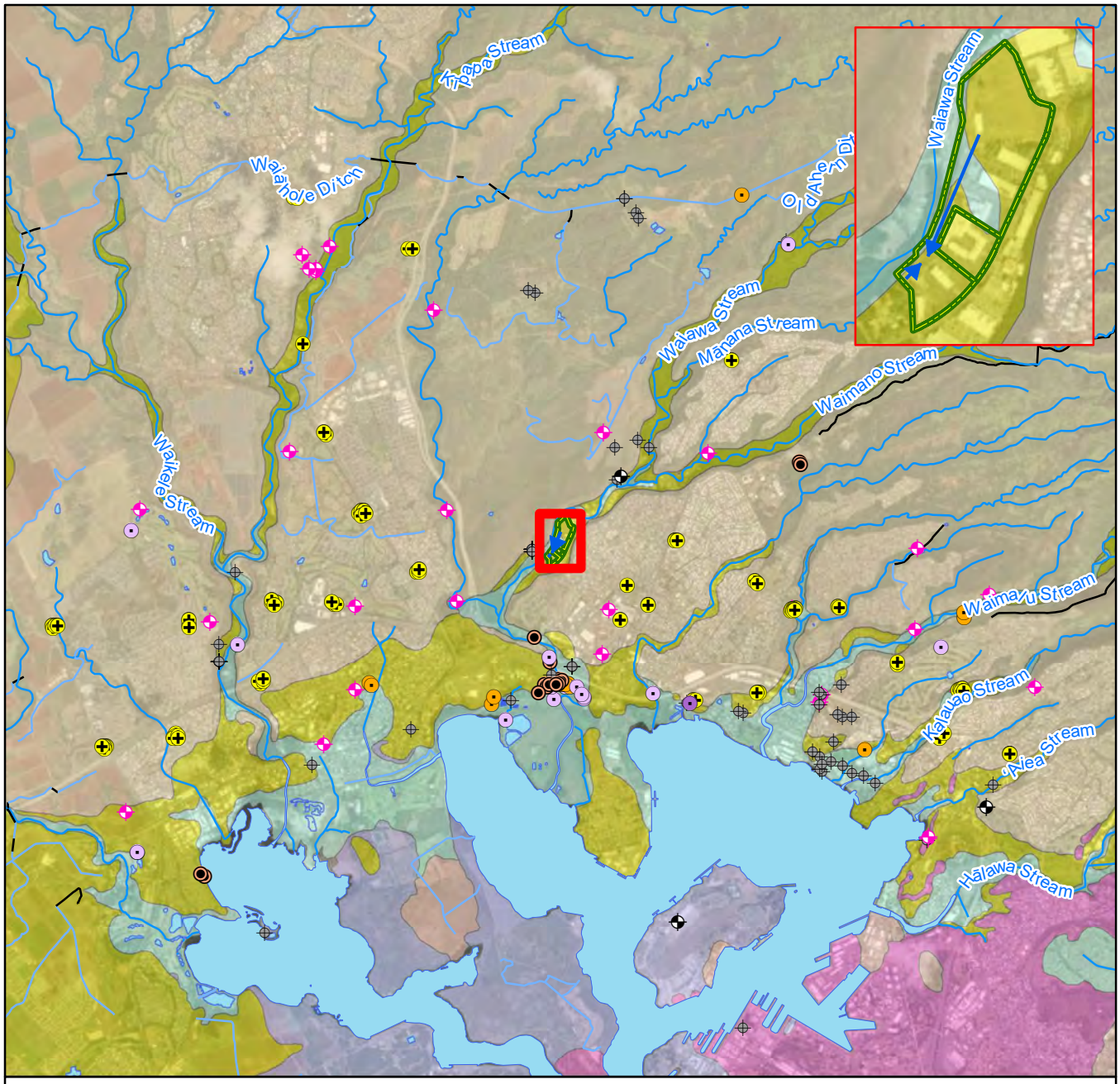
Base Map: USGS The National Map: National Boundaries Dataset, 3DEP Elevation Program,		PM	CM	10/25/2022

Facility Topography

AECOM
12420 Milestone Center Drive
Germantown, MD 20876

Figure 2-2



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Base Map: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community		PM	CM	1/26/2023

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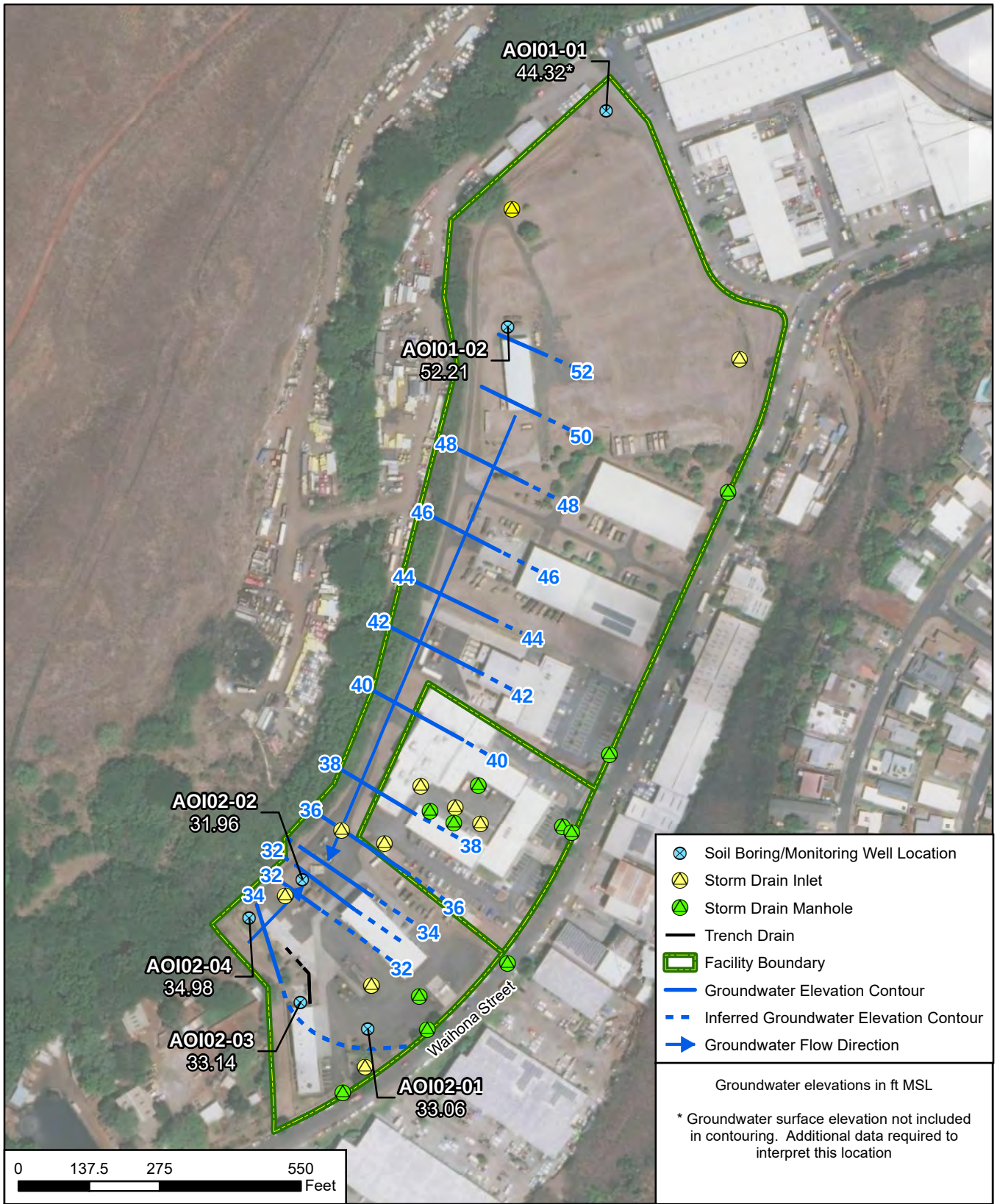
Groundwater Features

AECOM
12420 Milestone Center Drive
Germantown, MD 20876

Figure 2-3



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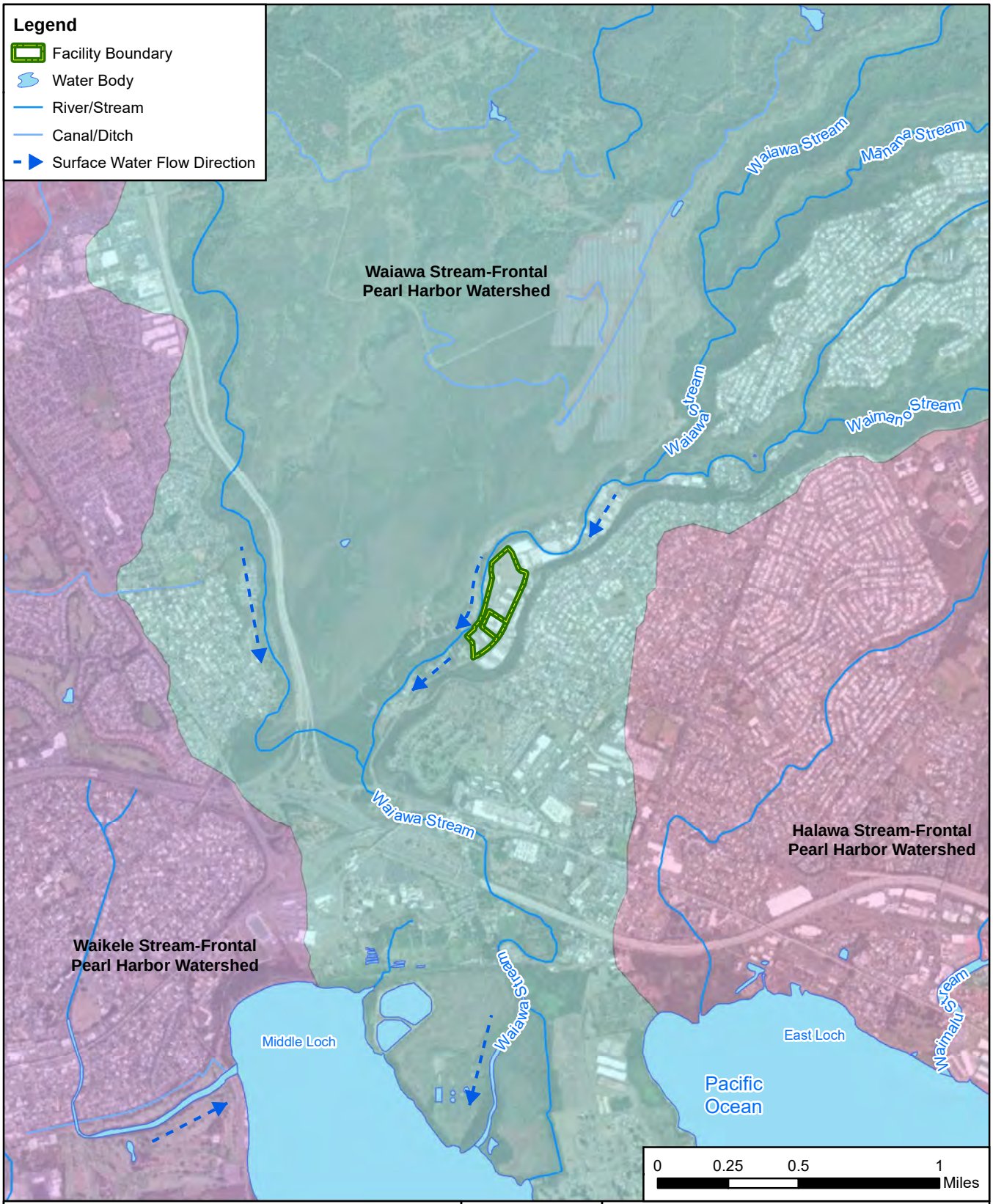
Base Map: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community		PM	CM	1/26/2023

Groundwater Elevations, April 2022

AECOM
12420 Milestone Center Drive
Germantown, MD 20876

Figure 2-4



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Surface Water Features

AECOM
12420 Milestone Center Drive
Germantown, MD 20876

Figure 2-5

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3. Summary of Areas of Interest

The PA evaluated areas where PFAS-containing materials may have been used, stored, disposed, or released historically. Based on the PA findings, four potential release areas were identified at Waiawa Gulch Training Site and UTES and grouped into two AOIs (AECOM, 2020). The potential release areas are shown on **Figure 3-1**.

3.1 AOI 1 Firetruck Pump Test Area

AOI 1 is in the north portion of the facility. Because there is little knowledge regarding historical pump testing activities, AFFF may have been released within the grassy area where testing occurs. AOI 1 is an open grassy area that is used for vehicle storage and for pump testing of the firetruck. According to interviews, the pumps on the truck were tested once a month by spraying water at a tree located within the northern portion of the facility. During the pump testing, the firetruck parked in the northern portion of the facility. The testing activities may have released AFFF into the grass and migrated via surface runoff to the adjacent Waiawa Stream. Stormwater runoff at AOI 1 is captured by storm drains that ultimately discharge into Waiawa Stream, which is located in the vicinity of the storage buildings. The Waiawa Stream flows south to Middle Loch, within Pearl Harbor, and subsequently the Pacific Ocean.

3.2 AOI 2 Vehicle Maintenance Area, Firetruck Parking Area, and Storage Buildings

AOI 2 is in the southern portion of the facility and includes the vehicle maintenance area and surrounding areas where AFFF was discharged from the facility firetruck in the early 2000s, the grassy firetruck parking area, and the storage buildings where AFFF has been stored. One 55-gallon drum of 3% Ansulite AFFF and one 5-gallon pail of 6% 3M AFFF were originally located in the metal portable storage units located north of the maintenance building. Later, the drum and pail were moved to the right side of a future stone hazardous materials storage building. The drum and pail were transported in September 2020 for disposal at a mainland facility.

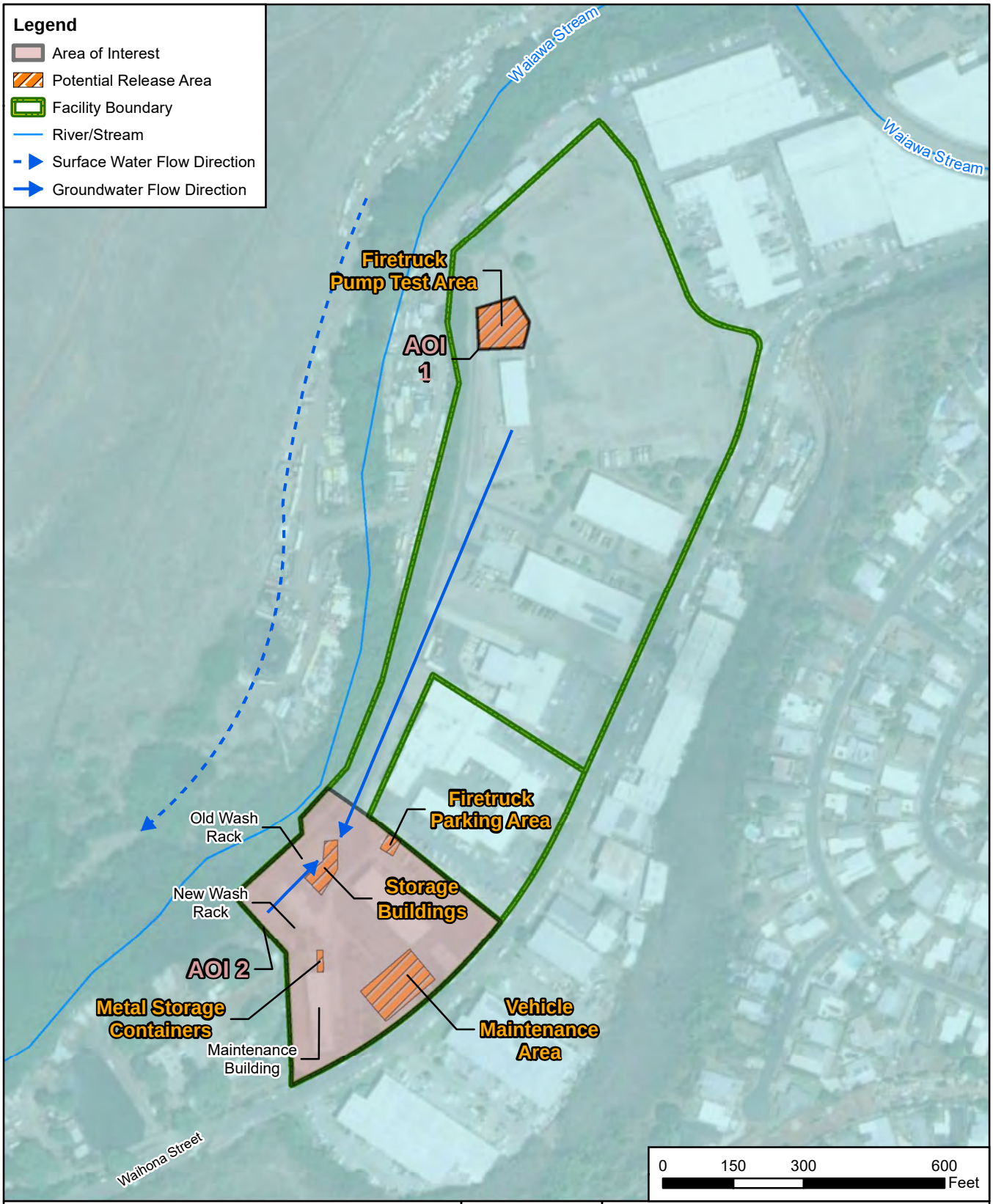
During interviews, it was confirmed that the firetruck was filled with 3% AFFF concentrate in the early 2000s, and an unknown quantity of foam was released in a large open area covered in asphalt between the vehicle maintenance buildings adjacent to Waihona Street. There are two storm drains located within the reported area of release that discharge to Waiawa Stream. One storm drain is located northwest of the release area, and the second is located southeast of the release area. Additionally, Tri-Max™ units may have been serviced at the vehicle maintenance buildings by discharging a volume of foam from the extinguishers into plastic trash bags; however, this is uncertain based on interviews. The disposition of the bagged AFFF is unknown.

AFFF discharge and storage within AOI 2 may have resulted in releases to the paved and grassy areas at the firetruck parking area, vehicle maintenance buildings, and the storage buildings. AFFF released to the pavement may also have drained to storm drains that discharge to an outfall located along Waiawa Stream.

3.3 Adjacent Sources

No potential off-site sources of were identified during the PA; however, fires have been documented at the adjacent, privately owned junk yard. Facility staff noted that a large explosion historically occurred in the 1990s at the adjacent junk yard. The explosion caused items from within the junk yard to be projected over onto the Waiawa Gulch Training Site and UTES property.

According to interviewee’s knowledge of the associated firefighting efforts, the fires were put out with water.



CLIENT	ARNG			
PROJECT	Site Inspection at Waiawa Gulch Training Site and UTES, HI			
REVISED	1/26/2023	GIS BY	MS	1/26/2023
SCALE	1:3,600	CHK BY	JW	1/26/2023
Base Map: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community		PM	CM	1/26/2023

N

Areas of Interest

AECOM
12420 Milestone Center Drive
Germantown, MD 20876

Figure 3-1

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4. Project Data Quality Objectives

As identified during the Data Quality Objective (DQO) process and outlined in the SI Quality Assurance Project Plan (QAPP) Addendum (AECOM, 2021), the objective of the SI is to identify whether there has been a release to the environment at the AOIs identified in the PA. For each AOI, ARNG determines if further investigation is warranted, a removal action is required to address immediate threats, or whether no further action is warranted. This SI evaluated groundwater and soil for presence or absence of relevant compounds at each of the sampled AOIs.

4.1 Problem Statement

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

4.2 Information Inputs

Primary information inputs included:

- The PA for Waiawa Gulch Training Site and UTES (AECOM, 2020);
- Analytical data from groundwater and soil samples collected as part of this SI in accordance with the site-specific Uniform Federal Policy (UFP)-QAPP Addendum (AECOM, 2021); and
- Field data collected during the SI, including groundwater elevation and water quality parameters measured at the time of sampling.

4.3 Study Boundaries

The scope of the SI was bounded by the property limits of the facility (**Figure 2-2**) with respect to soil and groundwater sampling. The scope of the SI was vertically bounded by the basal aquifer underlying the facility. All drilling was performed within the surficial unconsolidated aquifer, not the Pearl Harbor Aquifer. There is not much seasonable variability at the facility, thus temporal boundaries did not limit the scope of the SI. SI activities performed at the facility were conducted in March and April, and the results reflect conditions at the facility at that time. There was no severe weather event just before or during field activities. Additionally, off-facility sampling may be performed if drinking water wells are identified within 1.25 miles of the facility boundary in the southern direction. If the wells to the south are identified as drinking water wells, the proper stakeholders will be notified, and necessary rights-of-entry will be obtained by ARNG with property owner(s). The results of the off-facility potable well sampling will be reported in a separate memorandum.

4.4 Analytical Approach

Samples were analyzed by Pace Analytical Gulf Coast, accredited under the Department of Defense (DoD) Environmental Laboratory Accreditation Program (ELAP; Accreditation Number 74960) and the National Environmental Laboratory Accreditation Program (NELAP; Certificate Number 01955). Data were compared to applicable SLs within this document and decision rules as defined in the SI QAPP Addendum (AECOM, 2021).

Discrete bulk soil samples were collected in the field and sent to the laboratory where they were subsampled and prepared using incremental sample methodology (ISM), per the SI QAPP Addendum. Soil samples were not collected in the field using ISM. A subset of soil samples

collected were also incidentally prepared using standard preparation technique in addition to ISM preparation. When this error was discovered, these samples were reprepared via ISM. For the purpose of this report, the ISM preparation concentration data for those samples are used to evaluate sample locations and are provided on figures and tables. The standard preparation analysis concentration results for those samples is provided in **Appendix F**. Groundwater samples were collected via low-flow sampling ar newly installed permanent monitoring wells and submitted to the laboratory for analysis. Groundwater samples were not collected or prepared using ISM.

4.5 Data Usability Assessment

The Data Usability Assessment (DUA), which is provided in **Appendix A**, is an evaluation at the conclusion of data collection activities that uses the results of both data verification and validation in the context of the overall project decisions or objectives. Using both quantitative and qualitative methods, the assessment determines whether project execution and the resulting data have met installation-specific DQOs. Both sampling and analytical activities are considered to assess whether the collected data are of the right type, quality, and quantity to support the decision-making (DoD, 2019a; DoD, 2019b; USEPA, 2017).

Based on the DUA, the environmental data collected during the SI were found to be acceptable and usable for this SI evaluation with the qualifications documented in the DUA and its associated data validation reports. These data are of sufficient quality to meet the objectives and requirements of the SI QAPP Addendum (AECOM, 2021).

5. Site Inspection Activities

This section describes the environmental investigation and sampling activities that occurred as part of the SI. The SI sampling approach was based on the findings of the PA and implemented in accordance with the following approved documents:

- *Final Site Inspection Programmatic Uniform Federal Policy-Quality Assurance Project Plan (PQAPP)* dated March 2018 (AECOM, 2018a);
- *Final Programmatic Accident Prevention Plan* dated July 2018 (AECOM, 2018b);
- *Final Preliminary Assessment Report, Waiawa Gulch Training Site and Unit Training and Equipment Site, O'ahu, Hawai'i* dated September 2020 (AECOM, 2020);
- *Final Site Inspection Uniform Federal Policy-Quality Assurance Project Plan Addendum, Waiawa Gulch Training Site and Unit Training and Equipment Site, O'ahu, Hawai'i* dated November 2021 (AECOM, 2021); and
- *Final Site Safety and Health Plan, Waiawa Gulch Training Site and Unit Training and Equipment Site, O'ahu, Hawai'i* dated March 2022 (AECOM, 2022).

The SI field activities were conducted from 18 March to 11 April 2022 and consisted of utility clearance, direct push boring, soil sample collection, permanent monitoring well installation via solid flight auger drilling, well development, groundwater sample collection, and land surveying. Field activities were conducted in accordance with the SI QAPP Addendum (AECOM, 2021), except as noted in **Section 5.8**.

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

- Fifteen (15) soil samples from nine boring locations;
- Six groundwater samples from six permanent monitoring wells;
- Nineteen (19) quality assurance (QA)/quality control (QC) samples.

Figure 5-1 provides the sample locations for all media across the facility. **Table 5-1** presents the list of samples collected for each media. Field documentation is provided in **Appendix B**. A Log of Daily Notice of Field Activity was completed throughout the SI field activities, which is provided in **Appendix B1**. Sampling forms are provided in **Appendix B2**, Field Change Requests are provided in **Appendix B3**, and land survey data are provided in **Appendix B4**. Additionally, a photographic log of field activities is provided in **Appendix C**.

5.1 Pre-Investigation Activities

In preparation for the SI field activities, project team members participated in Technical Project Planning (TPP) meetings, performed utility clearance, and sampled decontamination source water. Details for each of these activities are presented below.

5.1.1 Technical Project Planning

The US Army Corps of Engineers (USACE) TPP Process, Engineer Manual (EM) 200-1-2 (USACE, 2016) defines four phases to project planning: 1.) defining the project phase; 2.) determining data needs; 3.) developing data collection strategies; and 4.) finalizing the data

collection plan. The process encourages stakeholder involvement in the SI, beginning with defining overall project objectives, including DQOs, and formulating a sampling approach to address the AOIs identified in the PA.

A combined TPP Meeting 1 and 2 was held on 20 July 2021, prior to SI field activities. The combined TPP Meeting 1 and 2 was conducted in general accordance with EM 200-1-2. The stakeholders for this SI include the ARNG, HIARNG, USACE, and HDOH. EA Engineering, Science, and Technology, Inc. (EA) participated in these meetings for informational purposes. Stakeholders were provided the opportunity to make comments on the technical sampling approach and methods at the combined TPP Meeting 1 and 2. The outcome of the combined TPP Meeting 1 and 2 was memorialized in the SI QAPP Addendum (AECOM, 2021).

A TPP Meeting 3 will be held after the field event to discuss the results of the SI. Meeting minutes for TPP 3 will be included in **Appendix D** of this report. Future TPP meetings will provide an opportunity to discuss the results and findings, and future actions, where warranted.

5.1.2 Utility Clearance

AECOM placed a ticket with the AT&T JHITS for cable toning to provide utility clearance and notify them of intrusive work on 15 March 2022. Additionally, AECOM contracted Ground Penetrating Radar Systems (GPRS), a private utility location service, to perform utility clearance. GPRS performed utility clearance of the proposed boring locations on 18 March 2022 with input from the AECOM field team and facility staff. General locating services and ground-penetrating radar were used to complete the clearance. Additionally, the first 5 feet of each boring were pre-cleared using a hand auger to verify utility clearance in shallow subsurface where utilities would typically be encountered.

5.1.3 Source Water and Sampling Equipment Acceptability

Two potable water sources at Waiawa Gulch Training Site and UTES were sampled on 9 August 2021 to assess usability for decontamination of drilling equipment. Results of the samples collected (WU-DECON-01 and WU-DECON-02) confirmed the sources to be acceptable for use in this investigation; therefore, they were used throughout the field activities. A third sample was collected from the drillers tote tank used to contain the potable water from the decontamination water sources (WU-DECON-03). The results of the decontamination water sample collected from the drillers tote tank confirmed the tote water to be acceptable for use in the investigation as well. The samples were analyzed by LC/MS/MS compliant with QSM 5.3 Table B-15. The results of the decontamination water samples used during the SI are provided in **Appendix F**. A discussion of the results is presented in the DUA (**Appendix A**).

Materials that were used within the sampling zone were confirmed as acceptable for use in the sampling environment. The checklist of acceptable materials for use in the sampling environment was provided in the Standard Operating Procedures (SOPs) appendix to the SI QAPP Addendum (AECOM, 2021). Prior to the start of field work each day, a Sampling Checklist was completed as an additional layer of control. The checklist served as a daily reminder to each field team member regarding the allowable materials within the sampling environment.

5.2 Soil Borings and Soil Sampling

Borings were installed by GeoTek Hawai'i, Inc., a Hawai'i-licensed driller, under direction by AECOM. Borings were installed in grass areas where applicable, to avoid disturbing concrete or asphalt surfaces. One boring was installed through an asphalt surface (AOI02-01). Soil samples were collected via direct push technology (DPT), in accordance with the SI QAPP Addendum (AECOM, 2021). A GeoProbe® 7822DT dual-tube sampling system was used to collect continuous

soil cores to the target depth. A hand auger was used to collect soil from the top 5 feet of the boring, in accordance with AECOM utility clearance procedures. The soil boring locations are shown on **Figure 5-1**, and depths are provided **Table 5-1**. Several boring locations were adjusted within a 50-feet offset for reasons including drill rig access and utility avoidance. Soil boring location AOI02-04 was relocated approximately 57 feet to the northwest to avoid subsurface and overhead utilities, as described in **Section 5.8**.

In general, two discrete bulk soil samples (between 1 kilogram [kg] and 1.5 kg) were collected from the vadose zone for chemical analysis from each soil boring where permanent monitoring wells were installed: one bulk surface soil sample (0 to 2 feet bgs), and one bulk subsurface soil sample from approximately 2 feet above the groundwater table extending down to the groundwater interface. Additionally, three locations where permanent monitoring wells were not installed were sampled for only bulk surface soil from 0 to 2 feet bgs. Bulk samples were collected from soil spanning the entire 2-foot interval identified from the hand auger or DPT liner and submitted to the laboratory for incremental subsampling and analysis. Soil samples were not collected via ISM but were prepared at the laboratory via ISM.

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

SI soil boring depths ranged from 24.25 to 56 feet bgs. The borings consisted primarily of lean clay and sandy silt with varying concentrations of gravel. Fat clay was reported in one boring (AOI01-02) at 5 to 10 feet bgs. Many of the logs also reported fill (sampled as sandy silt, lean clay, and well graded sand) at the surface. At greater depths, weathered basalt and basalt rock flour were observed interbedded with the unconsolidated alluvial clayey and silty soils.

Each soil sample was collected into laboratory-supplied PFAS-free plastic bags and labeled using a PFAS-free marker or pen. Samples were packaged on ice and transported via Federal Express (FedEx) under standard chain of custody (CoC) procedures to the laboratory and analyzed by LC/MS/MS compliant with QSM 5.3 Table B-15, total organic carbon (TOC) (USEPA Method 9060A), and pH (USEPA Method 9045D) in accordance with the SI QAPP Addendum (AECOM, 2021). Grain size analysis was not performed, in accordance with the SI QAPP Addendum, because discrete horizontal and vertical clay units were not encountered in the field (AECOM, 2021). Clay layers were present across the facility.

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

DPT borings were converted to permanent monitoring wells in accordance with the SI QAPP Addendum (AECOM, 2021).

5.3 Permanent Well Installation and Groundwater Sampling

During the SI, six permanent monitoring wells were installed within or downgradient of potential source areas. The locations of the wells are shown on **Figure 5-1**.

A GeoProbe® 7822DT drill rig was used to install six 2-inch diameter monitoring wells into the unconfined alluvium underlying the facility; the wells were not installed into the basal aquifer. The monitoring wells were constructed with Schedule 40 PVC, flush threaded 10-foot sections of riser, 0.010-inch slotted well screen, and a threaded bottom cap. A filter pack of Cemex clean, graded, kiln-dried, Monterey sand was installed in the annulus around the well screen to a minimum of 2 feet above the well screen. A seal was installed above the filter pack using hydrated 3/8 inch bentonite chip pellets, followed by hydrated bentonite installed in lifts to within two feet of the well pad, per the HDOH Hazard Evaluation and Emergency Response Office (HEER) Technical Guidance Manual (TGM) (HDOH, 2021). A Field Change Request describing the use of hydrated bentonite lifts instead of bentonite grout is included in **Appendix B3**. The hydrated bentonite was overlain with 2 feet of neat Portland cement. All monitoring wells were completed with flush mount well vaults and constructed with a concrete well pad. The screen interval of each groundwater monitoring well is provided in **Table 5-2**.

Development and sampling of wells was completed in accordance with the SI QAPP Addendum (AECOM, 2021). The newly installed monitoring wells were developed no sooner than 24 hours following installation by pumping and surging using a variable speed submersible pump. Samples were collected no sooner than 24 hours following development via low-flow sampling methods using a peristaltic pump or a QED Sample Pro® bladder pump with disposable PFAS-free, HDPE tubing. A peristaltic pump was used to sample the shallower wells at AOI 2; a bladder pump was used to sample the deeper wells at AOI 1. New tubing was used at each well, and the pumps were decontaminated between each well. The pump tubing, or pump itself when using a bladder pump, were placed at the center of the well screen during purging. The wells were purged at a rate determined in the field to minimize draw down during pre-sample purging, and during sample collection. Water quality parameters (e.g., temperature, specific conductance, pH, dissolved oxygen [DO], and oxidation-reduction potential [ORP]) were measured using a water quality meter and recorded on the field sampling form (**Appendix B2**). Purging was considered complete when three consecutive field parameter measurements of temperature, pH, specific conductivity, DO and ORP stabilized within approximately 10% and the turbidity was at or below 10 nephelometric turbidity units (NTU) or within ± 10% if above 10 NTU. Water levels were measured to the nearest 0.01 inch and recorded. Additionally, a subsample of each groundwater sample was collected in a separate container, and a shaker test was completed to determine the presence or absence of foaming capability in the sample. No foaming was noted in any of the groundwater samples.

Each sample was collected into laboratory-supplied PFAS-free HDPE bottles and labeled using a PFAS-free marker or pen. Samples were packaged on ice and transported via FedEx under standard CoC procedures to the laboratory and analyzed by LC/MS/MS compliant with QSM 5.3 Table B-15 in accordance with the SI QAPP Addendum (AECOM, 2021). **Appendix G** contains the CoCs by sample delivery group within the laboratory reports.

Field duplicate samples were collected at a rate of 10% and analyzed for the same parameters as the accompanying samples. MS/MSDs were collected at a rate of 5% and analyzed for the same parameters as the accompanying samples. One field reagent blank was collected in accordance with the PQAPP (AECOM, 2018a). A temperature blank was placed in each cooler to ensure that samples were preserved at or below 6 °C during shipment.

5.4 Synoptic Water Level Measurements

A synoptic groundwater gauging event was performed on 6 April 2022. Groundwater elevation measurements were collected from the six new permanent monitoring wells. Water level measurements were taken from the northern side of the well casing. A groundwater flow contour map is provided in **Figure 2-4**. Groundwater elevation data are provided in **Table 5-2**.

5.5 Surveying

The northern side of each well casing was surveyed by Hawai'i-licensed land surveyors following guidelines provided in the SI QAPP Addendum SOPs (AECOM, 2021). Survey data from the newly installed wells on the facility were collected on 11 April 2022 in the applicable World Geodetic System 1984 Universal Transverse Mercator Zone 4 datum (horizontal) as well as the North American Datum 1983 State Plane Hawai'i Zone 3 (horizontal), and Hawai'i's Local Mean Sea Level datum (vertical). The surveyed well data are provided in **Appendix B4**.

5.6 Investigation-Derived Waste

As of the date of this report, the disposal of investigation-derived waste (IDW) is not regulated federally. IDW generated during the SI is considered non-hazardous waste and was managed in accordance with the SI QAPP Addendum (AECOM, 2021) and with the DA Guidance for Addressing Releases of PFAS, Q18 (DA, 2018).

All solid (i.e., soil cuttings) and liquid (i.e., purge water, development water, and decontamination fluids) IDW were contained in labeled, 55-gallon steel drums and left onsite in a waste storage area designated by HIARNG. ARNG will manage and dispose of the solid and liquid IDW under a separate contract in accordance with SOP No. 042A for Treating Liquid Investigation-Derived Material (Purge water, drilling water, and decontamination fluids) (EA, 2021). Other solids such as spent personal protective equipment, plastic sheeting, tubing, rope, unused monitoring well construction materials, and other environmental media generated during the field activities were disposed of as non-hazardous solid waste to be transported to a licensed solid waste landfill.

5.7 Laboratory Analytical Methods

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

5.8 Deviations from SI QAPP Addendum

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

- During the pre-drilling utility clearance, one boring (AOI02-04) was relocated due to accessibility issues. The original location was within 10 feet of overhead power lines. The proposed drilling location was moved approximately 57 feet to the northwest to allow for safe drilling away from overhead power lines, subsurface utilities, and the newly installed facility wash rack infrastructure. This action was documented in a Field Change Request provided in **Appendix B3**.
- During permanent monitoring well installation, the well construction details were revised. Based on the current HDOH HEER TGM and recommendation from the experienced, Hawai'i-licensed driller, the use of slurry/grout seals is not recommended due to the potential

for infiltration and clogging of the filter pack. The permanent wells were constructed with a seal above the sand filter pack using hydrated 3/8-inch bentonite chip pellets, followed by hydrated bentonite installed in lifts to prevent bridging instead of a bentonite grout, as described in the SI QAPP Addendum (AECOM, 2021). These actions were documented in a nonconformance report dated July 2022 and are provided in **Appendix B3.**

Table 5-1
Site Inspection Samples by Medium
Site Inspection Report, Waiawa UTES, Hawai'i

Sample Identification	Sample Collection Date/Time	Sample Depth (feet bgs)	LC/MS/MS compliant with QSM 5.3 Table B-15 (ISM Preparation)	LC/MS/MS compliant with QSM 5.3 Table B-15 (Standard Preparation)	TOC (USEPA Method 9060A)	pH (USEPA Method 9045D)	Comments
Soil Samples							
AOI01-01-SB-0-2	3/21/2022 10:45	0 - 2	x				
AOI01-01-SB-0-2-D	3/21/2022 10:45	0 - 2	x				FD
AOI01-01-SB-0-2-MS	3/21/2022 10:45	0 - 2	x				MS
AOI01-01-SB-0-2-MSD	3/21/2022 10:45	0 - 2	x				MSD
AOI01-01-SB-37-39	3/21/2022 9:45	37 - 39	x				
AOI01-02-SB-0-1	3/28/2022 9:00	0 - 1	x	x	x	x	
AOI01-02-SB-0-1-D	3/28/2022 9:10	0 - 1	x	x			FD
AOI01-02-SB-25.5-27.5	3/28/2022 11:05	25.5 - 27.5	x	x			
AOI02-01-SB-0-2	3/24/2022 13:40	0 - 2	x	x			
AOI02-01-SB-14.5-16.5	3/24/2022 14:10	14.5 - 16.5	x	x	x	x	
AOI02-01-SB-14.5-16.5-D	3/24/2022 14:30	14.5 - 16.5			x	x	FD
AOI02-01-SB-14.5-16.5-MS	3/24/2022 14:25	14.5 - 16.5			x	x	MS
AOI02-01-SB-14.5-16.5-MSD	3/24/2022 14:25	14.5 - 16.5			x	x	MSD
AOI02-02-SB-0-2	3/23/2022 9:40	0 - 2	x				
AOI02-02-SB-14-16	3/23/2022 11:50	14 - 16	x				
AOI02-03-SB-0-2	3/24/2021 9:35	0 - 2	x	x			
AOI02-03-SB-16.5-18.5	3/24/2022 10:05	16.5 - 18.5	x	x			
AOI02-04-SB-0-2	3/23/2022 14:30	0 - 2	x				
AOI02-04-SB-14-16	3/23/2022 15:55	14 - 16	x				
AOI02-05-SB-0.0-0.5	3/29/2022 13:50	0 - 0.5	x	x			
AOI02-06-SB-0.0-0.5	3/29/2022 14:00	0 - 0.5	x	x			
AOI02-07-SB-0-2	3/29/2022 14:10	0 - 2	x	x			
Groundwater Samples							
AOI01-01-GW	4/5/2022 12:30	NA		x			
AOI01-02-GW	4/5/2022 13:35	NA		x			
AOI02-01-GW	4/4/2022 15:45	NA		x			
AOI02-01-GW-D	4/4/2022 15:45	NA		x			FD
AOI02-01-GW-MS	4/4/2022 15:45	NA		x			MS
AOI02-01-GW-MSD	4/4/2022 15:45	NA		x			MSD
AOI02-02-GW	4/5/2022 8:30	NA		x			
AOI02-03-GW	4/5/2022 14:55	NA		x			
AOI02-04-GW	4/5/2022 15:45	NA		x			

Table 5-1
Site Inspection Samples by Medium
Site Inspection Report, Waiawa UTES, Hawai'i

Sample Identification	Sample Collection Date/Time	Sample Depth (feet bgs)	LC/MS/MS compliant with QSM 5.3 Table B-15 (ISM Preparation)	LC/MS/MS compliant with QSM 5.3 Table B-15 (Standard Preparation)	TOC (USEPA Method 9060A)	pH (USEPA Method 9045D)	Comments
Quality Control Samples							
WU-ERB-01	3/21/2022 12:00	NA		x			Hand Auger
WU-ERB-03	3/28/2022 11:20	NA		x			Hand Trowel
WU-ERB-04	3/28/2022 15:00	NA		x			Macrocore Shoe
WU-ERB-05	3/28/2022 15:05	NA		x			DT32 Drill Tooling
WU-ERB-06	3/28/2022 15:30	NA		x			Solid Flight Auger Shoe
WU-ERB-07	4/5/2022 17:00	NA		x			Development Pump
WU-ERB-08	4/6/2022 10:00	NA		x			Water Level Meter
WU-Decon-01	8/9/2021 8:55	NA		x			Decontamination Water Source
WU-Decon-02	8/9/2021 9:15	NA		x			Decontamination Water Source
WU-Decon-03	3/29/2022 9:45	NA		x			Driller Water Tank
WU-FRB-01	3/21/2022 13:30	NA	x				Lab-provided Sand
WU-FRB-02	4/1/2022 10:45	NA		x			Lab-provided Water

Notes:
ASTM = American Society for Testing and Materials
bgs = below ground surface
ERB = equipment rinsate blank
FD = field duplicate
FRB = field reagent blank
LC/MS/MS = Liquid Chromatography Mass Spectrometry
MS/MSD = matrix spike/ matrix spike duplicate
QSM = Quality Systems Manual
TOC = total organic carbon
USEPA = United States Environmental Protection Agency

Table 5-2
Soil Boring Depths, Monitoring Well Screen Intervals, and Groundwater Elevations
Site Inspection Report, Waiawa UTES, Hawai'i

Area of Interest	Boring Location	Soil Boring Depth (feet bgs)	Monitoring Well Screen Interval (feet bgs)[1]	Top of Casing Elevation (local mean sea level)	Ground Surface Elevation (local mean sea level)	Depth to Water (feet btoc)	Depth to Water (feet bgs)	Groundwater Elevation (local mean sea level)
1	AOI01-01	56	45 - 55	89.40	89.70	45.08	45.39	44.32
	AOI01-02	48	37 - 47	83.13	83.50	30.92	31.28	52.21
2	AOI02-01	25.25	15 - 25	48.86	49.13	15.8	16.08	33.06
	AOI02-02	25.25	15 - 25	49.61	49.98	17.65	18.02	31.96
	AOI02-03	25.25	15 - 25	50.35	50.75	17.21	17.61	33.14
	AOI02-04	24.25	14 - 24	50.40	50.76	15.42	15.78	34.98
	AOI02-05	0.5	NA	NA	48.21	NA	NA	NA
	AOI02-06	0.5	NA	NA	48.67	NA	NA	NA
	AOI02-07	2	NA	NA	48.55	NA	NA	NA

Notes:

[1] Well screen set above total depth to capture groundwater interface

bgs = below ground surface
btoc = below top of casing
NA = not applicable

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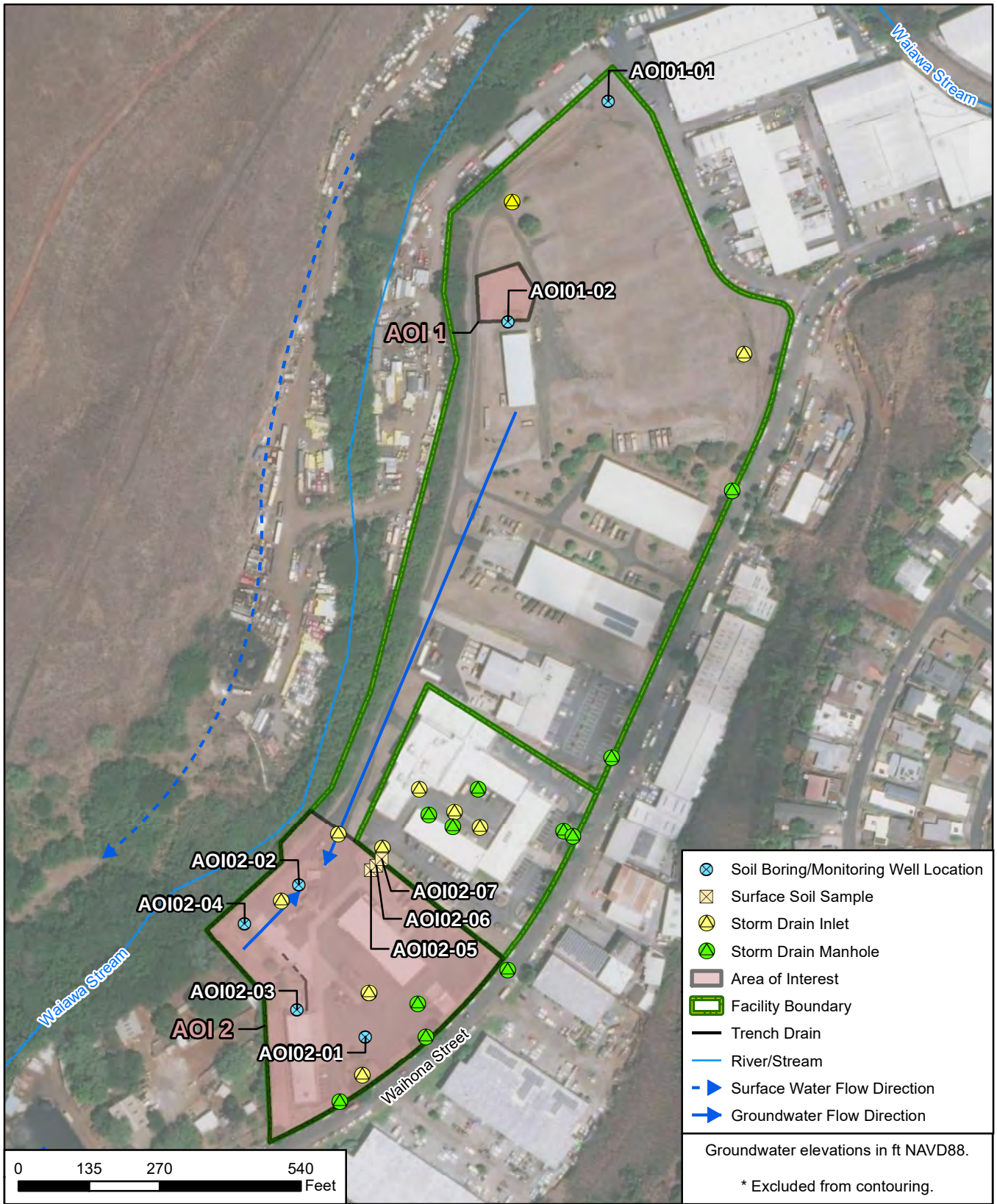

CLIENT	ARNG			
PROJECT	Site Inspection at Waiawa Gulch Training Site and UTES, HI			
REVISED	1/26/2023	GIS BY	MS	1/26/2023
SCALE	1:3,240	CHK BY	JW	1/26/2023
Base Map: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community		PM	CM	1/26/2023

N

Site Inspection Sample Locations

AECOM
12420 Milestone Center Drive
Germantown, MD 20876

Figure 5-1

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6. Site Inspection Results

This section presents the analytical results of the SI. The SLs used in this evaluation are presented in **Section 6.1**. A discussion of the results for each AOI is provided in **Section 6.3** and **Section 6.4**. **Table 6-2** through **Table 6-5** present results in soil or groundwater for the relevant compounds. Tables that contain all results are provided in **Appendix F**, and the laboratory reports are provided in **Appendix G**.

6.1 Screening Levels

The DoD has adopted a policy to retain facilities in the CERCLA process based on risk-based SLs for soil and groundwater, as described in a memorandum from the OSD dated 6 July 2022 (Assistant Secretary of Defense, 2022). The ARNG program under which this SI was performed follows this DoD policy. Should the maximum site concentration for sampled media exceed the SLs established in the OSD memorandum, the AOI will proceed to the next phase under CERCLA. The SLs established in the OSD memorandum apply to the five compounds presented on **Table 6-1** below.

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

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

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

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

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

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

6.2 Soil Physicochemical Analyses

To provide basic soil parameter information, soil samples were analyzed for TOC, and pH, which are important for evaluating transport through the soil medium. **Appendix F** contains the results of the TOC and pH sampling. Grain size analysis was not performed, in accordance with the SI QAPP Addendum, because discrete horizontal and vertical clay units were not encountered in the field (AECOM,2021).

The data collected in this investigation will be used in subsequent investigations, where appropriate, to assess fate and transport. According to the Interstate Technology Regulatory Council (ITRC), several important partitioning mechanisms include hydrophobic and lipophobic effects, electrostatic interactions, and interfacial behaviors. At relevant environmental pH values, certain PFAS are present as organic anions and are therefore relatively mobile in groundwater (Xiao et al., 2015), but tend to associate with the organic carbon fraction that may be present in soil or sediment (Higgins and Luthy, 2006; Guelfo and Higgins, 2013). When sufficient organic carbon is present, organic carbon normalized distribution coefficients (K_{oc} values) can help in evaluating transport potential, though other geochemical factors (for example, pH and presence of polyvalent cations) may also affect PFAS sorption to solid phases (ITRC, 2018).

6.3 AOI 1

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

6.3.1 AOI 1 Soil Analytical Results

Figure 6-1 through **Figure 6-5** present the ranges of detections in soil. **Table 6-2** through **Table 6-4** summarize the soil results.

Surface soil was sampled from 0 to 2 feet bgs and deep subsurface soil collected from 25.5 to 39 feet bgs at boring locations AOI01-01 and AOI01-02. PFOS, PFHxS, and PFNA were detected in surface soil samples at concentrations less than 1.73 J (estimated concentration) micrograms per kilogram (µg/kg); all detected concentrations were below the SLs in surface soil. PFOA and PFBS were not detected in surface soil. In the deep subsurface soil, PFOS and PFHxS were detected at one location, AOI01-02 (25.5 to 27.5 feet bgs), with concentrations of 0.524 J µg/kg and 0.325 J µg/kg, respectively. PFOA, PFBS, and PFNA were not detected in deep subsurface soil.

6.3.2 AOI 1 Groundwater Analytical Results

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

Groundwater was sampled from permanent monitoring wells AOI01-01 and AOI01-02. The following exceedances of the SLs were measured:

- PFOA was detected above the SL of 6 nanograms per liter (ng/L) at AOI01-02, with a concentration of 18.0 ng/L.
- PFOS was detected above the SL of 4 ng/L at AOI01-02, with a concentration of 11.1 ng/L.
- PFHxS was detected above the SL of 39 ng/L at AOI01-02, with a concentration of 89.3 ng/L.

PFBS and PFNA were detected below their SLs at AOI01-02. PFOA and PFOS were detected below their SLs at AOI01-01; PFBS, PFHxS, and PFNA were not detected at AOI01-01.

6.3.3 AOI 1 Conclusions

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

6.4 AOI 2

This section presents the analytical results for soil and groundwater in comparison to SLs for AOI 2: Vehicle Maintenance Area, Firetruck Parking Area, and Storage Buildings. The results in soil and groundwater are summarized on **Table 6-2** through **Table 6-5**. Soil and groundwater results are presented on **Figure 6-1** through **Figure 6-7**.

6.4.1 AOI 2 Soil Analytical Results

Figure 6-1 through **Figure 6-5** present the ranges of detections in soil. **Table 6-2** through **Table 6-4** summarize the soil results.

Surface soil was sampled from 0 to 2 feet bgs at boring locations AOI02-01 through AOI02-07. Soil was also sampled from the shallow subsurface (14 to 16.5 feet bgs) at boring locations AOI02-01, AOI02-02, and AOI02-04; and deeper subsurface (16.5 to 18.5 feet bgs) from boring location AOI02-03.

PFOA, PFOS, PFBS, PFHxS, and PFNA were detected in soil at concentrations less than 2.50 J+ (estimated concentration, biased high) µg/kg and below their SLs in surface soil.

PFOS, PFHxS, and PFNA were detected in shallow subsurface soil, at concentrations less than 0.387 J µg/kg; all detected concentrations were below the SLs in shallow subsurface soil. PFOA and PFBS were not detected in shallow subsurface soil.

In deep subsurface soil, PFOS and PFHxS were detected at concentrations of 0.125 J µg/kg and 0.076 J µg/kg, respectively; PFOA, PFBS, and PFNA were not detected.

6.4.2 AOI 2 Groundwater Analytical Results

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

Groundwater was sampled from permanent monitoring wells AOI2-01 through AOI02-04. The following exceedances of the SLs were measured:

- PFOA was detected above the SL of 6 ng/L in all four wells, with concentrations ranging from 13.3 ng/L to 57.0 ng/L.
- PFOS was detected above the SL of 4 ng/L in all four wells, with concentrations ranging from 31.2 ng/L to 271 ng/L.
- PFHxS was detected above the SL of 39 ng/L in all four wells, with concentrations ranging from 39.7 ng/L to 1,110 ng/L.

PFBS and PFNA were detected below their SLs in all four wells.

6.4.3 AOI 2 Conclusions

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

Table 6-2
PFOA, PFOS, PFBS, PFNA, and PFHxS ISM Results in Surface Soil
Site Inspection Report, Waiawa Gulch Training Site and UTES

Area of Interest		AOI01								AOI02											
Sample ID		AOI01-01-SB-0.0-2.0		AOI01-01-SB-0.0-2.0-D		AOI01-02-SB-0.0-1.0		AOI01-02-SB-0.0-1.0-D		AOI02-01-SB-0.0-2.0		AOI02-02-SB-0.0-2.0		AOI02-03-SB-0.0-2.0		AOI02-04-SB-0.0-2.0		AOI02-05-SB-0.0-0.5		AOI02-06-SB-0.0-0.5	
Sample Date		03/21/2022		03/21/2022		03/28/2022		03/28/2022		03/24/2022		03/23/2022		03/24/2022		03/23/2022		03/29/2022		03/29/2022	
Depth		0-2 ft		0-2 ft		0-1 ft		0-1 ft		0-2 ft		0-2 ft		0-2 ft		0-2 ft		0-0.5 ft		0-0.5 ft	
Analyte	OSD Screening Level [a]	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual
Soil, LCMSMS compliant with QSM 5.3 Table B-15 (µg/kg)																					
PFBS	1900	ND	UJ	ND	UJ	ND	UJ	ND	UJ	0.046	J	ND	UJ	ND	UJ	0.023	J	ND	UJ	ND	UJ
PFHxS	130	0.050	J	0.042	J	ND	UJ	0.032	J	1.41	J	ND	UJ	ND	UJ	0.054	J	0.048	J+	0.032	J
PFNA	19	0.053	J	0.056	J	0.081	J	0.100	J	ND	UJ	0.736	J	0.049	J	0.046	J	0.795	J+	0.185	J
PFOA	19	ND	UJ	ND	UJ	ND	UJ	ND	UJ	ND	UJ	0.271	J	ND	UJ	0.127	J	0.347	J+	0.166	J
PFOS	13	1.73	J	1.65	J	0.547	J	0.675	J	2.48	J	0.735	J	0.223	J	0.498	J	2.50	J+	0.944	J

Notes

Grey Fill — Detected concentration exceeded OSD Screening Levels

ND = Analyte not detected above the LOD

LOD values are presented in Appendix F.

References

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

Interpreted Qualifiers

J = Estimated concentration

J+ = Estimated concentration, biased high

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

Chemical Abbreviations

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

Acronyms and Abbreviations

AOI	Area of Interest
D	duplicate
DL	detection limit
ft	feet
HQ	hazard quotient
ID	identification
ISM	Incremental Sampling Methodology
LCMSMS	liquid chromatography with tandem mass spectrometry
LOD	limit of detection
ND	analyte not detected above the LOD
OSD	Office of the Secretary of Defense
QSM	Quality Systems Manual
Qual	interpreted qualifier
SB	soil boring
USEPA	United States Environmental Protection Agency
UTES	Unit Training and Equipment Site
µg/kg	micrograms per kilogram

Table 6-2
PFOA, PFOS, PFBS, PFNA, and PFHxS ISM Results in Surface Soil
Site Inspection Report, Waiawa Gulch Training Site and UTES

Area of Interest		AOI02	
Sample ID		AOI02-07-SB-0.0-2.0	
Sample Date		03/29/2022	
Depth		0-2 ft	
Analyte	**OSD Screening Level [a]**	**Result**	**Qual**
Soil, LCMSMS compliant with QSM 5.3 Table B-15 (µg/kg)			
PFBS	1900	ND	UJ
PFHxS	130	ND	UJ
PFNA	19	0.068	J
PFOA	19	0.099	J
PFOS	13	0.455	J

Notes

Grey Fill — Detected concentration exceeded OSD Screening Levels

ND = Analyte not detected above the LOD

LOD values are presented in Appendix F.

References

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

Interpreted Qualifiers

J = Estimated concentration

J+ = Estimated concentration, biased high

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

Chemical Abbreviations

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

Acronyms and Abbreviations

AOI	Area of Interest
D	duplicate
DL	detection limit
ft	feet
HQ	hazard quotient
ID	identification
ISM	Incremental Sampling Methodology
LCMSMS	liquid chromatography with tandem mass spectrometry
LOD	limit of detection
ND	analyte not detected above the LOD
OSD	Office of the Secretary of Defense
QSM	Quality Systems Manual
Qual	interpreted qualifier
SB	soil boring
USEPA	United States Environmental Protection Agency
UTES	Unit Training and Equipment Site
µg/kg	micrograms per kilogram

Table 6-3
PFOA, PFOS, PFBS, PFNA, and PFHxS ISM Results in Shallow Subsurface Soil
Site Inspection Report, Waiawa Gulch Training Site and UTES

Area of Interest		AOI02					
Sample ID		AOI02-01-SB-14.5-16.5		AOI02-02-SB-14.0-16.0		AOI02-04-SB-14.0-16.0	
Sample Date		03/24/2022		03/23/2022		03/23/2022	
Depth		14.5-16.5 ft		14-16 ft		14-16 ft	
Analyte	**OSD Screening Level [a]**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**
Soil, LCMSMS compliant with QSM 5.3 Table B-15 (µg/kg)							
PFBS	25000	ND	UJ	ND	UJ	ND	UJ
PFHxS	1600	ND	UJ	0.065	J	0.387	J
PFNA	250	0.021	J	0.032	J	ND	UJ
PFOA	250	ND	UJ	ND	UJ	ND	UJ
PFOS	160	0.132	J	0.162	J	ND	UJ

Notes

Grey Fill — Detected concentration exceeded OSD Screening Levels

ND = Analyte not detected above the LOD

LOD values are presented in Appendix F.

References

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

Interpreted Qualifiers

J = Estimated concentration

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

Chemical Abbreviations

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

Acronyms and Abbreviations

AOI	Area of Interest
DL	detection limit
ft	feet
HQ	hazard quotient
ID	identification
ISM	Incremental Sampling Methodology
LCMSMS	liquid chromatography with tandem mass spectrometry
LOD	limit of detection
ND	analyte not detected above the LOD
OSD	Office of the Secretary of Defense
QSM	Quality Systems Manual
Qual	interpreted qualifier
SB	soil boring
USEPA	United States Environmental Protection Agency
UTES	Unit Training and Equipment Site
µg/kg	micrograms per kilogram

Table 6-4
PFOA, PFOS, PFBS, PFNA, and PFHxS ISM Results in Deep Subsurface Soil
Site Inspection Report, Waiawa Gulch Training Site and UTES

Area of Interest	AOI01		AOI01		AOI02	
Sample ID	AOI01-01-SB-37.0-39.0		AOI01-02-SB-25.5-27.5		AOI02-03-SB-16.5-18.5	
Sample Date	03/22/2022		03/28/2022		03/24/2022	
Depth	37-39 ft		25.5-27.5 ft		16.5-18.5 ft	
Analyte	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**
Soil, LCMSMS compliant with QSM 5.3 Table B-15 (µg/kg)						
PFBS	ND	UJ	ND	UJ	ND	UJ
PFHxS	ND	UJ	0.325	J	0.076	J
PFNA	ND	UJ	ND	UJ	ND	UJ
PFOA	ND	UJ	ND	UJ	ND	UJ
PFOS	ND	UJ	0.524	J	0.125	J

Notes

ND = Analyte not detected above the LOD

LOD values are presented in Appendix F.

Interpreted Qualifiers

J = Estimated concentration

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

Chemical Abbreviations

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

Acronyms and Abbreviations

AOI	Area of Interest
DL	detection limit
ft	feet
ID	identification
ISM	Incremental Sampling Methodology
LCMSMS	liquid chromatography with tandem mass spectrometry
LOD	limit of detection
ND	analyte not detected above the LOD
QSM	Quality Systems Manual
Qual	interpreted qualifier
SB	soil boring
UTES	Unit Training and Equipment Site
µg/kg	micrograms per kilogram

Table 6-5
PFOA, PFOS, PFBS, PFNA, and PFHxS Results in Groundwater
Site Inspection Report, Waiawa Gulch Training Site and UTES

Area of Interest		AOI01				AOI02									
Sample ID		AOI01-01-GW		AOI01-02-GW		AOI02-01-GW		AOI02-01-GW-D		AOI02-02-GW		AOI02-03-GW		AOI02-04-GW	
Sample Date		04/05/2022		04/05/2022		04/04/2022		04/04/2022		04/05/2022		04/05/2022		04/05/2022	
Analyte	OSD Screening Level [a]	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual
Water, LCMSMS compliant with QSM 5.3 Table B-15 (ng/l)															
PFBS	601	ND	U	13.7		8.00		8.66		56.2		125		12.5	
PFHxS	39	ND	U	89.3		39.7		40.6		1110		409		459	
PFNA	6	ND	U	1.97	J	2.71	J	2.68	J	5.44		1.32	J	1.01	J
PFOA	6	1.26	J	18.0		13.3		13.7		57.0		27.9		25.3	
PFOS	4	2.64	J	11.1		31.4		31.2		271		212		71.2	

Notes

Grey Fill — Detected concentration exceeded OSD Screening Levels

ND = Analyte not detected above the LOD

LOD values are presented in Appendix F.

References

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

Interpreted Qualifiers

J = Estimated concentration

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

Chemical Abbreviations

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

Acronyms and Abbreviations

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

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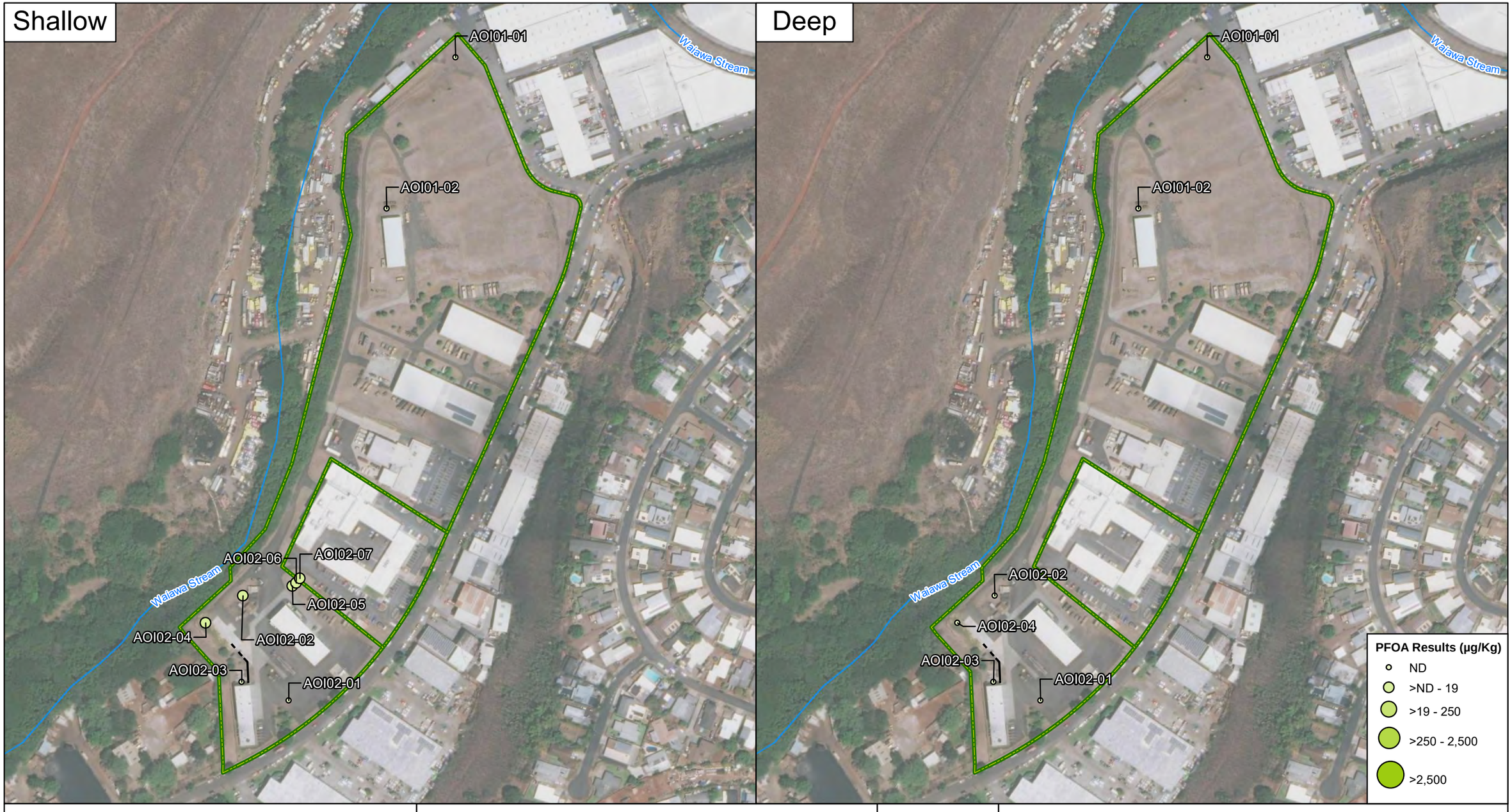


CLIENT	ARNG			
PROJECT	Site Inspection at Waiawa Gulch Training Site and UTES, HI			
REVISED	1/26/2023	GIS BY	MS	1/26/2023
SCALE	1:3,240	CHK BY	JW	1/26/2023
Base Map: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community		PM	CM	1/26/2023

Facility Boundary
River/Stream
Trench Drain

0 135 270 540 Feet

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

N

PFOA Detections in Soil

AECOM
12420 Milestone Center Drive
Germantown, MD 20876

Figure 6-1

Shallow

Deep

AOI01-01
AOI01-02
AOI02-01
AOI02-02
AOI02-03
AOI02-04
AOI02-05
AOI02-06
AOI02-07
Waiawa Stream

PFOS Results (µg/Kg)
- ND
- >ND - 13
- >13 - 160
- >160 - 1,600
- >1,600

CLIENT	ARNG			
PROJECT	Site Inspection at Waiawa Gulch Training Site and UTES, HI			
REVISED	1/26/2023	GIS BY	MS	1/26/2023
SCALE	1:3,240	CHK BY	JW	1/26/2023
Base Map: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community		PM	CM	1/26/2023

Facility Boundary
River/Stream
Trench Drain

0 135 270 540 Feet

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

N

PFOS Detections in Soil

AECOM
12420 Milestone Center Drive
Germantown, MD 20876

Figure 6-2

Shallow

Deep

AOI01-01
AOI01-02
Waiawa Stream
AOI02-06
AOI02-07
AOI02-02
AOI02-05
AOI02-04
AOI02-03
AOI02-01

PFBS Results (µg/Kg)
- ND
- >ND - 10
- >10 - 1,900
- >1,900 - 25,000
- >25,000

CLIENT	ARNG			
PROJECT	Site Inspection at Waiawa Gulch Training Site and UTES, HI			
REVISED	1/26/2023	GIS BY	MS	1/26/2023
SCALE	1:3,240	CHK BY	JW	1/26/2023
Base Map: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community		PM	CM	1/26/2023

Facility Boundary
River/Stream
Trench Drain

0 135 270 540 Feet

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

N

PFBS Detections in Soil

AECOM
12420 Milestone Center Drive
Germantown, MD 20876

Figure 6-3

Shallow

Deep

AOI01-01
AOI01-02
Waiawa Stream
AOI02-06
AOI02-07
AOI02-05
AOI02-02
AOI02-04
AOI02-03
AOI02-01

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

CLIENT	ARNG			
PROJECT	Site Inspection at Waiawa Gulch Training Site and UTES, HI			
REVISED	1/26/2023	GIS BY	MS	1/26/2023
SCALE	1:3,240	CHK BY	JW	1/26/2023
Base Map: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community		PM	CM	1/26/2023

Facility Boundary
River/Stream
Trench Drain

0 135 270 540 Feet

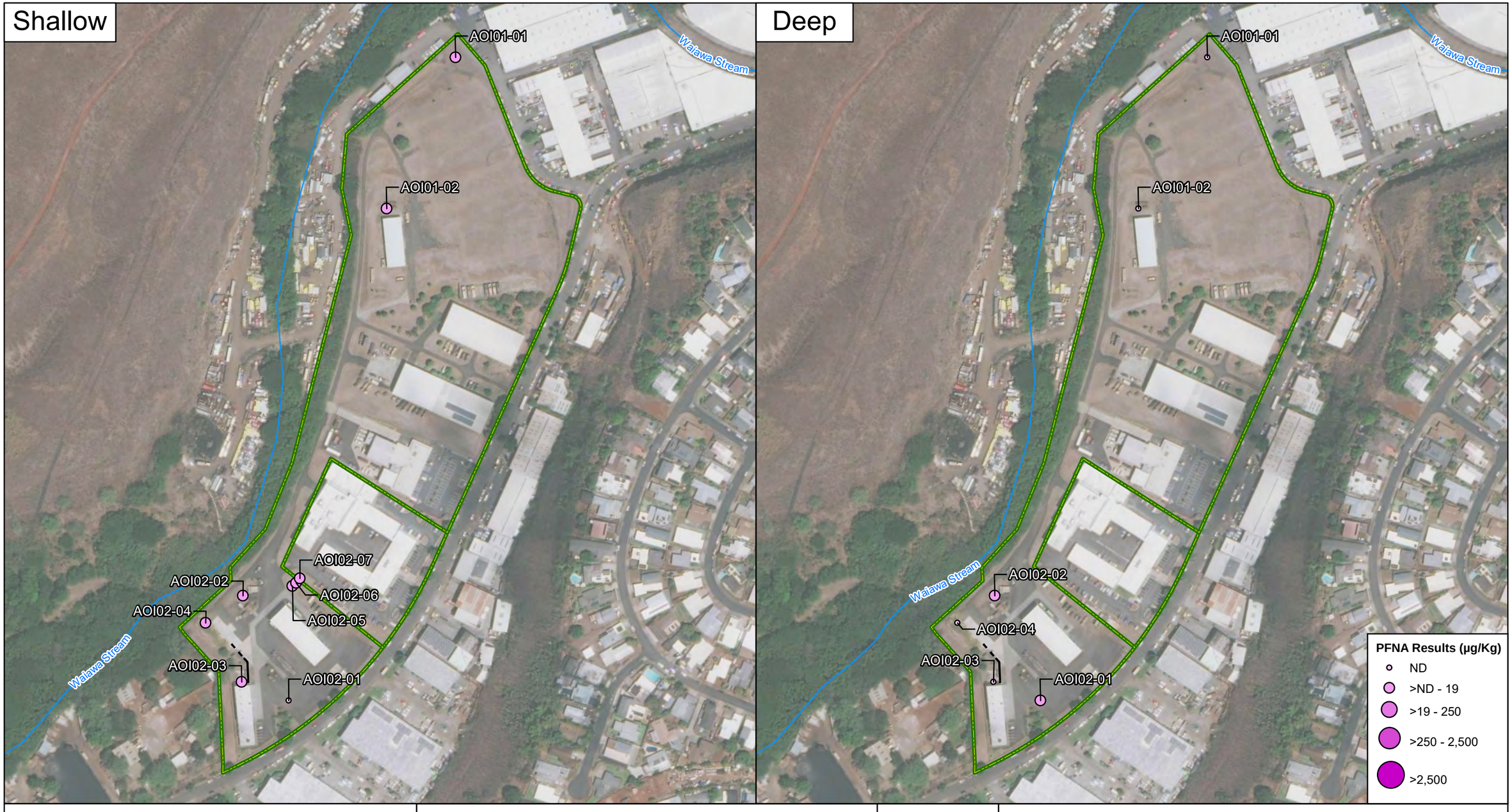
Exceedances of the OSD SL are depicted with a yellow halo.
Depth intervals shown represent respective sampling position within a given soil boring location.

N

PFHxS Detections in Soil

AECOM
12420 Milestone Center Drive
Germantown, MD 20876

Figure 6-4



CLIENT	ARNG			
PROJECT	Site Inspection at Waiawa Gulch Training Site and UTES, HI			
REVISED	1/26/2023	GIS BY	MS	1/26/2023
SCALE	1:3,240	CHK BY	JW	1/26/2023
Base Map: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community		PM	CM	1/26/2023

Facility Boundary
River/Stream
Trench Drain

0 135 270 540 Feet

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

N

PFNA Detections in Soil

AECOM
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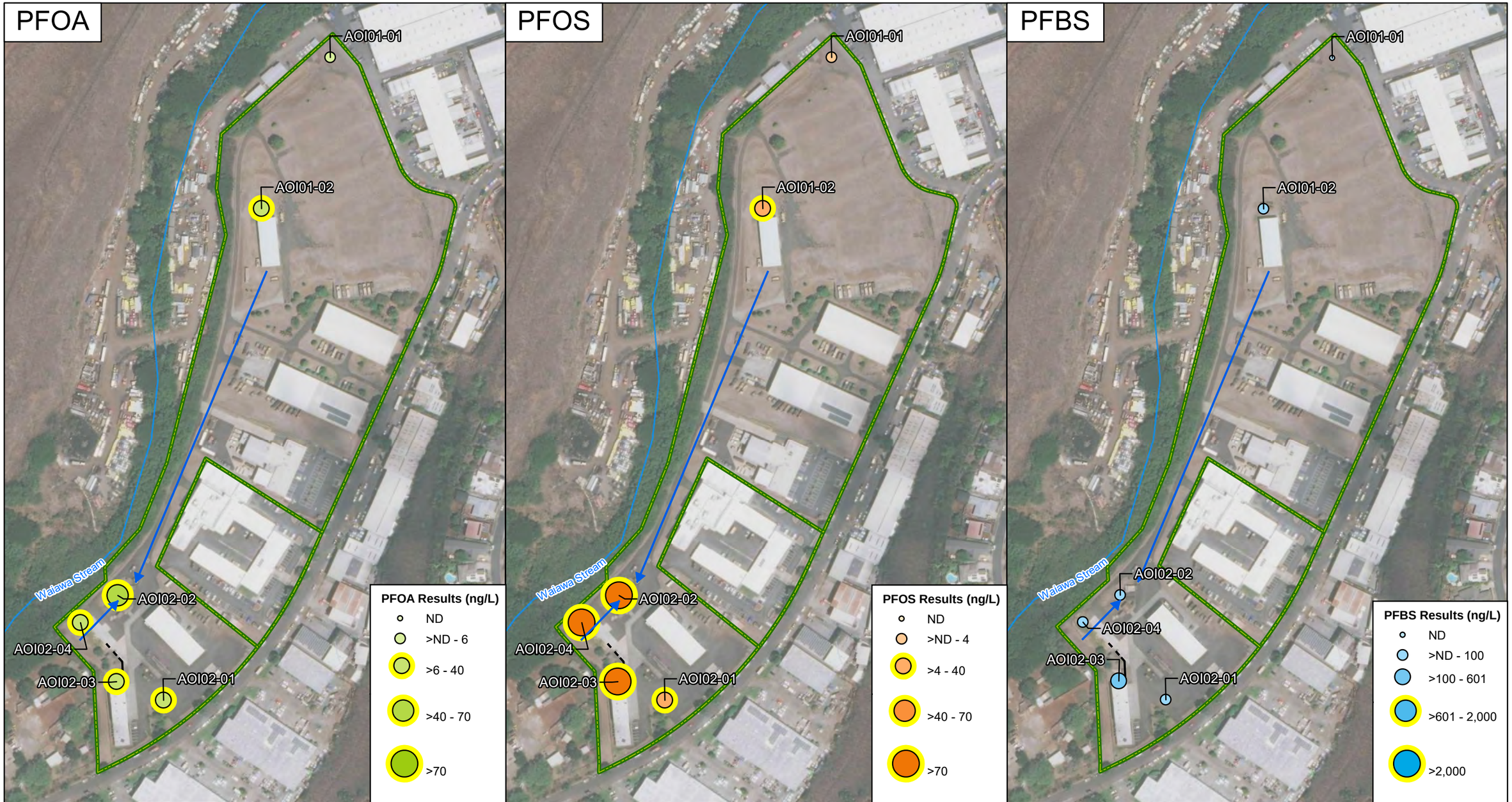
Germantown, MD 20876

Figure 6-5



CLIENT	ARNG			
PROJECT	Site Inspection at Waiawa Gulch Training Site and UTES, HI			
REVISED	1/26/2023	GIS BY	MS	1/26/2023
SCALE	1:3,240	CHK BY	JW	1/26/2023
Base Map: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community		PM	CM	1/26/2023

Facility Boundary
River/Stream
Trench Drain
Groundwater Flow Direction

0 135 270 540 Feet

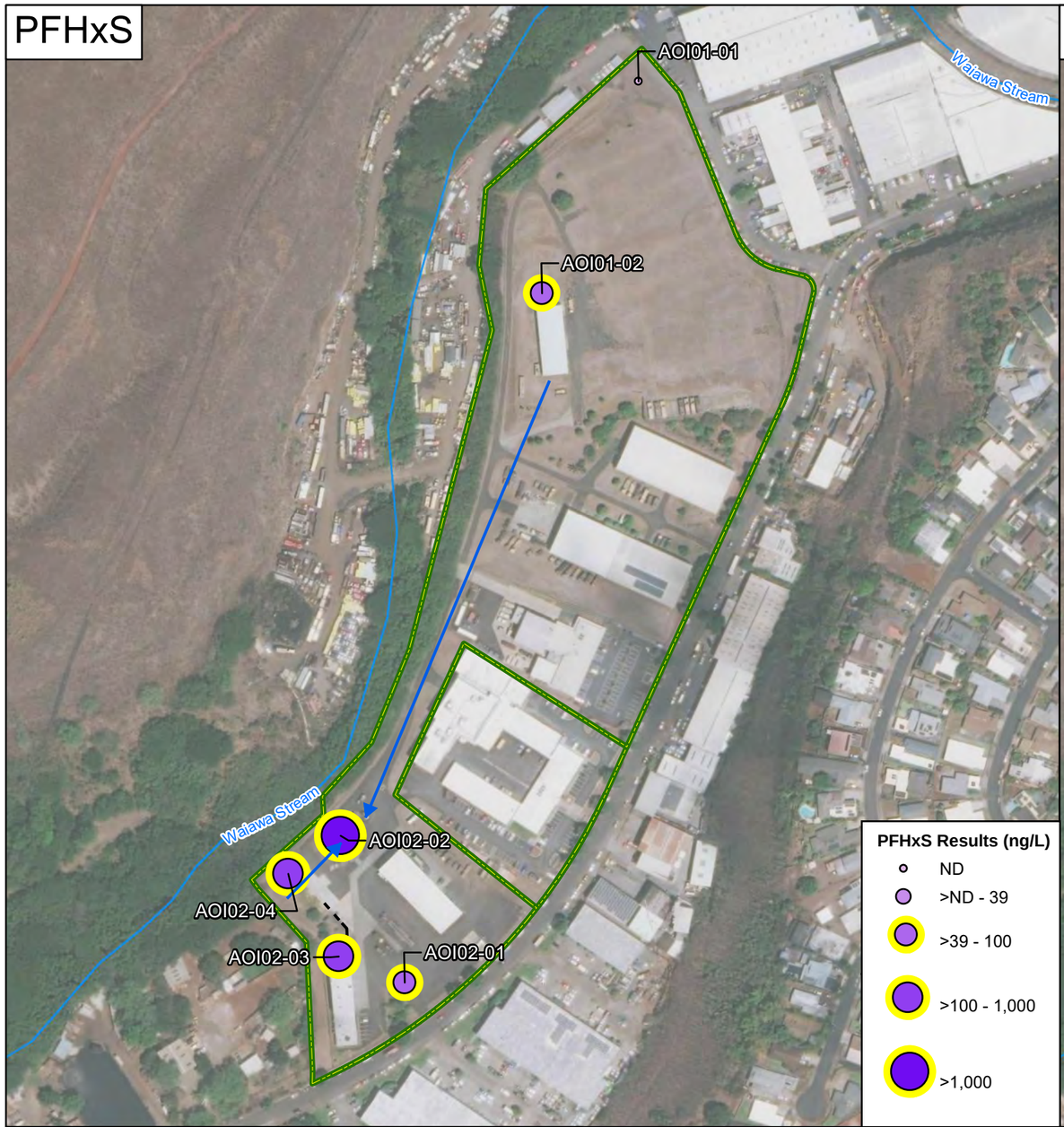
Exceedances of the OSD SL are depicted with a yellow halo.

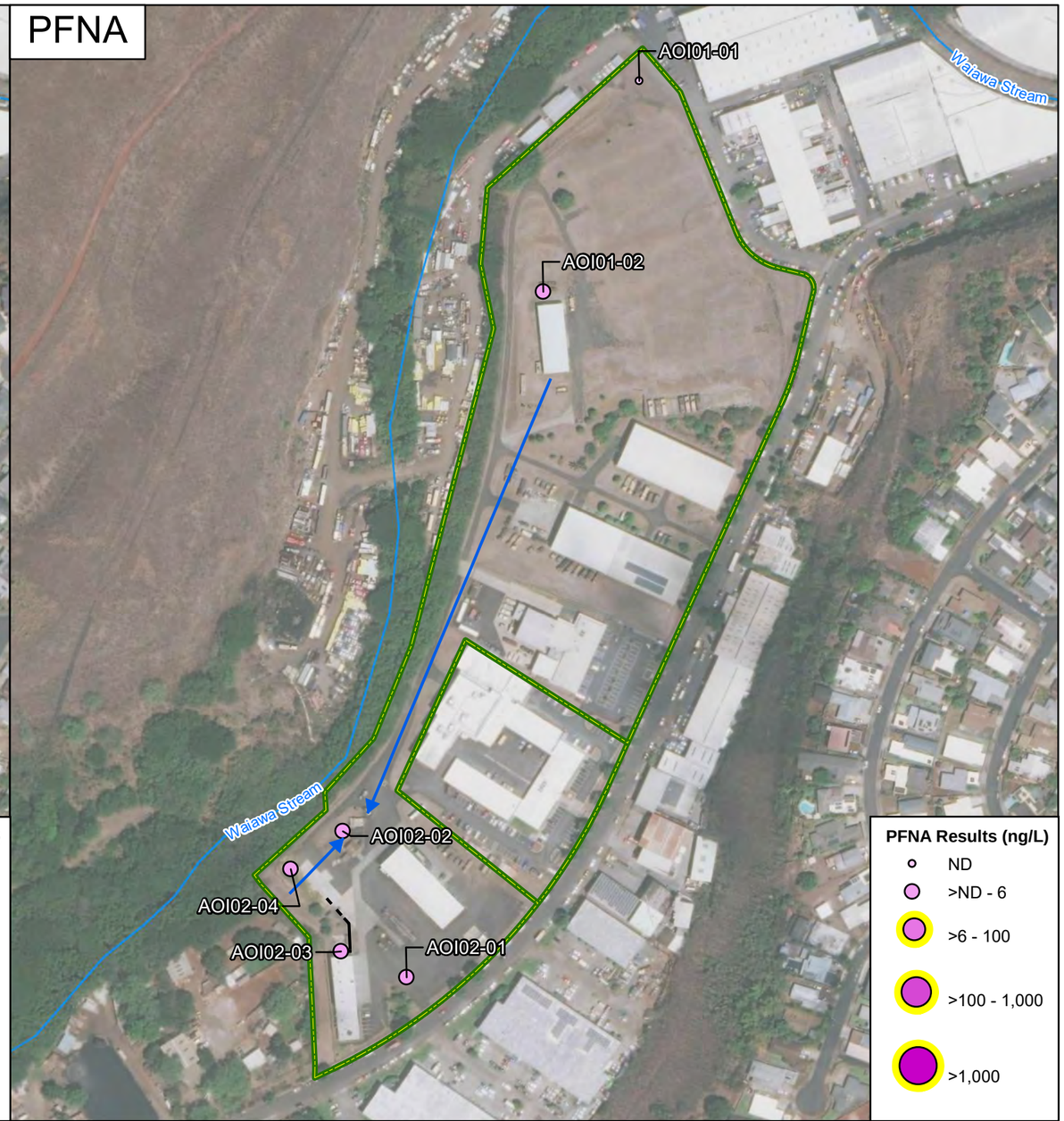
N

PFOA, PFOS, and PFBS Detections in Groundwater

AECOM
12420 Milestone Center Drive
Germantown, MD 20876

Figure 6-6





CLIENT	ARNG			
PROJECT	Site Inspection at Waiawa Gulch Training Site and UTES, HI			
REVISED	1/26/2023	GIS BY	MS	1/26/2023
SCALE	1:3,240	CHK BY	JW	1/26/2023
Base Map: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community		PM	CM	1/26/2023

Facility Boundary
River/Stream
Trench Drain
Groundwater Flow Direction

0 135 270 540 Feet

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

N

PFHxS and PFNA Detections in Groundwater

AECOM
12420 Milestone Center Drive
Germantown, MD 20876

Figure 6-7

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7. Exposure Pathways

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

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

If any of these elements are missing, the pathway is incomplete. The CSM figures use an empty circle symbol to represent an incomplete exposure pathway. Areas with an incomplete pathway generally warrant no further action. However, the pathway is considered potentially complete if the relevant compounds are detected, in which case the CSM figure uses a half-filled circle symbol to represent a potentially complete exposure pathway. Additionally, a completely filled circle symbol is used to indicate when a potentially complete exposure pathway has detections of relevant compounds (PFOA, PFOS, PFBS, PFHxS, and PFNA) above the SLs. Areas with an identified potentially complete pathway that have detections of the relevant compounds above the SLs may warrant further investigation. Although the CSMs indicate whether potentially complete exposure pathways may exist, the recommendation for future study in an RI or no action at this time is based on the comparison of the SI analytical results for the relevant compounds to the SLs.

In general, the potential routes of exposure to the relevant compounds are ingestion and inhalation. Human exposure via the dermal contact pathway may occur, and current risk practice suggests it is an insignificant pathway compared to ingestion; however, exposure data for dermal pathways are sparse and continue to be the subject of toxicological study. The receptors evaluated are consistent with those listed in USEPA guidance for risk screening (USEPA, 2001). Receptors at the facility include site workers (e.g., facility staff and visiting soldiers), construction workers, trespassers (though unlikely due to restricted access), residents outside the facility boundary, and recreational users outside of the facility boundary.

7.1 Soil Exposure Pathway

The SI results in soil were used to determine whether a potentially complete pathway exists between the source and potential receptors at AOI 1 and AOI 2 based on the aforementioned criteria.

7.1.1 AOI 1

AOI 1 is the grassy area in the north portion of the facility, where historical firetruck parking and pump testing activities may have resulted in the release of AFFF.

PFOS, PFHxS, and PFNA were detected below their SLs in surface soil at AOI 1. Site workers, future construction workers, and trespassers could contact constituents in surface soil via

incidental ingestion and inhalation of dust. Therefore, the surface soil exposure pathway for site workers, future construction workers, and trespassers are potentially complete. There was no active construction observed at AOI 1 during SI field work. PFOS and PFHxS were detected in subsurface soil at AOI 1. Construction workers could contact constituents in subsurface soil via incidental ingestion; therefore, the subsurface soil exposure pathway for future construction workers is potentially complete. The CSM for AOI 1 is presented on **Figure 7-1**.

7.1.2 AOI 2

AOI 2 is in the southern portion of the facility and includes the vehicle maintenance area and surrounding areas where AFFF was discharged from the facility firetruck in the early 2000s, the grassy firetruck parking area, and the storage buildings on the edge of the grassy area where AFFF has been stored. AFFF discharge and storage within AOI 2 may have resulted in releases to grassy areas at the firetruck parking area, vehicle maintenance area, and the storage buildings.

PFOA, PFOS, PFBS, PFHxS, and PFNA were detected below their SLs in surface soil at AOI 2. Site workers and construction workers could contact constituents in surface soil via incidental ingestion and inhalation of dust. Therefore, the surface soil exposure pathway for site workers, future construction workers, and trespassers are potentially complete. There was no active construction observed at AOI 2 during SI field work. PFOS, PFHxS, and PFNA were detected in subsurface soil at AOI 2; therefore, the subsurface soil exposure pathway for future construction workers is potentially complete. The CSM for AOI 2 is presented on **Figure 7-1**.

7.2 Groundwater Exposure Pathway

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

7.2.1 AOI 1

PFOA, PFOS, and PFHxS were detected above their SLs in groundwater samples collected at AOI 1. Groundwater elevations across the facility indicate groundwater from AOI 1 flows south following the flow of the basal aquifer south towards Pearl Harbor. Domestic, agricultural, and irrigation wells are present in the southern, downgradient direction within 4 miles of the facility; however, most of these wells are set in the basal aquifer at depths greater than 75 feet bgs (State of Hawai'i CWRM, 2022). At least one well is listed as being set in the alluvial aquifer. Although the groundwater samples collected during this SI were collected from shallow wells set in the alluvium, it is conservatively assumed that the pathway for exposure to off-facility residents via ingestion of groundwater is potentially complete. Because the Waiawa Gulch Training Site and UTES facility is provided drinking water from municipal wells that range in depth from 140 to 151 feet bgs and are cross-gradient to the southeast of the facility, the pathway for exposure to site workers via ingestion of groundwater is considered incomplete. Depths to water measured at AOI 1 in April 2022 during the SI ranged from 31.28 to 45.39 feet bgs. Therefore, the ingestion exposure pathway for future construction workers is considered incomplete. The CSM for AOI 1 is presented on **Figure 7-1**.

7.2.2 AOI 2

PFOA, PFOS, and PFHxS were detected above their SLs in groundwater samples collected at AOI 2. Although groundwater elevations at AOI 2 indicate a convergence on AOI02-02, it is presumed that the prevailing flow of groundwater from AOI 2 is to the south. This presumption is based on the groundwater elevations observed at each AOI and the understood flow direction of the regional basal aquifer. For the same reasons described in **Section 7.2.1**, the pathway for exposure to off-facility residents via ingestion of groundwater is considered potentially complete,

and the pathway for exposure to site workers, future construction workers, and trespassers via ingestion of groundwater is considered incomplete. Depths to water measured at AOI 2 in April 2022 during the SI ranged from 15.78 to 18.02 feet bgs. Therefore, the ingestion exposure pathway for future construction workers is considered incomplete. The CSM for AOI 2 is presented on **Figure 7-1**.

7.3 Surface Water and Sediment Exposure Pathway

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

7.3.1 AOI 1

PFAS are water soluble and can migrate readily from soil to surface water via leaching and run-off. Because PFOA, PFOS, PFBS, PFHxS, and PFNA were detected in soil and/or groundwater at AOI 1, it is possible that those compounds may have migrated from soil to storm drains in the area that capture runoff. Stormwater runoff at AOI 1 discharges into Waiawa Stream, which is located in the vicinity of the storage buildings. The Waiawa Stream flows south to Middle Loch, within Pearl Harbor, and subsequently the Pacific Ocean. Therefore, the surface water and sediment ingestion exposure pathway for recreational users of those surface water bodies is considered potentially complete. There is no surface water or sediment on the Waiawa Gulch Training Site and UTES property. As a result, the surface water and sediment ingestion exposure pathway for site workers, construction workers, and trespassers is considered incomplete. Municipal drinking water is not supplied by nearby surface water bodies, such as Waiawa Stream. Consequently, the residential exposure pathway is incomplete for surface water and sediment ingestion. The OSD SLs for soil and groundwater are based on human receptors. Future surface water and sediment sampling may be performed to evaluate potential impacts to ecological receptors.

7.3.2 AOI 2

Because PFOA, PFOS, PFBS, PFHxS, and PFNA were detected in soil and/or groundwater at AOI 2, it is possible that those compounds may have migrated from soil to storm drains in the area that capture runoff. Storm drains discharge to an outfall located along Waiawa Stream. For the same reasons described in **Section 7.3.1**, the surface water and sediment ingestion exposure pathway for recreational users of downgradient surface water bodies is considered potentially complete; and the pathway for exposure pathway for site workers, construction workers, and trespassers is considered incomplete. Municipal drinking water is not supplied by nearby surface water bodies, such as Waiawa Stream. Consequently, the residential exposure pathway is incomplete for surface water and sediment ingestion. The OSD SLs for soil and groundwater are based on human receptors. Future surface water and sediment sampling may be performed to evaluate potential impacts to ecological receptors.

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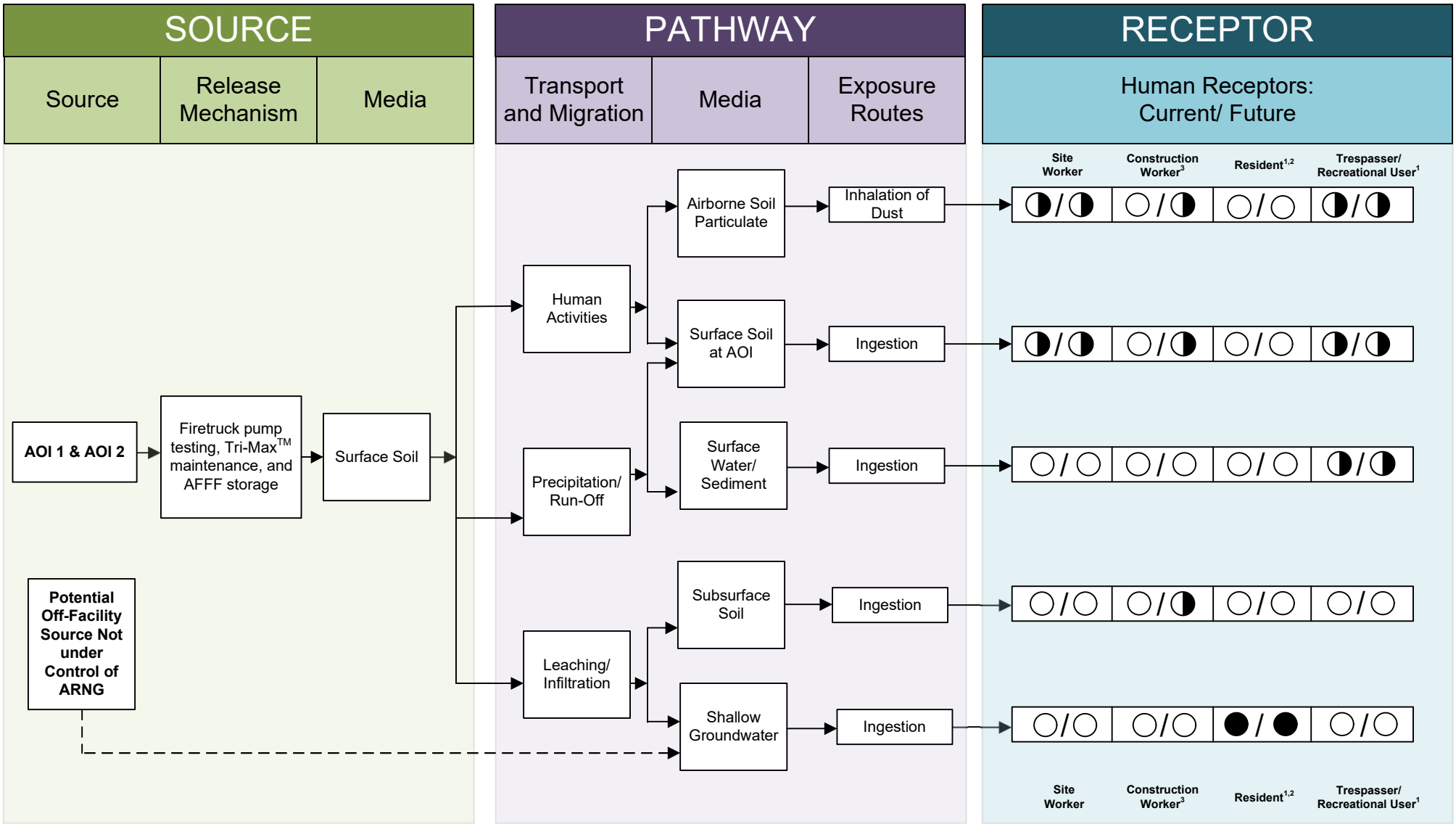

LEGEND

- Flow-Chart Stops
- Flow-Chart Continues
- Partial / Possible Flow
- ○ Incomplete Pathway
- ◑ Potentially Complete Pathway
- ● Potentially Complete Pathway with Exceedance of SL for PFOA, PFOS, PFBS, PFHxS, and/or PFNA

Notes:

1. The resident and recreational users refer to off-site receptors.
2. Inhalation of dust for off-site receptors is likely insignificant.
3. No current active construction at the facility.

Figure 7-1
Conceptual Site Model, AOI 1 and AOI 2
Waiawa Gulch Training Site and UTES, HI

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8. Summary and Outcome

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

8.1 SI Activities

The SI field activities were conducted from 18 March to 11 April 2022 and consisted of utility clearance, direct push boring, soil sample collection, permanent monitoring well installation via solid flight auger drilling, well development, groundwater sample collection, and land surveying. Field activities were conducted in accordance with the SI QAPP Addendum (AECOM, 2021), except as previously noted in **Section 5.8**.

To fulfill the project DQOs set forth in the approved SI QAPP Addendum (AECOM, 2021), samples were collected and analyzed for a subset of 18 compounds by LC/MS/MS compliant with QSM 5.3 Table B-15 as follows.

- Fifteen (15) soil samples from nine boring locations;
- Six groundwater samples from six permanent monitoring wells;
- Nineteen (19) quality assurance QA/QC samples.

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

8.2 Outcome

Based on the results of this SI, further evaluation is warranted in an RI for AOI 1: Firetruck Pump Test Area and AOI 2: Vehicle Maintenance Area, Firetruck Parking Area, and Storage Buildings. Based on the CSMs developed and revised in light of the SI findings, there is potential for exposure to drinking water receptors from AOI 1 and AOI 2 from sources on the facility resulting from historical DoD activities. Sample analytical concentrations collected during the SI were compared to the project SLs in soil and groundwater, as described in **Table 6-1**. A summary of the results of the SI data relative to the SLs is as follows:

- At AOI 1:
    - The detected concentrations of PFOS, PFHxS, and PFNA in soil at AOI 1 were below their SLs.
    - PFOA, PFOS, and PFHxS in groundwater exceeded their SLs. PFOA exceeded the SL of 6 ng/L, with a concentration of 18.0 ng/L at location AOI01-02. PFOS exceeded the SL of 4 ng/L, with a concentration of 11.1 ng/L at location AOI01-02. PFHxS exceeded the SL of 39 ng/L, with a concentration of 89.3 ng/L at location AOI01-02. Based on the results of the SI, further evaluation of AOI 1 is warranted in the RI.

- At AOI 2:
    - The detected concentrations of PFOA, PFOS, PFBS, PFHxS, and PFNA in soil at AOI 2 were below their SLs.
    - PFOA, PFOS, and PFHxS in groundwater exceeded their SLs. PFOA exceeded the SL of 6 ng/L at all four locations, with a maximum concentration of 57.0 ng/L at location AOI02-02. PFOS exceeded the SL of 4 ng/L at all four locations, with a maximum concentration of 271 ng/L at location AOI02-02. PFHxS exceeded the SL of 39 ng/L at all four locations, with a maximum concentration of 1,110 ng/L at location AOI02-02. Based on the results of the SI, further evaluation of AOI 2 is warranted in an RI.

Due to the complex hydrogeologic setting encountered at the facility, there is uncertainty regarding local groundwater flow direction at AOI 1 and AOI 2. It is possible that wells within AOI 1 are screened in discontinuous water-bearing units, and the influence of the nearby Waiawa Stream on groundwater flow is unknown. A future RI will provide additional data to clarify the hydrogeology.

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

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

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

AOI	Potential Release Area	Soil – Source Area	Groundwater – Source Area	Future Action
1	Firetruck Pump Test Area	◐	●	Proceed to RI
2	Firetruck Parking Area, Vehicle Maintenance Area, and Storage Buildings	◐	●	Proceed to RI

Legend:

● = detected; exceedance of the screening levels

◐ = detected; no exceedance of the screening levels

○ = not detected

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