FINAL
Site Inspection Report
Papago Park Military Reservation
Phoenix, Arizona

Perfluorooctanesulfonic Acid (PFOS) and
Perfluorooctanoic Acid (PFOA) Impacted Sites
ARNG Installations, Nationwide

November 2021

Prepared for:

Army National Guard Bureau
111 S. George Mason Drive
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Acronyms and Abbreviations

%	percent
°C	degrees Celsius
°F	degrees Fahrenheit
µg/kg	micrograms per kilogram
6:2 FTS	6:2 Fluorotelomer sulfonic acid
8:2 FTS	8:2 Fluorotelomer sulfonic acid
AASF	Army Aviation Support Facility
ADEQ	Arizona Department of Environmental Quality
AECOM	AECOM Technical Services, Inc.
AFFF	aqueous film forming foam
AOI	Area of Interest
ARNG	Army National Guard
ASTM	American Society for Testing and Materials
AZARNG	Arizona Army National Guard
AZDEMA	Arizona Department of Emergency and Military Affairs
bgs	below ground surface
btoc	below top of casing
CAP	Central Arizona Project
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CoC	chain of custody
CSM	conceptual site model
DA	Department of the Army
DoD	Department of Defense
DQI	data quality indicator
DQO	data quality objective
DUA	data usability assessment
DVR	data validation report
EDR™	Environmental Data Resources, Inc.™
EEC	Engineering and Environmental Consultants
EIS	extraction internal standards
ELAP	Environmental Laboratory Accreditation Program
EM	Engineer Manual
ERB	equipment rinsate blank
FedEx	Federal Express
FRB	Field Reagent Blank
GPRS	Ground Penetrating Radar Systems, LLC
HA	Health Advisory
HDPE	high-density polyethylene
IDW	investigation-derived waste
IIS	injection internal standards
ITRC	Interstate Technology Regulatory Council
LC/MS/MS	liquid chromatography with tandem mass spectrometry
LCS	laboratory control spike

LCSD	laboratory control spike duplicate
LOQ	limit of quantitation
MDL	method detection limit
mg/Kg	milligram per kilogram
MS	matrix spike
MSD	matrix spike duplicate
NELAP	National Environmental Laboratory Accreditation Program
NEtFOSAA	N-ethyl perfluorooctanesulfonamidoacetic acid
ng/L	nanograms per liter
NMeFOSAA	N-methyl perfluorooctanesulfonamidoacetic acid
NOAA	National Oceanic and Atmospheric Administration
OSD	Office of the Secretary of Defense
PA	Preliminary Assessment
PFAS	per- and polyfluoroalkyl substances
PFBA	perfluorobutyrate
PFBS	perfluorobutanesulfonic acid
PFDA	perfluorodecanoic acid
PFDoA	perfluorododecanoic acid
PFHpA	perfluoroheptanoic acid
PFHxA	perfluorohexanoic acid
PFHxS	perfluorohexanesulfonic acid
PFNA	perfluorononanoic acid
PFOA	perfluorooctanoic acid
PFOS	perfluorooctanesulfonic acid
PFPeA	perfluoropentanoic acid
PFTeDA	perfluorotetradecanoic acid
PFTrDA	perfluorotridecanoic acid
PFUdA	perfluoroundecanoic acid
PID	photoionization detector
PPMR	Papago Park Military Reservation
PQAPP	Programmatic UFP-QAPP
QAPP	Quality Assurance Project Plan
QC	quality control
QSM	Quality Systems Manual
RI	Remedial Investigation
RPD	relative percent differences
SI	Site Inspection
SL	screening level
SOP	standard operating procedure
SRP	Salt River Project
TCRA	time-critical removal action
TOC	total organic carbon
TPP	Technical Project Planning
UCMR3	Unregulated Contaminant Monitoring Rule 3
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

Executive Summary

The Army National Guard (ARNG) G9 is performing Preliminary Assessments (PAs) and Site Inspections (SIs) at per- and polyfluoroalkyl substances (PFAS)-impacted sites at ARNG facilities nationwide. The objective of the SI at each facility is to identify whether there has been a release to the environment from the Areas of Interest (AOIs) identified in the PA and determine the presence or absence of perfluorooctanoic acid (PFOA), perfluorooctanesulfonic acid (PFOS), and perfluorobutanesulfonic acid (PFBS) at or above screening levels (SLs). An SI was completed at Papago Park Military Reservation (PPMR) in Phoenix, Arizona. PPMR will be referred to as the "facility" throughout this document.

PPMR occupies approximately 480 acres in the eastern portion of Maricopa County, Arizona, within the City of Phoenix. The PFAS PA identified four potential release areas which were grouped into one AOI and investigated during the SI. The SI field activities were conducted from 19 April to 22 April 2021 and included surface soil sampling and groundwater sampling from existing monitoring wells.

To fulfill the project Data Quality Objectives (DQOs) set forth in the approved SI Quality Assurance Project Plan (QAPP) Addendum (AECOM, 2021a), samples were collected and analyzed for a subset of 18 PFAS by liquid chromatography with tandem mass spectrometry (LC/MS/MS) compliant with Quality Systems Manual (QSM) 5.3 Table B-15. The 18 PFAS analyzed as part of the ARNG SI program are specified in **Section 5.7** of this Report.

The Department of Defense (DoD) has adopted a policy to retain facilities in the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) process based on risk-based SLs for soil and groundwater, as described in a memorandum from the Office of the Secretary of Defense (OSD) dated 15 September 2021 (Assistant Secretary of Defense, 2021). 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 and there is a release identified that is likely attributed to ARNG activities, the AOI will proceed to the next phase under CERCLA. The SLs established in the OSD memorandum apply to three compounds: PFOS, PFOA, and PFBS.

The SLs are presented in **Table ES-1** below. All other results presented in this report are considered informational in nature and serve as an indication as to whether soil and groundwater contain or do not contain the 18 PFAS analyzed within the boundaries of the facility.

Sample chemical analytical concentrations were compared against the project SLs as described in **Table ES-1**. A summary of the results of the SI data relative to the SLs is as follows:

- PFOA and PFOS were detected in groundwater at AOI 1 and exceeded the individual SL of 40 nanograms per liter (ng/L), with maximum concentrations of 292 ng/L and 170 ng/L at locations MW-25 and MW-26, respectively. PFBS was also detected in groundwater at AOI 1, but it did not exceed the SL. Based on the results of the SI, further evaluation of AOI 1 is warranted in a Remedial Investigation (RI).
- The detected concentrations of PFOA, PFOS, and PFBS in soil samples from the AOI were below the SLs.

Table ES-2 summarizes the SI results for soil and groundwater. Based on the conceptual site model (CSM) developed and revised in light of the SI findings, there is a potential for exposure to receptors caused by DoD activities at the facility.

Table ES-3 summarizes the rationale used to determine if an AOI should be considered for further investigation under CERCLA and undergo an RI. Based on the results of this SI, further evaluation is warranted in an RI for AOI 1.

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

Analyte	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	130	1,600	40
PFOS	130	1,600	40
PFBS	1,900	25,000	600

Notes:

a.) Assistant Secretary of Defense, 2021. Risk Based Screening Levels Calculated for PFOS, PFOA, PFBS in Groundwater and Soil using United States Environmental Protection Agency's (USEPA's) Regional Screening Level Calculator. Hazard Quotient (HQ) = 0.1. 15 September 2021.

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

Table ES-2: Summary of Site Inspection Findings

AOI	Potential PFAS Release Area	Soil – Source Area	Groundwater – Source Area	Groundwater – Facility Boundary
1	Army Aviation and Support Facility #1 and Vicinity	◐	N/A	●

Legend:
N/A = Not applicable
● = detected; exceedance of the screening levels
◐ = detected; no exceedance of the screening levels
○ = not detected

Table ES-3: Site Inspection Recommendations

AOI	Description	Rationale	Future Action
1	Army Aviation and Support Facility #1 and Vicinity	Exceedances of SLs in groundwater within permanent monitoring wells at the facility boundary. No exceedances of SLs in soil.	Proceed to RI

1. Introduction

1.1 Project Authorization

The Army National Guard (ARNG) G9 is the lead agency in performing Preliminary Assessments (PAs) and Site Inspections (SIs) for Perfluorooctanesulfonic acid (PFOS) and Perfluorooctanoic acid (PFOA) at Impacted Sites, ARNG Installations, Nationwide. This work is supported by the United States (US) Army Corps of Engineers (USACE) Baltimore District and their contractor, AECOM Technical Services, Inc. (AECOM), under Contract Number W912DR-12-D-0014, Task Order W912DR17F0192, issued 11 August 2017. The ARNG performed this SI at Papago Park Military Reservation (PPMR) in Phoenix, Arizona. PPMR is 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; 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 including specific requirements for sampling for PFOA, PFOS, and perfluorobutanesulfonic acid (PFBS), and the group of related compounds known in the industry as per- and polyfluoroalkyl substances (PFAS). The term PFAS is used throughout this report to encompass all PFAS chemicals being evaluated, including PFOA, PFOS, and PFBS, which are the key components of the suspected releases being evaluated, and the other 15 related compounds listed in the task order.

1.2 SI Purpose

A PA was performed at PPMR (AECOM, 2020) that identified four potential PFAS release areas and grouped them into one Area of Interest (AOI). The objective of the SI is to identify whether there has been a release to the environment from the AOI and determine the presence or absence of PFOA, PFOS, and PFBS at or above screening levels (SLs).

As stated in the *Federal Facilities Remedial Site Inspection Summary Guide* (USEPA, 2005), an SI has five goals:

1. Develop information to potentially eliminate a release from further consideration because it is determined that it poses no significant threat to human health or the environment;
2. Determine the potential need for a removal action;
3. Collect or develop data to evaluate potential release;
4. Collect data to better characterize the release for more effective and rapid initiation of a Remedial Investigation (RI), if determined necessary; and
5. Collect data to determine whether the release is more than likely the result of activities associated with the Department of Defense (DoD).

In addition to the USEPA-identified goals of an SI, the ARNG SI also identifies whether there are potential off-facility PFAS sources.

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2. Facility Background

2.1 Facility Location and Description

PPMR occupies approximately 480 acres in the eastern portion of Maricopa County, about 7 miles east of downtown Phoenix and 1.5 miles from Phoenix Sky Harbor International Airport (**Figure 2-1**). The properties south and east of PPMR are public parks and recreational areas owned by the City of Phoenix (Arizona Department of Environmental Quality [ADEQ], 2018). Residential properties are to the north and west of PPMR.

PPMR has been an active military facility and rifle range since its congressional designation in 1930. PPMR serves as the Joint Forces Headquarters for the Arizona ARNG (AZARNG) and also hosts operational National Guard units at the installation. The current and historical activities at the installation include training and administration, aircraft fueling and maintenance activities, motor vehicle fueling and maintenance activities, fuel and solvent storage areas, gunnery ranges, detonation areas, and bunkers. The AZARNG leases portions of the installation to the US Air Force for administrative and training purposes (ADEQ, 2018). Historical records indicate that two runways existed at the installation. One runway was oriented 080°/260° and was 3,500 feet long, and the second runway was oriented 0°/180°. According to the Arizona Department of Emergency and Military Affairs (AZDEMA), the second runway is abandoned and has not been used by any fixed-wing aircraft for several decades. An active helicopter landing pad and taxiway have operated at PPMR since 1974.

2.2 Facility Environmental Setting

PPMR is located in the eastern portion of Maricopa County, Arizona and is approximately 1,242 feet above sea level (**Figure 2-2**). Major geographic features near PPMR are the Barnes Buttes to the east, the Salt River, which flows westerly about 2.5 miles to the south, the Old Crosscut Canal, located along 46th Street, and the Grand Canal, which flows northwesterly through the area west of 40th Street and Van Buren Street. The majority of the installation is developed with buildings, concrete, and asphalt features, with the exception of an area to the east, which is undeveloped, and a retention basin that lies to the south-central portion of the installation.

2.2.1 Geology

PPMR is constructed on a Quaternary pediment (colluvium/alluvium) that originated from the western and southwestern flanks of Barnes Butte. The pediment is the erosional remnant of the upthrown fault block, which has been cut by several smaller northwest-trending faults (Engineering and Environmental Consultants [EEC], 2005).

Bedrock in the area around and including PPMR is covered by a thin colluvium/alluvium veneer up to 30 feet thick in some areas. The bedrock is composed of calichified angular to subangular sediments and rock fragments. Tertiary sedimentary rocks exposed at PPMR indicate a variation of sediment sources and reflect separate lobes of alluvial fans that coalesce with and overlie each other. The older, proximal facies are members of the Camel's Head Formation (Stadium Breccia, Barnes Butte Breccia, Zoo Breccia) and are typically very coarse and poorly stratified arkosic breccias, having originated as talus, mud flows, and debris flows. Mid-fan facies are represented by the Papago Park member and consist of water-laid deposits that were interbedded with debris flow deposits. Distal-facies are represented by the Tempe Beds, which are finer-grained, well-stratified, and well-sorted (TechLaw, 2004).

Basement rocks beneath PPMR consist of Proterozoic Porphyritic Camelback granite, which is characterized by large feldspar crystals, and metarhyolite. Metarhyolitic rocks consist of gray to pink, blocky, low-grade, metamorphosed rhyolite, which are common throughout the subsurface of PPMR (EEC, 2005).

The soils at PPMR are composed of fine- to medium-grained sands. Variable amounts of clay, silt, and gravel are also present. Intervals of gravel or gravel and sand/silt mixtures are present at depths greater than 10 feet below ground surface (bgs). The content of the gravel and sand is indicative of weather and eroded material originating from proximal sources of exposed bedrock around the facility. The thickness of soil/alluvium varies across PPMR; however, thicker deposits are typically found in the western portions of the facility (TechLaw, 2004).

In addition to the soil and alluvial material described above, many areas at PPMR have been overlain with variable amounts of backfill or artificial cover during the operational history of the installation. The types of artificial fill material found at PPMR range in content from pea gravel to aggregate base course (TechLaw, 2004).

2.2.2 Hydrogeology

PPMR lies within the West Salt River Valley area of the Phoenix Active Management Area. Since 1947, groundwater extraction for irrigation has lowered groundwater levels and caused changes in regional and local flow directions. Despite these changes, groundwater movement is still primarily westward toward the Salt River and Gila Rivers, as seen in **Figure 2-3** (ADEQ, 2017). PPMR is on a bedrock highland that is underlain by crystalline rock. Consequently, very little water, if any, is present beneath the facility. Water-saturated layers have been historically identified at points near the western margin of PPMR from 6 to 42 feet bgs; however, a continuous groundwater zone does not appear to exist beneath most of the facility. Based on lithologic logs from historical monitoring wells, the main occurrence of groundwater exists under unconfined conditions within fractured Precambrian Camelback granite and/or metarhyolite. In some portions of PPMR, locally perched groundwater layers are found in the artificial fill material and calichified pediment colluvium/alluvium (EEC, 2005).

Water level measurements were collected from four existing monitoring wells during the SI. Depth to water readings ranged from 14.41 feet below top of casing (btoc) to 20.71 feet btoc. A groundwater flow contour map was drafted using groundwater elevations calculated from existing survey data and the synoptic gauging data; however, the limited number and spatial coverage of the monitoring wells gauged did not provide a representative understanding of groundwater flow across the area. As a result, no groundwater contour map is included in this SI Report.

According to data received from ADEQ and the Environmental Data Resources, Inc.™ (EDR™) report for PPMR, several dozen wells are located within a 4-mile radius of the facility. The majority of these wells are classified as monitoring wells and are not screened within the target interval of this SI. Several wells are listed as exempt, non-exempt, or other type of wells. Records from the AZDEMA indicate that there are 25 monitoring wells, and no drinking water or irrigation wells are present at or downgradient of the facility. The State of Arizona describes exempt wells as small, non-irrigation wells typically used to provide water for domestic purposes and non-exempt wells as a well drilled within an Active Management Area pursuant to different groundwater rights.

Based on the USEPA's Unregulated Contaminant Monitoring Rule 3 (UCMR3) data, no PFAS were detected in a public water system above the Health Advisory (HA) within 20 miles of the facility (USEPA, 2017a). The HA is 70 nanograms per liter (ng/L) for PFOA and PFOS, individually or combined. PFAS analyses performed in 2016 had method detection limits (MDLs) that were higher than currently achievable. Thus, it is possible that low concentrations of PFAS were not detected during the UCMR3 but might be detected if analyzed today.

2.2.3 Hydrology

The City of Phoenix water supply comes primarily from the Salt River Project (SRP), which brings water by canal and pipeline from the Salt and Verde Rivers, and the Central Arizona Project (CAP), which transports Colorado River water. Approximately 3 percent (%) of the water supply comes from groundwater. The City of Phoenix also uses a portion of its reclaimed effluent to maintain parks and for recharging local groundwater aquifers. The surface water near PPMR flows generally northeast to southwest (TechLaw, 2004).

The Salt River is the principal drainage feature of the Phoenix Basin and is the nearest surface water body to the facility, approximately 2.5 miles south of PPMR. The Salt River is typically dry throughout the greater Phoenix metropolitan area due to flood control/water retention structures; however, the river occasionally flows after heavy rainfall events or controlled releases from upstream structures (GEC-SA&B, 2005). There are surface water features onsite at PPMR; however, there are no perennial surface water bodies. Surface water drainage at PPMR runs from the northern portion of the facility (north of East McDowell Road), through a culvert under East McDowell Road, to a retention basin on the southern part of the installation (south of East McDowell Road). Prior to 1987, the Water Retention Basin (84748) located on the southern part of the facility did not exist. Surface water from PPMR may have flowed southwest and flooded the Motorola complex during extreme or high precipitation events; however, in 1987, the retention basin was reconfigured to hold surface flow and stormwater coming from the northern portion of PPMR. Surface water and stormwater entering the retention basin from the northern portion of PPMR either evaporates (due to the high rates of evapotranspiration in Arizona) or infiltrates. Surface water features near the facility are shown in **Figure 2-4**.

2.2.4 Climate

PPMR is situated in central Arizona, and the climate is characterized as arid, with low annual rainfall and low relative humidity. Daytime temperatures are high through the summer months. Winters are mild, and temperatures can drop below freezing during winter months (Arizona State Climate Office, 2019). There are two rainfall seasons. The first rainfall season occurs during winter months, from November through March, when the area is subject to storms from the Pacific Ocean. The second rainfall season occurs during July and August, when Arizona is subject to thunderstorms whose moisture originates in the Gulf of Mexico, in the Pacific Ocean, off the west coast of Mexico, and the Gulf of California. Although these periods are classified as rainy seasons, there can be periods of a month or more in any season when zero to less than one inch of precipitation occurs. Although rare, light snow occurs in the higher mountains surrounding the Salt River Valley (Arizona State Climate Office, 2019). The maximum average monthly temperature in nearby Phoenix, Arizona occurs in July (106.1 degrees Fahrenheit [°F]), with an average maximum annual temperature of 86.6°F. The minimum average monthly temperature occurs in December (44.8 °F), with an average minimum annual temperature of 63.4°F. The average annual precipitation in Phoenix, Arizona from 1981-2010 was 8.03 inches (National Oceanic and Atmospheric Administration [NOAA], 2019).

2.2.5 Current and Future Land Use

PPMR is federally owned and operated by AZARNG and has been an active military installation and rifle range since its congressional designation in 1930. Currently, the facility is used for training and administration, aircraft fueling and maintenance activities, motor vehicle fueling and maintenance activities, fuel and solvent storage areas, gunnery ranges, detonation areas, and bunkers. The facility development includes numerous structures, open storage areas, and training areas, including two abandoned runways and active heliport. Land surrounding the facility is mostly a mix of residential, recreational, and light industrial use. According to the City of Phoenix Zoning Database, the facility is zoned for R1-6, single family residential; however, it is a military

industrial complex that will not be used for residential development. Reasonably anticipated future land use is not expected to change from the current land use, and the facility will continue to be used as a military industrial complex.

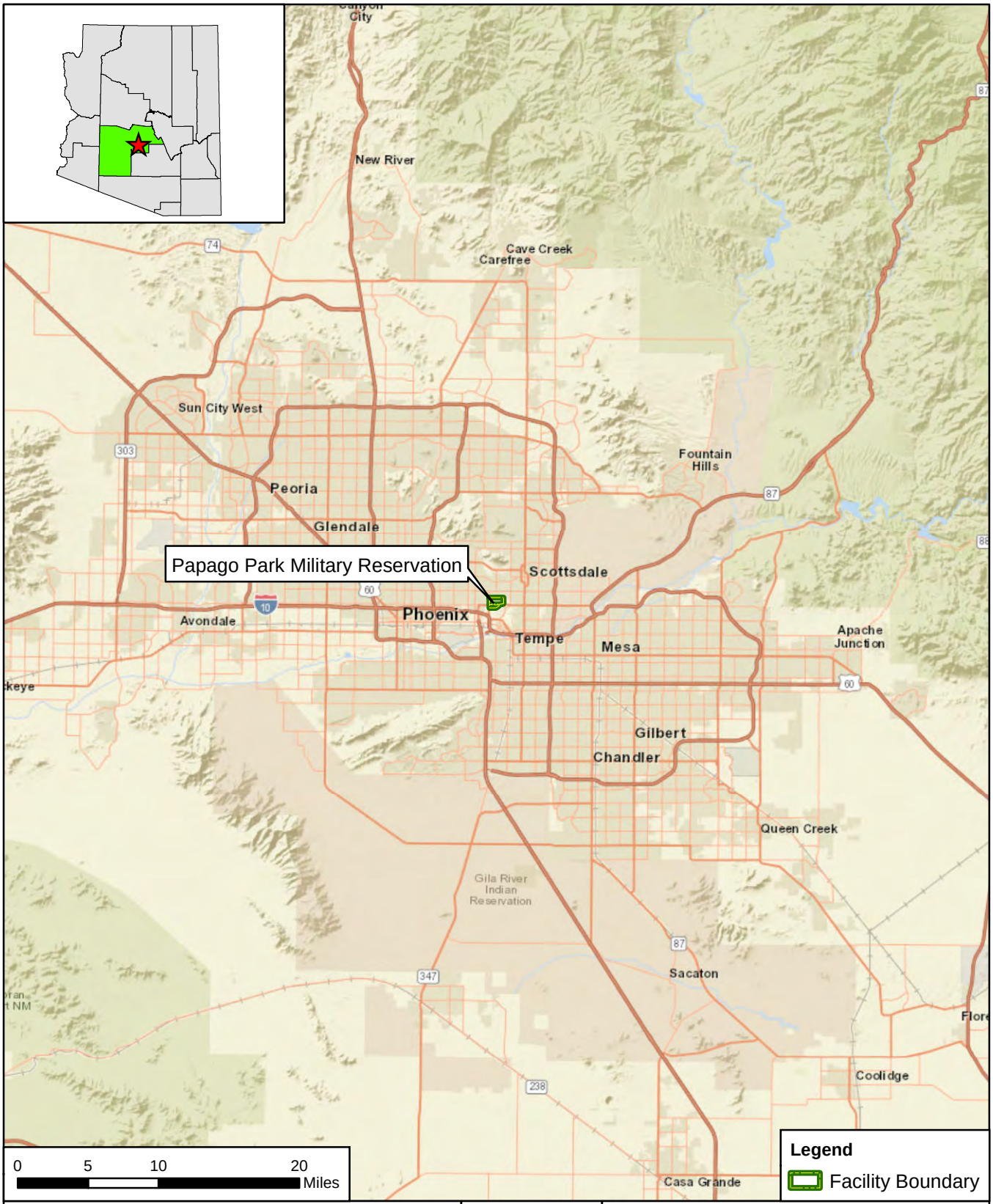
2.2.6 Sensitive Habitat and Threatened/ Endangered Species

The following birds, reptiles, insects, and fish are federally endangered, threatened, proposed, and/ or are listed as candidate species likely to be found at PPMR (US Fish and Wildlife Service [USFWS] IPCA, 2021).

- **Birds**:
    - Yuma Ridgways (clapper) rail, *Rallus obsoletus [longirostris] yumanensis* (endangered)
    - Yellow-billed Cuckoo, *Coccyzus americanus* (threatened)
    - Southwestern willow flycatcher, *Empidonax traillii extimus* (endangered)
    - California least tern, *Sterna antillarum browni* (endangered)
- **Reptiles**:
    - Sonoran Desert Tortoise, *Gopherus morafkai* (candidate)
- **Insects**:
    - Monarch Butterfly, *Danaus plexippus* (candidate)
- **Fish:**
    - Roundtail Chub, *Gila robusta* (candidate)

2.3 History of PFAS Use

Four potential release areas were identified where PFAS were potentially released to soil within the boundary of PPMR through fire training exercises and storm water conveyance (AECOM, 2020). Fire training, equipment testing, and aqueous film forming foam (AFFF) storage occurred at PPMR from the 1970s to mid-2000s. Presently, AFFF is no longer stored at the facility, and current mobile fire extinguishers have been tested and do not contain AFFF. The four potential release areas were grouped into one AOI (AOI 1). A description of AOI 1 is presented in **Section 3**.



CLIENT	ARNG			
NOTES	Site Inspection for PFAS at Papago Park Military Res, AZ			
REVISED	4/23/2020	GIS BY	MS	4/23/2020
SCALE	1:633,600	CHK BY	AB	4/23/2020
Base Map: Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI,		PM	RG	4/23/2020

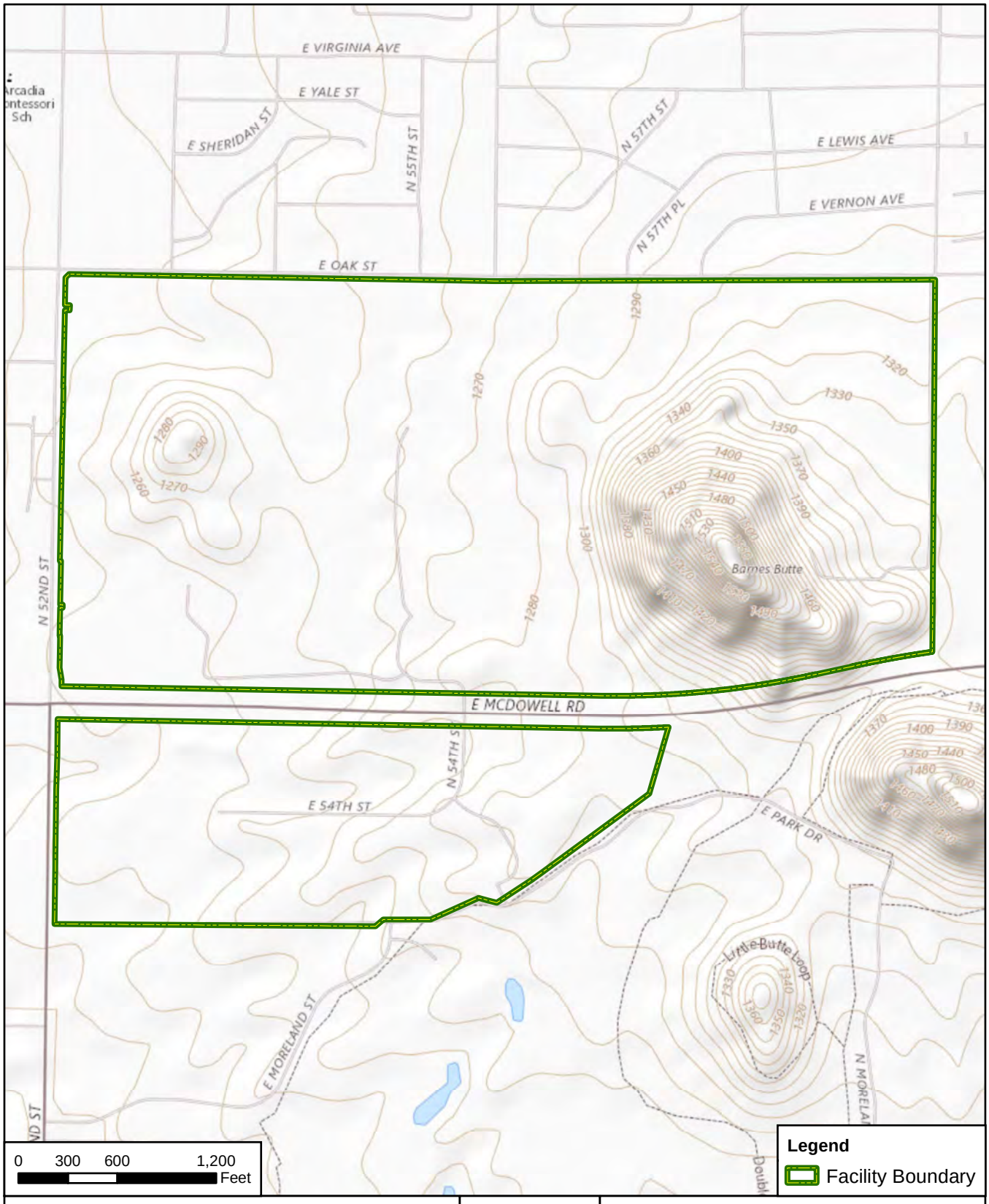
N

Facility Location

AECOM
12420 Milestone Center Drive
Germantown, MD 20876

Figure 2-1

C:\Users\stankevichm\OneDrive - AECOM Directory\ARNG_PFAS_GIS_60552172\MXDs\AZ\Papago_Park_MR_Figures\Papago_Park_MR_SI_Figures\SI_QAPP\Fig_10-1_Papago_Facility_Location.mxd



CLIENT	ARNG			
NOTES	Site Inspection for PFAS at Papago Park Military Res, AZ			
REVISED	6/24/2021	GIS BY	MS	6/24/2021
SCALE	1:10,200	CHK BY	AB	6/24/2021
Base Map: USGS The National Map: National Boundaries Dataset, 3DEP Elevation Program,		PM	CM	6/24/2021

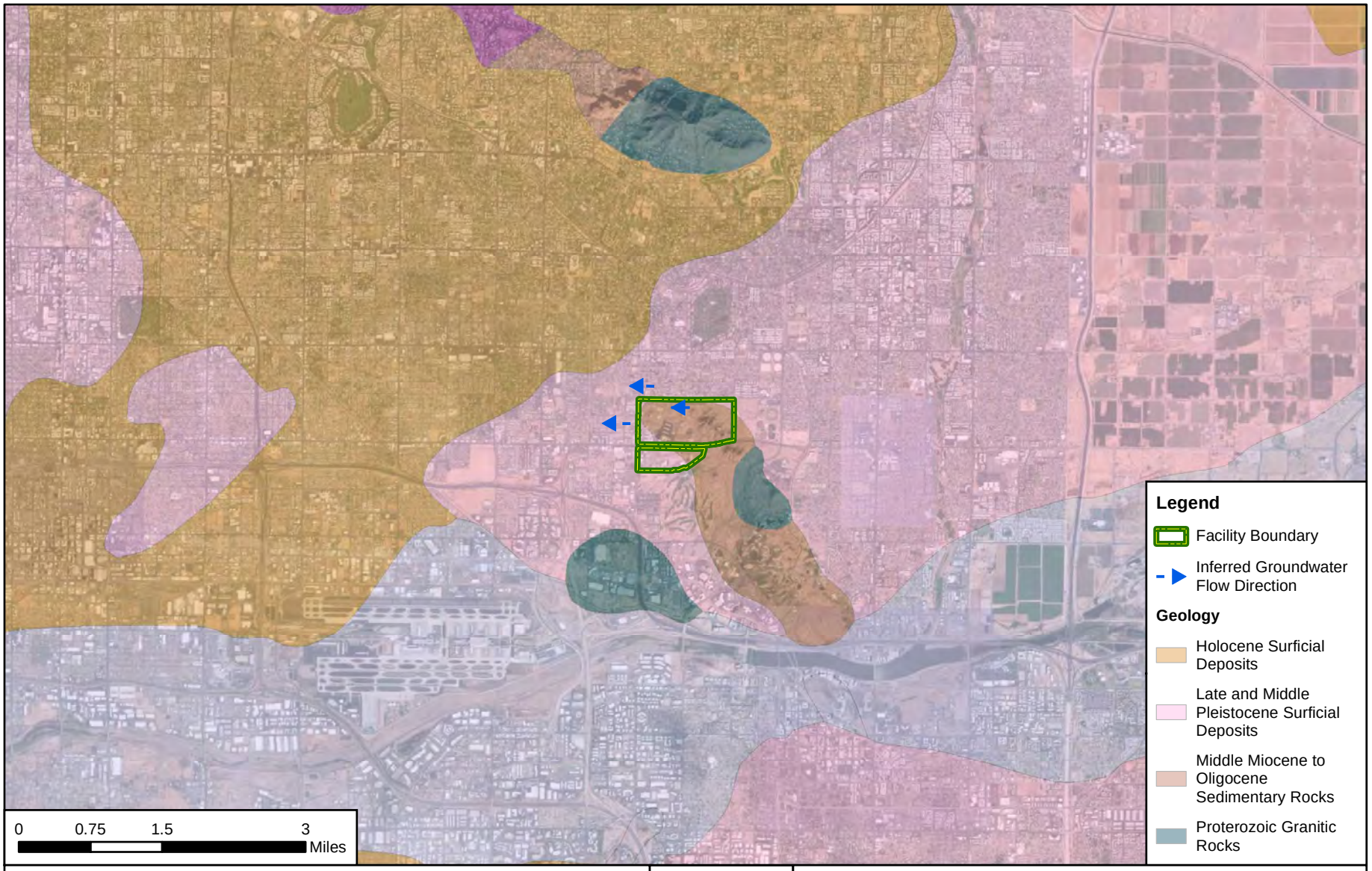
N

Facility Topography

AECOM
12420 Milestone Center Drive
Germantown, MD 20876

Figure 2-2

C:\Users\stankevichm\OneDrive - AECOM Directory\ARNG_PFAS_GIS_60552172\MXDs\AZ\Papago_Park_MR_Figures\Papago_Park_MR_SI_Figures\SI_Report\Fig_2-2_Papago_SI_Facility_Topo.mxd



CLIENT	ARNG			
PROJECT	Site Inspection for PFAS at Papago Park Military Res, AZ			
REVISED	8/18/2021	GIS BY	MS	8/18/2021
SCALE	1:95,040	CHK BY	AB	8/18/2021
Base Map: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community		PM	CM	8/18/2021

Geology and Groundwater Features

AECOM
12420 Milestone Center Drive
Germantown, MD 20876

Figure 2-3

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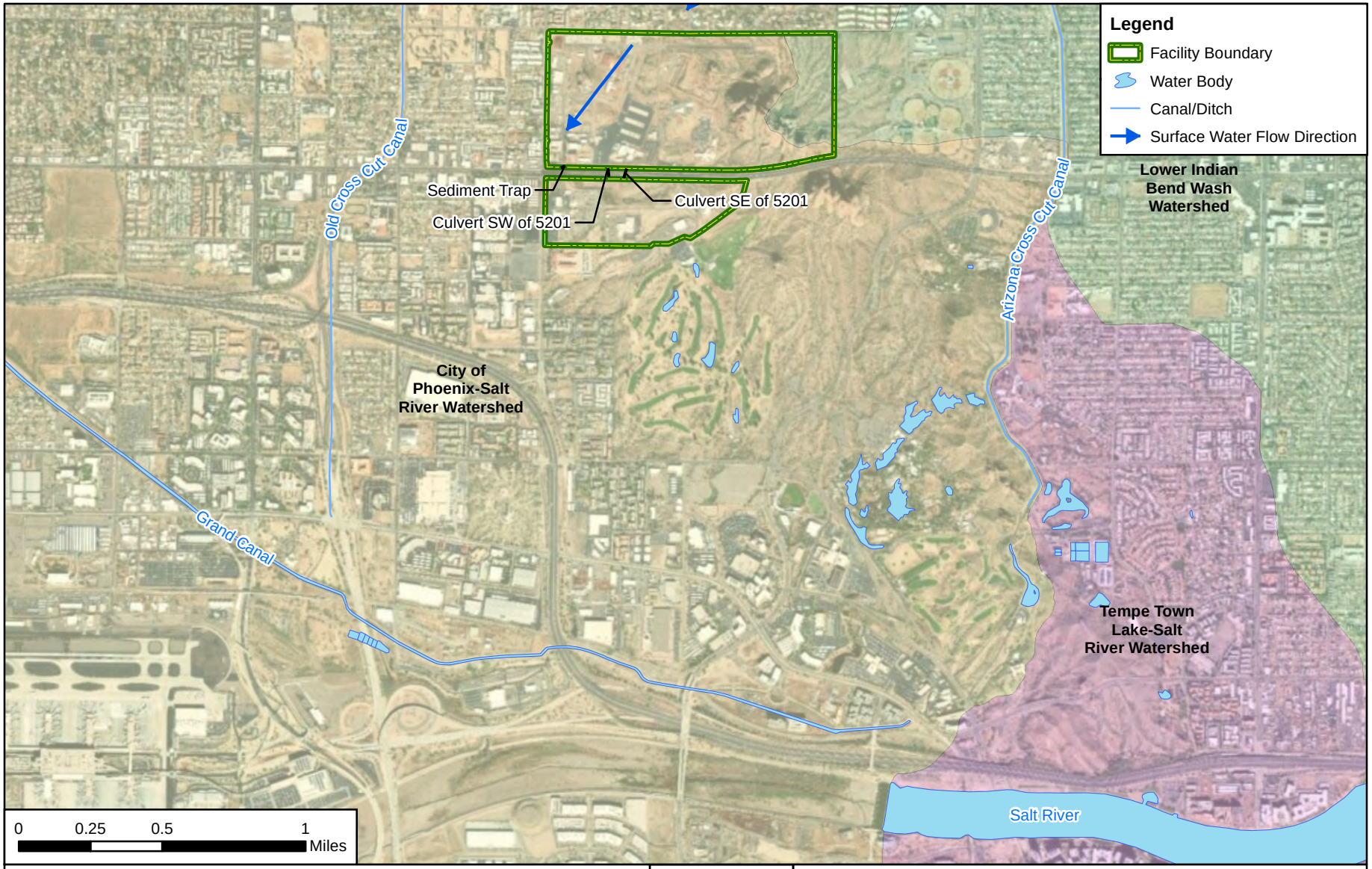

CLIENT	ARNG			
PROJECT	Site Inspection for PFAS at Papago Park Military Res, AZ			
REVISED	4/23/2020	GIS BY	MS	4/23/2020
SCALE	1:31,680	CHK BY	AB	4/23/2020
Base Map: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community		PM	RG	4/23/2020

Surface Water Features

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Figure 2-4

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3. Summary of Areas of Interest

This section presents a summary of each potential PFAS release area by AOI. Based on the PA findings, four potential PFAS release areas were identified at PPMR and were grouped into one AOI. The potential PFAS release areas are shown on **Figure 3-1**.

3.1 AOI 1

AOI 1 encompasses the general location in which fire training, equipment testing, and AFFF storage occurred at PPMR. These activities all occurred in close enough proximity of each other to be considered a single AOI. The AOI includes the former fire truck bay, flight line/main ramp, former storage area, and fuel point station.

The Former Fire Truck Bay is located within Army Aviation Support Facility (AASF) #1 (M5201). This building housed a single standard crash fire rescue truck and related equipment for the airfield from the time the building was constructed in 1973 until the mid-2000s, when it was converted into a gym. According to personnel interviews, the former fire truck bay stored AFFF, but it is unclear what methods of storage or handling were used. No suspected discharge of AFFF has been recorded in historical documents related to this potential release area, but personnel interviewed indicated that a discharge had occurred on site (within the boundary of the defined AOI).

From the 1970s to the mid-2000s, the nozzle on the crash fire rescue truck was tested weekly using AFFF. The testing occurred on the Runway (M5228) and Rotary Wing Parking Apron (M5204), which originally was exposed soil until it was paved in 1973. According to the interviewee, once the foam was deployed, it was allowed to dry on the exposed soil. The equipment was rinsed, and any water that did not infiltrate or evaporate flowed south towards East McDowell Road and a stormwater culvert (the stormwater culvert likely did not exist prior to 1973). Water from this culvert flows underneath East McDowell Road and discharges into the retention basin on the south side of East McDowell Road.

According to interviews, a second former storage area was located just outside of the AASF #1 (M5201 Exterior). Notes from the PA identified this area as a current picnic area, and the area is labeled ‘ M5201 Exterior’ on **Figure 3-1**. In this area, bulk containers of AFFF were stored in a covered area on the ground surface. The area no longer contains these storage containers and is now an open patch of land. No suspected discharge of AFFF has been recorded in historical documents related to this potential release area, but personnel interviewed indicated that a release had occurred on site (within the boundary of the defined AOI).

In addition to training with the former fire truck, Tri-Max™ mobile extinguishers were used at the AASF #1 for a number of years; however, the exact number of units is unknown. The units were reported to have been stored near the flight line/main ramp when in use. The mobile extinguishers were demilled before disposal at the adjacent vehicle maintenance area, but it is unknown if the contents of the units were captured and disposed or released to the ground surface.

The Fuel Point Station located on PPMR is used to refuel various vehicles and machinery. This area is labeled ‘Mobile Fire Extinguishers’ on **Figure 3-1.** Tri-Max™ and other mobile fire extinguishers have historically been and are currently located at the fuel point. At the time of the PA, the mobile extinguishers were inspected and determined to be non-AFFF fire extinguishers. It is unknown if mobile extinguishers used in the past contained AFFF.

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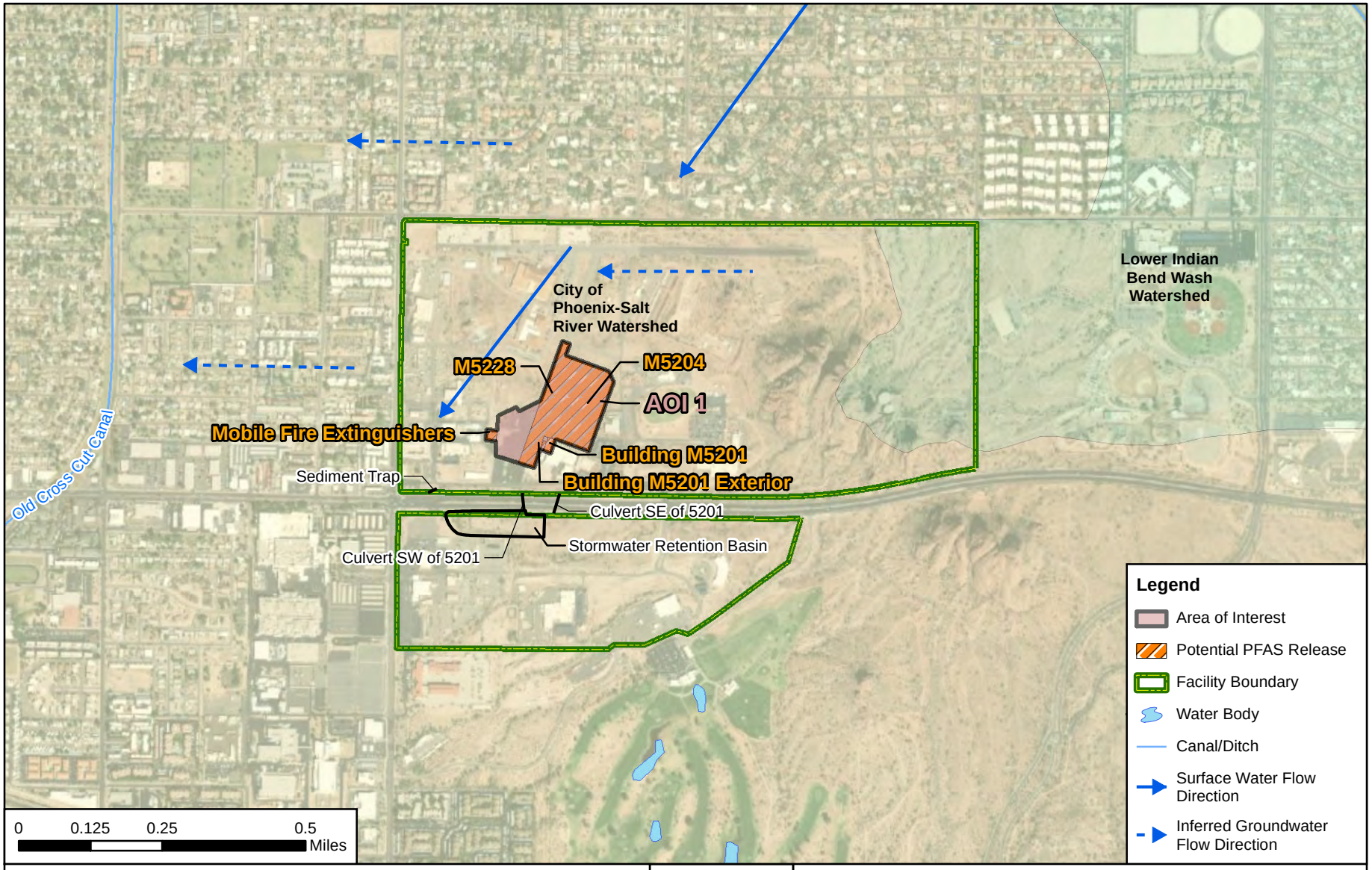

CLIENT	ARNG			
PROJECT	Site Inspection for PFAS at Papago Park Military Res, AZ			
REVISED	2/3/2021	GIS BY	MS	2/3/2021
SCALE	1:15,840	CHK BY	AB	2/3/2021
Base Map: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community		PM	RG	2/3/2021

N

Area of Interest

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Figure 3-1

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4. Project Data Quality Objectives

Project Data Quality Objectives (DQOs) are qualitative and quantitative statements that specify the quality of data and define the level of certainty required to support the project decision-making process. The specific DQOs established for this facility are described below. These DQOs were developed in accordance with the USEPA's seven-step iterative process (USEPA, 2006).

4.1 Problem Statement

The following problem statement was developed during project planning:

The presence of PFAS, which may pose a risk to human health or the environment, in environmental media at the facility is currently unknown. PFAS are classified as emerging environmental contaminants that are garnering increasing regulatory interest due to their potential risks to human health and the environment. The regulatory framework for managing PFAS at both the federal and state level continues to evolve.

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 Office of the Secretary of Defense (OSD) dated 15 September 2021 (Assistant Secretary of Defense, 2021). 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 three compounds: PFOS, PFOA, and PFBS.

The following quotes from the DA policy documents form the basis for this project (DA, 2016; DA, 2018):

- "The Army will research and identify locations where PFOS- and/or PFOA-containing products, such as AFFF, are known or suspected to have been used. Installations shall coordinate with installation/facility fire response or training offices to identify AFFF use or storage locations. The Army will consider FTAs, AFFF storage locations, hangars/buildings with AFFF suppression systems, fire equipment maintenance areas, and areas where emergency response operations required AFFF use as possible source areas. In addition, metal plating operations, which used certain PFOS-containing mist suppressants, shall be considered possible source areas."
- "Based on a review of site records…determine whether a CERCLA PA is appropriate for identifying PFOS/PFOA release sites. If the PA determines a PFOS/PFOA release may have occurred, a CERCLA SI shall be conducted to determine presence/absence of contamination."
- "Identify sites where perfluorinated compounds are known or suspected to have been released, with the priority being those sites within 20 miles of the public systems that tested above USEPA HA levels." (USEPA, 2016a; USEPA, 2016b).

4.2 Goals of the Study

The following goals were established for this SI:

1. Determine the presence or absence of PFOA, PFOS, and PFBS at or above SLs.
2. Develop information to potentially eliminate a release from further consideration because it is determined that it poses no significant threat to human health or the environment.

3. Determine the potential need for a time-critical removal action (TCRA) (applies to drinking water only). The primary actions that will be considered include provision of alternative water supplies or wellhead treatment.

4. Collect data to better characterize the release areas for more effective and rapid initiation of an RI (if determined necessary).

5. If PFOA, PFOS, and PFBS are determined to be present, aim to evaluate whether the concentrations can be attributed to on-facility or off-facility sources that were identified within 4 miles of the installation as part of the PA (e.g., fire stations, major manufacturers, other DoD facilities).

6. Determine whether a potentially complete pathway exists between the source and potential receptors and whether ARNG is the likely source of the contamination.

4.3 Information Inputs

Primary information inputs included:

- The PA for PPMR, Arizona (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)-Quality Assurance Project Plan (QAPP) Addendum (AECOM, 2021a); and
- Field data collected during the SI, including groundwater elevation and water quality parameters measured at the time of sampling.

4.4 Study Boundaries

The scope of the SI was bounded by the property limits of the facility (**Figure 2-1**). Off-facility sampling was not included in the scope of this SI. If future off-facility sampling is required, the proper stakeholders will be notified, and necessary rights of entry will be obtained by ARNG with property owner(s).

4.5 Analytical Approach

Samples were analyzed by Pace Analytical Gulf Coast, accredited under the DoD Environmental Laboratory Accreditation Program (ELAP; Accreditation Number 74960) and the National Environmental Laboratory Accreditation Program (NELAP; Certificate Number 01955). Data were compared to applicable SLs and decision rules as defined in the SI QAPP Addendum (AECOM, 2021a). These rules governed response actions based on the results of the SI sampling effort.

The decision rules described in the **Worksheet #11** of the SI QAPP Addendum identify actions based on the following:

Groundwater:

- Is there a human receptor within 4 miles of the facility?
- What is the concentration of PFOA, PFOS, and PFBS at the potential release areas?
- What is the concentration of PFOA, PFOS, and PFBS at the facility boundary upgradient and downgradient of the potential release areas?
- What does the conceptual site model (CSM) suggest in terms of source, pathway and receptor?

Soil:

- What is the concentration of PFOA, PFOS, and PFBS in shallow surface soil (0 to 2 feet bgs)?
- What is the concentration of PFOA, PFOS, and PFBS in deep soil (i.e., capillary fringe)?
- What does the CSM suggest in terms of source, pathway, and receptor?

Soil and groundwater samples were collected from each of the potential release areas. Groundwater was encountered in existing wells at approximately 14 to 21 feet bgs.

4.6 Data Usability Assessment

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

Data Quality Indicators (DQIs) (Precision, Accuracy, Representativeness, Comparability, Completeness and Sensitivity) are important components in assessing data usability. These DQIs were evaluated in the subsequent sections and demonstrate that the data presented in this SI report are of high quality. Although the SI data are considered reliable, some degree of uncertainty can be associated with the data collected. Specific factors that may contribute to the uncertainty of the data evaluation are described below. The Data Validation Report (DVR) (**Appendix A**) presents explanations for all qualified data in greater detail.

4.6.1 Precision

Precision is the degree of agreement among repeated measurements of the same characteristic on the same sample or on separate samples collected as close as possible in time and place. Field sampling precision is measured with the field duplicate relative percent differences (RPD); laboratory precision is measured with calibration verification, internal standard recoveries, laboratory control spike (LCS), and matrix spike (MS) duplicate RPD.

Extraction internal standards (EIS) were added by the laboratory during sample extraction to measure relative responses of target analytes and used to correct for bias associated with matrix interferences and sample preparation efficiencies, injection volume variances, mass spectrometry ionization efficiencies, and other associated preparation and analytical anomalies. The field sample results associated with EIS area counts less than the lower quality control (QC) limit were non-detect and were as estimated values with a negative bias.

Injection internal standards (IIS) were added by the laboratory after sample extraction and prior to analysis as a requirement of DoD Quality Systems Manual (QSM) 5.3 to measure relative responses of target analytes. The IIS samples were within the project established precision limits presented in the QAPP Addendum (AECOM, 2021a).

LCS/LCS duplicate (LCSD) pairs were prepared by addition of known concentrations of each analyte in a matrix-free media known to be free of target analytes. LCS/LCSD pairs were analyzed for every analytical batch to demonstrate the ability of the laboratory to detect similar concentrations of a known quantity in matrix-free media. The LCS/LCSD samples were within the project established precision limits presented in the QAPP Addendum (AECOM, 2021a).

MS/MS duplicate (MSD) samples were prepared, analyzed, and reported for all preparation batches. MS/MSD samples demonstrated that the analytical system was in control for the matrix being tested with limited exceptions. MS/MSD samples were submitted to the laboratory for analysis at a rate of 5%. One MS/MSD displayed an RPD greater than the QC limit of 20% for total organic carbon (TOC) at 26%. The parent sample result associated with the MS/MSD imprecision was qualified as an estimate value and should be considered usable as qualified.

Field duplicate samples were collected at a rate of 10% to assess the overall sampling and measurement precision for this sampling effort. The field duplicate samples were analyzed for PFAS and general chemistry parameters. A parent sample displayed a non-detect result for PFOA while the associated field sample duplicate displayed a positive result. The non-detect parent sample was qualified “UJ”, while the positive duplicate sample was qualified “J”. The parent and duplicate sample results should be considered usable as qualified as estimated values, the positive value was used to provide the most conservative value for this location.

4.6.2 Accuracy

Accuracy is a measure of confidence in a measurement. The smaller the difference between the measurement of a parameter and its "true" or expected value, the more accurate the measurement. The more precise or reproducible the result, the more reliable or accurate the result. Accuracy is measured through percent recoveries in the LCS/LCSD, MS/MSD, and surrogates.

LCS/LCSD samples were prepared by addition of known concentrations of each analyte in a matrix free media known to be free of target analytes. LCS/LCSD samples were analyzed for every analytical batch and demonstrated that the analytical system was in control during sample preparation and analysis. The LCS/LCSD samples were within the project established accuracy limits presented in the QAPP Addendum (AECOM, 2021a).

MS/MSD samples were prepared, analyzed, and reported at a rate of 5%. MS/MSD samples demonstrated that the analytical system was in control for the matrix being tested, with one exception. One parent sample displayed MS/MSD percent recoveries greater than the upper QC limit of 136% for PFOS at 381% in the MS and 465% in the MSD. The native soil sample result was greater than 4 times the spike concentration; no data qualifying action was required and the associated field sample result should be considered usable as reported.

Calibration verifications were performed routinely to ensure that instrument responses for all calibrated analytes were within established QC criteria. The calibration verifications performed during the laboratory analyses were within the project established precision limits presented in the QAPP Addendum (AECOM, 2021a), with limited exceptions. Two calibration verifications displayed a percent recovery slightly above the upper QC limit of 130% for perfluorotetradecanoic acid (PFTeDA) at 131% in one and PFBS at 136% in the other. PFTeDA and PFBS were not target analytes in the associated analytical batches; no data qualifying action was required.

4.6.3 Representativeness

Representativeness qualitatively expresses the degree to which data accurately reflect site conditions. Factors that affect the representativeness of analytical data include appropriate sample population definitions, proper sample collection and preservation techniques, analytical holding times, use of standard analytical methods, and determination of matrix or analyte interferences.

The laboratory followed the standard analytical techniques “PFAS by liquid chromatography with tandem mass spectrometry (LC/MS/MS) Compliant with QSM 5.3 Table B-15.” The method includes preparation requirements (i.e. ENVI-Carb or equivalent), mass calibration, spectra,

monitoring ion transitions, standards for both branch and linear isomers as available, and isotopically labeled standards.

Field QC samples were collected to assess the representativeness of the data collected. The laboratory met the field QC sample collection frequency: field duplicates were collected at a rate of 10% for all field samples and MS/MSD samples were collected at a rate of 5%. All preservation techniques were followed by the field staff, and all technical and analytical holding times were met by the laboratory. The laboratory used approved standard methods in accordance with the QAPP Addendum (AECOM, 2021a) for all analyses.

Blanks are collected to ensure the positive results are representative of site conditions instead of introduced by the sampling or analytical processes. Equipment blanks and field blanks were negative controls collected in the field to assess if cross-contamination was introduced during decontamination or ambient conditions. Equipment blanks and field blanks were also collected for groundwater and soil samples. Several equipment and field blanks displayed detections of multiple target analytes greater than the detection limit. The associated field sample results were either non-detect or displayed concentrations greater than 5X the blank detection. No data qualifying action was required and the associated field sample results should be considered usable as reported.

Laboratory blanks were prepared and analyzed as negative controls to assess if cross-contamination was introduced at the preparation (method blanks) or analytical (Instrument blanks) steps. Several instrument blanks displayed detections of multiple target analytes greater than the detection limit. The associated field sample results were either non-detect or displayed concentrations greater than 5X the blank detection. No data qualifying action was required and the associated field sample results should be considered usable as reported.

Field samples were extracted and analyzed within the appropriate holding time in order to qualitatively express the degree to which data accurately reflect site conditions with limited exceptions. The holding time for pH analysis is “immediate”; all field samples analyzed for pH were qualified “J” and should be considered usable as estimated values.

Overall, the data are usable for evaluating the presence or absence of PFAS at the facility. Sufficient usable data were obtained to meet the objectives of the SI.

4.6.4 Comparability

Comparability is the extent to which data from one study can be compared directly to either past data from the current project or data from another study. Using standardized sampling and analytical methods, units of reporting, and site selection procedures help ensure comparability. Standard field sampling and typical laboratory protocols were used during the SI and are considered comparable to ongoing investigations.

4.6.5 Completeness

Completeness is a measure of the amount of valid data obtained from a measurement system compared to the amount of data expected under normal conditions. The laboratory provided data meeting system QC acceptance criteria for all samples tested. Project completeness was determined by evaluating the planned versus actual quantities of data. Percent completeness per parameter is as follows and reflects the exclusion of ‘X”-flagged data, if applicable:

- PFAS in groundwater by USEPA Method 537 Modified at 100%
- PFAS in soil by USEPA Method 537 Modified at 100%
- pH in soil by USEPA Method 9045D at 100%

- TOC by USEPA Method 9060 at 100%

4.6.6 Sensitivity

Sensitivity is the capability of a test method or instrument to discriminate between measurement responses representing different levels (e.g., concentrations) of a variable of interest. Examples of QC measures for determining sensitivity include laboratory fortified blanks, an MDL study, and calibration standards at the limit of quantitation (LOQ). In order to meet the needs of the data users, project data must meet the measurement performance criteria for sensitivity and project LOQs specified in the QAPP Addendum (AECOM, 2021a). The laboratory provided the requested MDL studies and provided applicable calibration standards at the LOQ. In order to achieve the DQOs for sensitivity outlined in the QAPP Addendum (AECOM, 2021a), the laboratory reported all field sample results at the lowest possible dilution. Additionally, any analytes detected below the LOQ and above the MDL were reported and qualified “J” as estimated values by the laboratory. Several instrument calibration sensitivity checks recovered outside the QC limits for multiple target analytes. Re-extraction and reanalysis were not necessary, as the affected analytes were not reported in the associated batches; no data qualifying action was required.

5. Site Inspection Activities

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

- *Final Preliminary Assessment Report, Papago Park Military Reservation, Phoenix, Arizona* dated September 2020 (AECOM, 2020);
- *Final Site Inspection Programmatic Uniform Federal Policy-Quality Assurance Project Plan* dated March 2018 (AECOM, 2018a);
- *Final Site Inspection Uniform Federal Policy-Quality Assurance Project Plan Addendum, Papago Park Military Reservation, Phoenix, Arizona* dated March 2021 (AECOM, 2021a);
- *Final Programmatic Accident Prevention Plan* dated July 2018 (AECOM, 2018b); and
- *Final Site Safety and Health Plan, Papago Park Military Reservation, Phoenix, Arizona* dated April 2021 (AECOM, 2021b).

SI field activities were conducted from 19 April to 22 April 2021 and consisted of utility clearance, surface soil sampling, and low-flow groundwater sampling. Field activities were conducted in accordance with the SI QAPP Addendum (AECOM, 2021a), except as noted in **Section 5.7**.

The following samples were collected during the SI and analyzed for a subset of 18 PFAS by LC/MS/MS compliant with QSM 5.3 Table B-15 to fulfill the project DQOs:

- 18 soil grab samples from 18 boring locations; and
- Four groundwater samples from four permanent monitoring well locations.

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**, and investigation-derived waste (IDW) polygons are provided in **Appendix B3**. 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 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 quantitative and qualitative DQOs, and formulating a sampling approach to address the AOIs identified in the PA.

A combined TPP Meeting 1 and 2 was held on 19 January 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, AZARNG, USACE, and ADEQ. 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, 2021a).

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

5.1.2 Utility Clearance

AECOM contacted Arizona 811, the local one-call utility location system to notify them of intrusive work on 13 April 2021. 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 19 April 2021 with input from the AECOM field team, ARNG, AZARNG, and ADEQ. General locating services and ground-penetrating radar were used to complete the clearance.

5.1.3 Source Water and PFAS Sampling Equipment Acceptability

Since mechanized drilling was not part of the SI scope, a potable water source used for decontamination of drilling equipment was not collected at PPMR. Instead, American Society for Testing and Materials (ASTM) Type II water, provided by Grainger, was used to decontaminate dedicated sampling equipment during the field activities.

Materials that were used within the sampling zone were confirmed as acceptable for use in the PFAS sampling environment. The checklist of acceptable materials for use in the PFAS sampling environment was provided in the Standard Operating Procedures (SOPs) appendix to the SI QAPP Addendum (AECOM, 2021a). Prior to the start of field work each day, a PFAS 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

Soil samples were collected via hand auger in accordance with the SI QAPP Addendum (AECOM, 2021a). The soil boring locations are shown on **Figure 5-1** and depths are provided **Table 5-1**. Eighteen surface soil samples were collected from 0 to 2 feet bgs. Where refusal was encountered before reaching the target depth of 2 feet bgs, one additional attempt was made adjacent to the original location (within 10 feet of the original boring) to collect a soil sample from the proposed depth. Hand auger borings were abandoned by backfilling with native soil. Prior to collection in lab-provided bottleware, soil was placed in a Ziplock bag for characterization and homogenization.

The recovered soil was logged for lithological descriptions by a 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 boring logs and in a non-treated field logbook (i.e., composition notebook). Depth interval, recovery thickness, PID concentrations, moisture, relative density, color, and texture (using the USCS) were recorded. The boring logs are provided in **Appendix E**.

Each soil sample was collected into laboratory-supplied PFAS-free high-density polyethylene (HDPE) bottles and labeled using a PFAS-free marker or pen. Samples were packaged on ice and transported via Federal Express (FedEx) under standard chain of custody (CoC) procedures to the laboratory and analyzed for PFAS (LC/MS/MS compliant with QSM 5.3 Table B-15), TOC (USEPA Method 9060A) and pH (USEPA Method 9045D) in accordance with the SI QAPP Addendum (AECOM, 2021a).

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. In instances when non-dedicated sampling equipment was used, such as a hand auger for the shallow soil samples, equipment rinsate blanks (ERBs) 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.

5.3 Groundwater Sampling

Due to the complex hydrogeology at PPMR, no temporary or permanent monitoring wells were installed as part of the SI. Instead, four existing monitoring wells were selected to be sampled based on their downgradient location to suspected release areas. Target depth of these wells is the surficial aquifer within fractured bedrock. The screen interval of each of the groundwater monitoring wells is provided in **Table 5-2** and well locations are shown on **Figure 5-1**.

Sampling of the existing groundwater monitoring wells was completed in accordance with the SI QAPP Addendum (AECOM, 2021a). Groundwater samples were collected via low-flow sampling methods using a peristaltic pump with disposable PFAS-free, HDPE tubing. The wells were purged at a rate determined in the field to reduce draw down prior to sampling. Water quality parameters (e.g., temperature, specific conductance, pH, dissolved oxygen, oxidation-reduction potential, and turbidity) were measured using a water quality meter and recorded on the field sampling form (**Appendix B2**). Water levels were measured to the nearest 0.01 inch and recorded. Additionally, a subsample of each groundwater sample was collected in a separate container, and a shaker test was completed to identify if there were any foaming. No foaming was noted in any of the groundwater samples.

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

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 (FRB) was collected in accordance with the Programmatic QAPP (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 20 April 2021. Groundwater elevation measurements were collected from the four existing monitoring wells sampled. Water level measurements were taken from the northern side of the well casing. A groundwater flow contour map was drafted using groundwater elevations calculated from existing survey data and the synoptic gauging data; however, the limited number and spatial coverage of the monitoring wells gauged did not provide a representative understanding of groundwater flow across the area. As a result, no groundwater contour map is included in this SI Report. The calculated groundwater elevation data is provided in **Table 5-2**.

5.5 Investigation-Derived Waste

As of the date of this report, the disposal of PFAS IDW is not regulated federally. PFAS IDW generated during the SI is considered non-hazardous waste and was managed in accordance

with the SI QAPP Addendum (AECOM, 2021a) and with the DA Guidance for Addressing Releases of PFAS, Q18 (DA, 2018).

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

Liquid IDW generated during SI activities (i.e. purge water and decontamination fluids) was containerized in a 55-gallon drum and stored in the air sparging system compound at the facility. The liquid IDW was not sampled and assumes the PFAS characteristics of the associated groundwater samples collected from that source location. The containerized IDW will be temporarily stored at the facility until the analytical results for the associated groundwater samples are available. ARNG will manage and dispose of the 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 Engineering, Science, and Technology, Inc., 2021). ARNG will further coordinate with the ADEQ to ensure proper disposal is in accordance with any state requirements and the Army Guidance for Addressing Releases of PFAS, Q18 (DA, 2018).

Geographic coordinates were collected using a global positioning system around each location where soil IDW was placed (i.e., an IDW polygon). The IDW polygons are displayed on the figure in **Appendix B3**.

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

5.6 Laboratory Analytical Methods

Samples were analyzed for a subset of 18 PFAS 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. The 18 PFAS analyzed as part of the ARNG SI program include the following:

- 6:2 fluorotelomer sulfonic acid (6:2 FTS)
- 8:2 fluorotelomer sulfonic acid (8:2 FTS)
- N-ethyl perfluorooctanesulfonamidoacetic acid (NEtFOSAA)
- N-methyl perfluorooctanesulfonamidoacetic acid (NMeFOSAA)
- Perfluorobutyrate (PFBA)
- Perfluorobutanesulfonic acid (PFBS)
- Perfluorodecanoic acid (PFDA)
- Perfluorododecanoic acid (PFDoA)
- Perfluoroheptanoic acid (PFHpA)
- Perfluorohexanoic acid (PFHxA)
- Perfluorohexanesulfonic acid (PFHxS)
- Perfluorononanoic acid (PFNA)
- Perfluorooctanoic acid (PFOA)
- Perfluorooctanesulfonic acid (PFOS)
- Perfluoropentanoic acid (PFPeA)
- PFTeDA
- Perfluorotridecanoic acid (PFTrDA)
- Perfluoroundecanoic acid (PFUdA)

Soil samples were also analyzed for TOC using USEPA Method 9060A and pH by USEPA Method 9045D.

5.7 Deviations from SI QAPP Addendum

Deviations from the SI QAPP Addendum occurred based on field conditions and discussion between AECOM, ARNG, and USACE. Deviations from the SI QAPP Addendum are noted below and are documented in the Field Change Request Forms (**Appendix B4**):

- During the site walk conducted on 19 April 2021 with the client and ADEQ, the team agreed to relocate AOI01-13 from its proposed location to an open lot adjacent to the 'Mobile Fire Extinguisher' potential release area. USACE was informed of the proposed change and agreed via email on 19 April 2021. This action was documented in a Field Change Request form provided in **Appendix B4**.
- During surface soil sampling, refusal was encountered before reaching the target depth of 2 feet bgs at 16 of 18 boring locations. Upon encountering refusal, one additional attempt to reach the desired depth was made within 10 feet of the original boring location. In each instance, refusal was encountered due to challenging soil conditions (presences of large cobbles and/or shallow bedrock).
- The soil and groundwater SLs for PFBS in this document has been updated since the Final SI QAPP due to a change in the OSD Memo (dated 15 September 2021). The revised SLs were developed using the USEPA Regional Screening Levels (RSLs) Calculator and are considered valid toxicity based values after peer review.

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Table 5-1
Site Inspection Samples by Medium
Site Inspection Report,
Papago Park Military Reserve, Phoenix, Arizona

Sample Identification	Sample Collection Date/Time	Sample Depth (feet bgs)	PFAS by LC/MS/MS compliant with QSM 5.3 Table B-15	TOC (USEPA Method 9060A)	pH (USEPA Method 9045D)	Comments
Soil Samples						
AOI01-01-SB-0-1	4/21/2021 10:50	1	x			
AOI01-02-SB-0-0.5	4/21/2021 10:25	0.5	x			
AOI01-03-SB-0-1	4/21/2021 9:50	1	x	x	x	
AOI01-03-SB-0-1-D	4/21/2021 9:50	1	x	x	x	Field Duplicate
AOI01-03-SB-0-1-MS	4/21/2021 9:50	1	x	x	x	MS/MSD
AOI01-03-SB-0-1-MSD	4/21/2021 9:50	1	x	x	x	MS/MSD
AOI01-04-SB-0-0.5	4/21/2021 9:15	0.5	x			
AOI01-04-SB-0-0.5-D	4/21/2021 9:15	0.5	x			Field Duplicate
AOI01-05-SB-0-0.75	4/21/2021 9:03	0.75	x			
AOI01-06-SB-0-0.75	4/21/2021 8:20	0.75	x			
AOI01-07-SB-0-2	4/22/2021 9:15	2	x			
AOI01-08-SB-0-1.25	4/22/2021 8:10	1.25	x			
AOI01-09-SB-0-0.25	4/22/2021 8:32	0.25	x			
AOI01-10-SB-0-1.7	4/22/2021 7:30	1.7	x			
AOI01-10-SB-0-1.7-D	4/22/2021 7:30	1.7	x			Field Duplicate
AOI01-11-SB-0-0.5	4/22/2021 12:20	0.5	x			
AOI01-12-SB-0-0.5	4/22/2021 12:38	0.5	x			
AOI01-13-SB-0-2	4/21/2021 7:50	2	x			
AOI01-13-SB-0-2-MS	4/21/2021 7:50	2	x			MS/MSD
AOI01-13-SB-0-2-MSD	4/21/2021 7:50	2	x			MS/MSD
AOI01-14-SB-0-1	4/21/2021 13:05	1	x			
AOI01-15-SB-0-1.9	4/21/2021 13:40	1.9	x			
AOI01-16-SB-0-0.75	4/22/2021 9:45	0.75	x			
AOI01-17-SB-0-0.58	4/22/2021 9:58	0.58	x			
AOI01-18-SB-0-1.25	4/22/2021 10:28	1.25	x			
Groundwater Samples						
MW-23-042021	4/20/2021 9:50	26	x			
MW-23-042021-MS	4/20/2021 9:50	26	x			MS/MSD
MW-23-042021-MSD	4/20/2021 9:50	26	x			MS/MSD
MW-24-042021	4/20/2021 10:30	25	x			
MW-25-042021	4/20/2021 11:25	27	x			
MW-26-042021	4/20/2021 11:10	28	x			
MW-26-042021-D	4/20/2021 11:10	28	x			Field Duplicate
Blank Samples						
PPMR-FRB-01	4/20/2021 11:50	---	x			Field Blank
PPMR-ERB-01	4/20/2021 12:35	---	x			Equipment Blank
PPMR-ERB-02	4/21/2021 14:00	---	x			Equipment Blank
PPMR-ERB-03	4/22/2021 10:55	---	x			Equipment Blank

Notes:
bgs = below ground surface
ERB = equipment rinsate blank
D = field duplicate
FRB = field reagent blank
LC/MS/MS = Liquid Chromatography Mass Spectrometry
MS/MSD = matrix spike/ matrix spike duplicate
PFAS = per- and polyfluoroalkyl substances
QSM = Quality Systems Manual
TOC = total organic carbon
USEPA = United States Environmental Protection Agency

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Table 5-2
Soil Boring Depths, Well Screen Intervals, and Groundwater Elevations
Site Inspection Report
Papago Park Military Reservation, Phoenix, Arizona

Area of Interest	Boring Location	Soil Boring Depth (feet bgs)	Well Screen Interval (feet bgs)	Top of Casing Elevation (feet NAVD88)	Ground Surface Elevation (feet NAVD88)	Depth to Water (feet btoc)	Depth to Water (feet bgs)	Groundwater Elevation (feet NAVD88)
1	AOI01-01	1	NA	NA	NA	NA	NA	NA
	AOI01-02	0.5	NA	NA	NA	NA	NA	NA
	AOI01-03	1	NA	NA	NA	NA	NA	NA
	AOI01-04	0.5	NA	NA	NA	NA	NA	NA
	AOI01-05	0.75	NA	NA	NA	NA	NA	NA
	AOI01-06	0.75	NA	NA	NA	NA	NA	NA
	AOI01-07	2	NA	NA	NA	NA	NA	NA
	AOI01-08	1.25	NA	NA	NA	NA	NA	NA
	AOI01-09	0.25	NA	NA	NA	NA	NA	NA
	AOI01-10	1.7	NA	NA	NA	NA	NA	NA
	AOI01-11	0.5	NA	NA	NA	NA	NA	NA
	AOI01-12	0.5	NA	NA	NA	NA	NA	NA
	AOI01-13	2	NA	NA	NA	NA	NA	NA
	AOI01-14	1	NA	NA	NA	NA	NA	NA
	AOI01-15	1.9	NA	NA	NA	NA	NA	NA
	AOI01-16	0.75	NA	NA	NA	NA	NA	NA
	AOI01-17	0.58	NA	NA	NA	NA	NA	NA
	AOI01-18	1.25	NA	NA	NA	NA	NA	NA
	MW-23	35.5	8-35.5	1234.94	NA	17.54	NA	1217.40
	MW-24	35.5	8-35.5	1236.27	NA	14.41	NA	1221.86
	MW-25	35	10-35	1235.53	NA	19.14	NA	1216.39
	MW-26	35	7.5-35	1235.76	NA	20.71	NA	1215.05

Notes:

[1] Total well depth not measured during groundwater sampling to avoid interference with the air sparging system. Well depths based on bottom of well screen interval.

bgs = below ground surface
btoc = below top of casing
NA = not applicable
NAVD88 = North American Vertical Datum 1988

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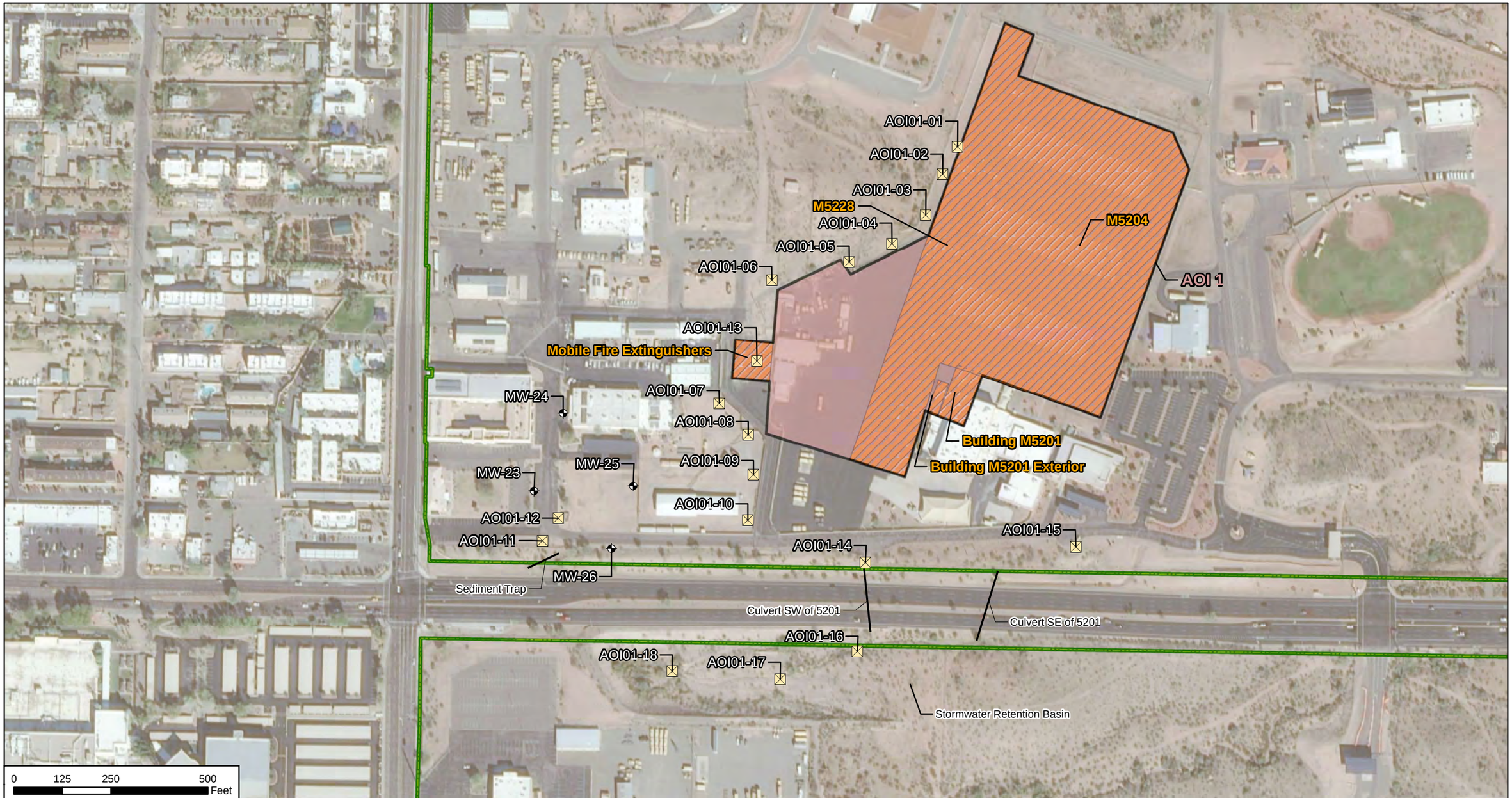

CLIENT	ARNG			
PROJECT	Site Inspection for PFAS at Papago Park Military Res, AZ			
REVISED	5/3/2021	GIS BY	MS	5/3/2021
SCALE	1:3,000	CHK BY	AB	5/3/2021
Base Map: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community		PM	CM	5/3/2021

- Hand Auger Surface Soil Sample
- Existing Monitoring Well
- Area of Interest
- Potential PFAS Release
- Facility Boundary

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 AOI 1 is provided in **Sections 6.2 and 6.3**. **Table 6-2** and **Table 6-3** present PFAS results for samples with detections in soil or groundwater; only constituents detected in one or more samples are included. 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 15 September 2021 (Assistant Secretary of Defense, 2021). 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 three compounds: PFOS, PFOA, and PFBS.

The SLs apply to three compounds, PFOA, PFOS, and PFBS, for both soil and groundwater, as presented in **Table 6-1**. All other results presented in this report are considered informational in nature and serve as an indication as to whether soil and groundwater contain or do not contain PFAS within the boundaries of the facility.

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

Analyte	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	130	1,600	40
PFOS	130	1,600	40
PFBS	1,900	25,000	600

Notes:

a.) Assistant Secretary of Defense, 2021. Risk Based Screening Levels Calculated for PFOS, PFOA, PFBS in Groundwater and Soil using United States Environmental Protection Agency's (USEPA's) Regional Screening Level Calculator. Hazard Quotient (HQ) = 0.1. 15 September 2021.

6.2 Soil Physicochemical Analyses

One soil sample was collected for TOC and pH analysis, which can be important for evaluating contaminant transport through the soil medium. The pH result was 8.46 and the TOC was 5,730 milligram per kilogram (mg/Kg). **Appendix F** contains the results of the TOC and pH sampling.

The data collected in this investigation will be used in subsequent investigations, where appropriate, to assess fate and transport of PFAS contaminants. According to the Interstate Technology Regulatory Council (ITRC), several important PFAS 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 they 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, which includes four potential PFAS release areas: the Former Fire Truck Bay (M5201), Runway (M5228) and Rotary Wing Parking Apron (M5204), AFFF Storage Area (M5201 Exterior), and the Mobile Fire Extinguishers Area. The detected compounds in soil and groundwater are summarized on **Table 6-2** and **Table 6-3**. The detections of PFOA, PFOS, and PFBS in soil and groundwater are presented on **Figure 6-1** through **Figure 6-4**.

6.3.1 AOI 1 Soil Analytical Results

PFOA, PFOS, and PFBS did not exceed the SLs in soil at any of the four potential PFAS release areas. **Figure 6-1** through **Figure 6-3** present the ranges of detections of PFOA, PFOS, and PFBS in soil. **Table 6-2** summarize the detected compounds in soil.

Along the Runway (M5228) and Rotary Wing Parking Apron (M5204), soil was sampled from surface soil (depths ranged from 0 to 0.5 feet bgs to 0 to 1 ft bgs) boring locations AOI01-1 through AOI01-06. PFOA, PFOS, and PFBS were detected in soil at concentrations several orders of magnitude lower than the SLs. PFOA was detected at all six boring locations at concentrations ranging from 0.062 J micrograms per kilogram (µg/kg) to 1.51 µg/kg. PFOS was detected at all six boring locations at concentrations ranging from 4.32 µg/kg to 24.1 µg/kg. PFBS was detected at locations AOI01-04, AOI01-05, and AOI01-06 at concentrations ranging from 0.074 J µg/kg (0.072 J µg/kg duplicate result) to 0.171 J µg/kg.

At the Mobile Fire Extinguisher Area, soil was sampled from surface soil (0 to 2 feet bgs) boring location AOI01-13. PFOA and PFOS were detected at concentrations of 0.464 J µg/kg and 26.1 J µg/kg, respectively. PFBS was not detected at location AOI01-13.

The Former Fire Truck Bay (M5201) and AFFF Storage Area (M5201 Exterior) potential release areas are covered by hard surface (asphalt and concrete). Therefore, per the QAPP Addendum, hand auger surface soil boring locations were positioned downgradient of the potential release areas in unpaved areas and included: AOI01-07 through AOI01-12 and AOI01-14 through AOI01-18. Samples -16, -17, and -18 were collected from a dry retention pond downstream and across the street from the potential release area. PFOA was detected at nine boring locations at concentrations ranging from 0.070 J µg/kg to 0.604 J µg/kg. PFOS was detected at ten boring locations at concentrations ranging from 0.203 J µg/kg to 20.0 µg/kg. PFBS was detected at three boring locations at concentrations ranging from 0.056 J µg/kg to 0.231 J µg/kg.

6.3.2 AOI 1 Groundwater Analytical Results

PFOA and PFOS in groundwater exceeded the SLs at the existing monitoring wells downgradient of AOI 1. PFBS did not exceed the SL at any of the existing monitoring wells downgradient of AOI 1. **Figure 6-4** presents the ranges of detections of PFOA, PFOS, and PFBS in groundwater. **Table 6-3** summarizes the detected compounds in groundwater.

Four existing monitoring wells were sampled downgradient of AOI 1. PFOA was detected at all four locations and exceeded the SL of 40 ng/L at three locations, with concentrations ranging from 20.9 ng/L to 292 ng/L. Similarly, PFOS was detected at all four locations and exceeded the SL of 40 ng/L at three locations with concentrations ranging from 3.36 J ng/L to 166 ng/L (170 ng/L duplicate). PFBS was detected at all four locations, but it did not exceed the SL. Concentrations ranged from 22.1 J ng/L to 249 ng/L.

6.3.3 AOI 1 Conclusions

Based on the results of the SI, PFOA, PFOS, and PFBS were detected in soil at AOI 1; however, the detected concentrations were several orders of magnitude lower than the soil SLs. At the existing monitoring wells downgradient of the potential PFAS release areas, PFOS and PFOA were detected in groundwater at concentrations exceeding the individual SLs of 40 ng/L. PFBS was detected in groundwater at concentrations below the SL. Based on the exceedances of the SLs for PFOA and PFOS in groundwater, further evaluation at AOI 1 is warranted.

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Table 6-2
PFAS Detections in Surface Soil
Site Inspection Report, Papago Park Military Reservation

Area of Interest		AOI01																			
Sample ID		AOI01-01-SB-0-1		AOI01-02-SB-0-0.5		AOI01-03-SB-0-1		AOI01-04-SB-0-0.5		AOI01-04-SB-0-0.5-D		AOI01-05-SB-0-0.75		AOI01-06-SB-0-0.75		AOI01-07-SB-0-2		AOI01-08-SB-0-1.25		AOI01-09-SB-0-0.25	
Sample Date		04/21/2021		04/21/2021		04/21/2021		04/21/2021		04/21/2021		04/21/2021		04/21/2021		04/22/2021		04/22/2021		04/22/2021	
Depth		0 - 1 ft		0 - 0.5 ft		0 - 1 ft		0 - 0.5 ft		0 - 0.5 ft		0 - 0.75 ft		0 - 0.75 ft		0 - 2 ft		0 - 1.25 ft		0 - 0.25 ft	
Analyte	**OSD Screening Level [a,b]**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**
Soil, PFAS by LCMSMS Compliant with QSM 5.3 Table B-15 (ug/Kg)																					
PFBA	-	ND		0.079	J	ND		ND		ND		ND		0.285	J	0.089	J	ND		0.170	J
PFBS	1900	ND		ND		ND		0.074	J	0.072	J	0.098	J	0.171	J	ND		0.056	J	ND	
PFDA	-	0.176	J	0.133	J	0.538	J	0.230	J	0.216	J	0.104	J	0.279	J	ND		ND		0.081	J
PFDoA	-	ND		ND		0.246	J	0.409	J	0.379	J	ND		ND		ND		ND		ND	
PFHpA	-	ND		ND		ND		ND		ND		ND		ND		0.131	J	ND		ND	
PFHxA	-	ND		0.042	J	0.049	J	0.087	J	0.078	J	0.275	J	0.156	J	0.206	J	0.243	J	0.169	J
PFHxS	-	ND		ND		0.278	J	0.517	J	0.490	J	1.29		0.399	J	3.09		0.423	J	0.265	J
PFNA	-	0.135	J	0.151	J	0.211	J	ND		ND		0.162	J	0.179	J	0.070	J	ND		0.233	J
PFOA	130	0.108	J	0.076	J	0.132	J	ND	UJ	0.062	J	1.51		0.256	J	0.460	J	0.070	J	0.571	J
PFOS	130	9.32		4.32		14.5		4.98		5.22		24.1		5.93		20.0		ND		8.22	
PFPeA	-	ND		ND		ND		0.399	J	0.353	J	0.171	J	0.124	J	ND		ND		0.062	J
PFTeDA	-	ND		ND		ND		0.142	J	0.135	J	ND		ND		ND		ND		ND	
PFTrDA	-	ND		ND		ND		0.146	J	0.142	J	ND		ND		ND		ND		ND	
PFUnDA	-	0.017	J	0.020	J	0.227	J	0.280	J	0.265	J	0.021	J	0.052	J	ND		ND		0.015	J

Grey Fill — Detected concentration exceeded OSD Screening Levels

References

a. Assistant Secretary of Defense, 2019. Risk Based Screening Levels Calculated for PFOS and PFOA in Groundwater or Soil using USEPA's Regional Screening Level Calculator. HQ=0.1. 15 October 2019. Soil screening levels based on residential scenario for direct ingestion of contaminated soil.

b. USEPA, 2021. Risk Based Screening Levels Calculated for PFBS in Groundwater and Soil using USEPA's Regional Screening Level Calculator. HQ=0.1. 8 April 2021.

Interpreted Qualifiers

J = Estimated concentration

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

Chemical Abbreviations

PFBA	perfluorobutanoic acid
PFBS	perfluorobutanesulfonic acid
PFDA	perfluorodecanoic acid
PFDoA	perfluorododecanoic acid
PFHpA	perfluoroheptanoic acid
PFHxA	perfluorohexanoic acid
PFHxS	perfluorohexanesulfonic acid
PFNA	perfluorononanoic acid
PFOA	perfluorooctanoic acid
PFOS	perfluorooctanesulfonic acid
PFPeA	perfluoropentanoic acid
PFTeDA	perfluorotetradecanoic acid
PFTrDA	perfluorotridecanoic acid
PFUnDA	perfluoro-n-undecanoic acid

Acronyms and Abbreviations

AOI	Area of Interest
D	Duplicate
ft	feet
HQ	Hazard quotient
LCMSMS	Liquid Chromatography Mass Spectrometry
LOD	Limit of Detection
ND	Analyte not detected above the LOD
OSD	Office of the Secretary of Defense
PFAS	per- and polyfluoroalkyl substances
QSM	Quality Systems Manual
Qual	Interpreted Qualifier
SB	Soil boring
USEPA	United States Environmental Protection Agency
ug/Kg	micrograms per Kilogram
-	Not applicable

Table 6-2
PFAS Detections in Surface Soil
Site Inspection Report, Papago Park Military Reservation

Area of Interest		AOI01																			
Sample ID		AOI01-10-SB-0-1.7		AOI01-10-SB-0-1.7-D		AOI01-11-SB-0-0.5		AOI01-12-SB-0-0.5		AOI01-13-SB-0-2		AOI01-14-SB-0-1		AOI01-15-SB-0-1.9		AOI01-16-SB-0-0.75		AOI01-17-SB-0-0.58		AOI01-18-SB-0-1.25	
Sample Date		04/22/2021		04/22/2021		04/21/2021		04/21/2021		04/21/2021		04/21/2021		04/21/2021		04/22/2021		04/22/2021		04/22/2021	
Depth		0 - 1.7 ft		0 - 1.7 ft		0 - 0.5 ft		0 - 0.5 ft		0 - 2 ft		0 - 1 ft		0 - 1.9 ft		0 - 0.75 ft		0 - 0.58 ft		0 - 1.25 ft	
Analyte	OSD Screening Level [a,b]	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual
Soil, PFAS by LCMSMS Compliant with QSM 5.3 Table B-15 (ug/Kg)																					
PFBA	-	0.088	J	0.079	J	0.090	J	ND		0.115	J	ND		0.168	J	ND		0.088	J	ND	
PFBS	1900	ND		ND		0.093	J	ND		ND		ND		ND		ND		ND		0.231	J
PFDA	-	ND		ND		0.048	J	ND		0.116	J	0.092	J	0.168	J	0.049	J	ND		0.358	J
PFDoA	-	ND		ND		ND		ND		ND		ND		ND		0.104	J	ND		0.446	J
PFHpA	-	ND		ND		ND		0.108	J	ND		ND		ND		ND		ND		ND	
PFHxA	-	0.155	J	0.123	J	0.152	J	0.074	J	0.106	J	ND		ND		ND		0.069	J	0.105	J
PFHxS	-	0.172	J	0.132	J	ND		1.02		0.857	J	ND		ND		ND		0.493	J	0.385	J
PFNA	-	ND		ND		ND		0.073	J	0.337	J	ND		0.124	J	ND		ND		ND	
PFOA	130	0.324	J	0.245	J	0.179	J	0.604	J	0.464	J	ND		0.155	J	ND		0.366	J	0.105	J
PFOS	130	0.779	J	0.581	J	0.271	J	1.20		26.1	J	0.660	J	1.05		0.203	J	0.292	J	3.47	
PFPeA	-	ND		ND		0.080	J	ND		0.140	J	ND		ND		ND		ND		ND	
PFTeDA	-	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
PFTrDA	-	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
PFUnDA	-	ND		ND		ND		ND		0.015	J	0.056	J	0.033	J	0.038	J	ND		0.350	J

Grey Fill — Detected concentration exceeded OSD Screening Levels

References

a. Assistant Secretary of Defense, 2019. Risk Based Screening Levels Calculated for PFOS and PFOA in Groundwater or Soil using USEPA's Regional Screening Level Calculator. HQ=0.1. 15 October 2019. Soil screening levels based on residential scenario for direct ingestion of contaminated soil.

b. USEPA, 2021. Risk Based Screening Levels Calculated for PFBS in Groundwater and Soil using USEPA's Regional Screening Level Calculator. HQ=0.1. 8 April 2021.

Interpreted Qualifiers

J = Estimated concentration

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

Chemical Abbreviations

PFBA	perfluorobutanoic acid
PFBS	perfluorobutanesulfonic acid
PFDA	perfluorodecanoic acid
PFDoA	perfluorododecanoic acid
PFHpA	perfluoroheptanoic acid
PFHxA	perfluorohexanoic acid
PFHxS	perfluorohexanesulfonic acid
PFNA	perfluorononanoic acid
PFOA	perfluorooctanoic acid
PFOS	perfluorooctanesulfonic acid
PFPeA	perfluoropentanoic acid
PFTeDA	perfluorotetradecanoic acid
PFTrDA	perfluorotridecanoic acid
PFUnDA	perfluoro-n-undecanoic acid

Acronyms and Abbreviations

AOI	Area of Interest
D	Duplicate
ft	feet
HQ	Hazard quotient
LCMSMS	Liquid Chromatography 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
ug/Kg	micrograms per Kilogram
-	Not applicable

Table 6-3
PFAS Detections in Groundwater
Site Inspection Report, Papago Park Military Reservation

Area of Interest		AOI01									
Sample ID		MW-23-042021		MW-24-042021		MW-25-042021		MW-26-042021		MW-26-042021-D	
Sample Date		04/20/2021		04/20/2021		04/20/2021		04/20/2021		04/20/2021	
Analyte	OSD Screening Level [a,b]	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual
Water, PFAS by LCMSMS Compliant with QSM 5.3 Table B-15 (ng/L)											
6:2 FTS	-	ND		20.1		ND		ND		ND	
PFBA	-	41.1		49.6		95.6		38.8		40.6	
PFBS	600	22.1	J	51.6		249		53.8		55.6	
PFHpA	-	35.1	J	29.8		246		44.5		46.9	
PFHxA	-	58.5		61.8		1900		123		125	
PFHxS	-	31.7	J	178		4430		683		659	
PFNA	-	ND		ND		ND		1.75	J	1.89	J
PFOA	40	65.1		20.9		292		77.2		79.6	
PFOS	40	124		101		3.36	J	166		170	
PFPeA	-	26.2	J	42.4		286		57.1		59.0	

Grey Fill — Detected concentration exceeded OSD Screening Levels

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a. Assistant Secretary of Defense, 2019. Risk Based Screening Levels Calculated for PFOS and PFOA in Groundwater or Soil using USEPA's Regional Screening Level Calculator. HQ=0.1. 15 October 2019. Groundwater screening levels based on residential scenario for direct ingestion of groundwater.

b. USEPA, 2021. Risk Based Screening Levels Calculated for PFBS in Groundwater and Soil using USEPA's Regional Screening Level Calculator. HQ=0.1. 8 April 2021.

Interpreted Qualifiers

J = Estimated concentration

Chemical Abbreviations

6:2 FTS	6:2 fluorotelomer sulfonate
PFBA	perfluorobutanoic acid
PFBS	perfluorobutanesulfonic acid
PFHpA	perfluoroheptanoic acid
PFHxA	perfluorohexanoic acid
PFHxS	perfluorohexanesulfonic acid
PFNA	perfluorononanoic acid
PFOA	perfluorooctanoic acid
PFOS	perfluorooctanesulfonic acid
PFPeA	perfluoropentanoic acid

Acronyms and Abbreviations

AOI	Area of Interest
D	Duplicate
GW	Groundwater
HA	Health advisory
HQ	Hazard quotient
LCMSMS	Liquid Chromatography Mass Spectrometry
LOD	Limit of Detection
ND	Analyte not detected above the LOD
OSD	Office of the Secretary of Defense
PFAS	per- and polyfluoroalkyl substances
QSM	Quality Systems Manual
Qual	Interpreted Qualifier
USEPA	United States Environmental Protection Agency
ng/L	nanogram per liter
-	Not applicable

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Legend

Facility Boundary

PFOA Results (µg/Kg)

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

0 90 180 360 Feet

Depth intervals shown represent respective sampling position within a given soil boring location.

PFOA Detections in Surface Soil

CLIENT	ARNG			
PROJECT	Site Inspection for PFAS at Papago Park Military Res, AZ			
REVISED	8/18/2021	GIS BY	MS	8/18/2021
SCALE	1:2,160	CHK BY	AB	8/18/2021
Base Map: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN,		PM	CM	8/18/2021

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Figure 6-1

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Legend

Facility Boundary

PFOS Results (µg/Kg)

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

0 90 180 360 Feet

Depth intervals shown represent respective sampling position within a given soil boring location.

PFOS Detections in Surface Soil

CLIENT	ARNG			
PROJECT	Site Inspection for PFAS at Papago Park Military Res, AZ			
REVISED	8/18/2021	GIS BY	MS	8/18/2021
SCALE	1:2,160	CHK BY	AB	8/18/2021
Base Map: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN,		PM	CM	8/18/2021

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Figure 6-2

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Legend

Facility Boundary

PFBS Results (µg/Kg)

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

0 90 180 360 Feet

Depth intervals shown represent respective sampling position within a given soil boring location.

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PFBS Detections in Surface Soil

CLIENT	ARNG			
PROJECT	Site Inspection for PFAS at Papago Park Military Res, AZ			
REVISED	10/18/2021	GIS BY	MS	10/18/2021
SCALE	1:2,160	CHK BY	AB	10/18/2021
Base Map: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN,		PM	CM	10/18/2021

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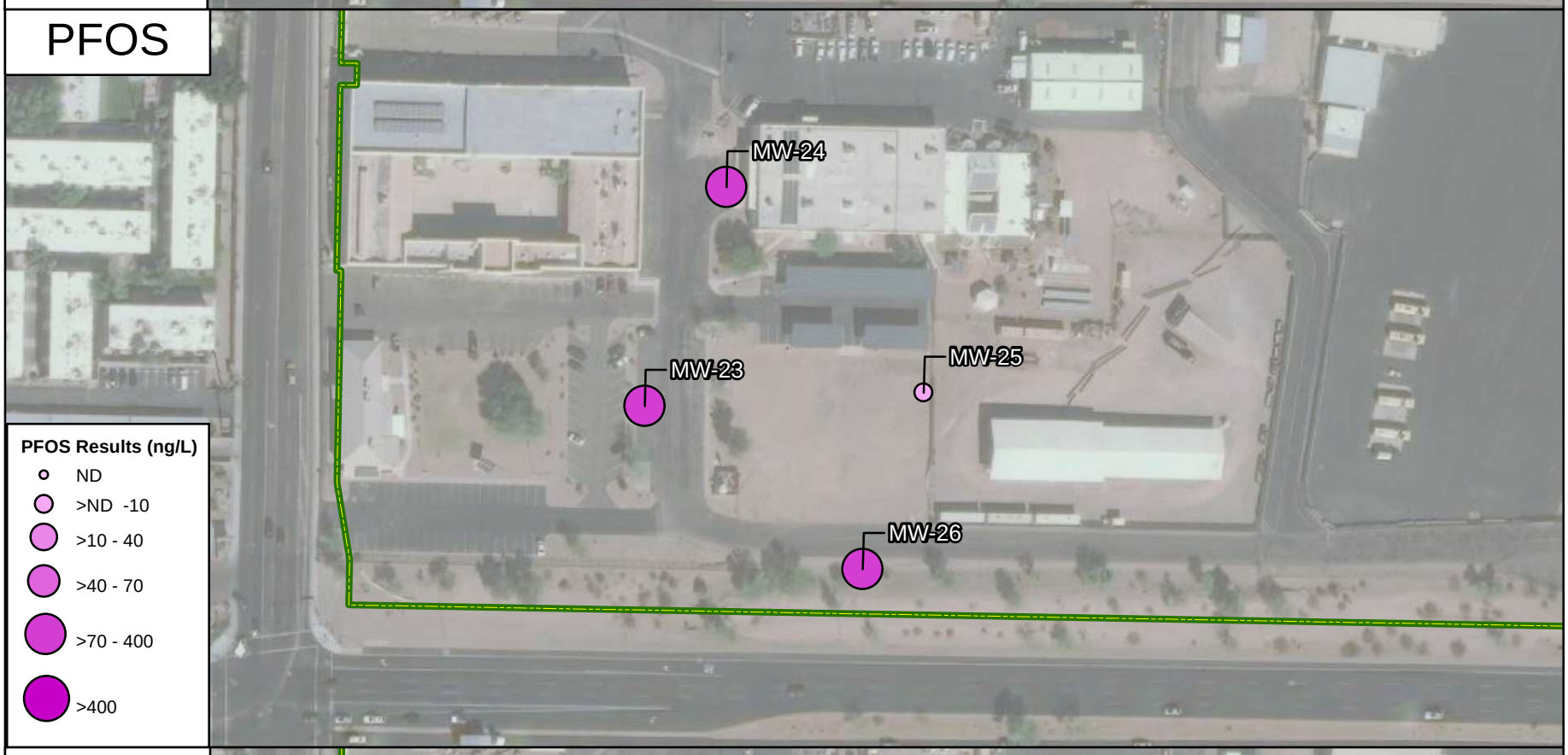
Figure 6-3

PFOA

PFOA Results (ng/L)
- ND
- >ND - 10
- >10 - 40
- >40 - 70
- >70 - 400
- >400

PFOS



PFOS Results (ng/L)
- ND
- >ND -10
- >10 - 40
- >40 - 70
- >70 - 400
- >400

PFBS

PFBS Results (ng/L)
- ND
- >ND - 100
- >100 - 600
- >600 - 1,000
- >1,000 - 6,000
- >6,000

Legend
- Facility Boundary

0 75 150 300 Feet

PFOA, PFOS, and PFBS Detections in Groundwater

CLIENT	ARNG			
PROJECT	Site Inspection for PFAS at Papago Park Military Res, AZ			
REVISED	10/18/2021	GIS BY	MS	10/18/2021
SCALE	1:1,800	CHK BY	AB	10/18/2021
Base Map: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN,		PM	CM	10/18/2021

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Figure 6-4

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7. Exposure Pathways

The CSM for AOI 1, revised based on the SI findings, is presented on **Figure 7-1**. 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 figure uses 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 PFOA, PFOS, or PFBS 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 PFOA, PFOS, or PFBS above the SLs. Areas with an identified potentially complete pathway that have detections of PFOA, PFOS, or PFBS above the SLs may warrant further investigation.

In general, the potential routes of exposure to PFAS 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 PFAS 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, residents outside the facility boundary, and recreational users outside of the facility boundary.

7.1 Soil Exposure Pathway

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

7.1.1 AOI 1

From the 1970s to the mid-2000s, AFFF was released to soil at four potential PFAS release areas within the AOI 1 through fire training, equipment testing, and AFFF storage. PFOA, PFOS, and PFBS were detected in soil at AOI 1 and confirm the release of PFAS to soil.

Based on the results of the SI in AOI 1, ground-disturbing activities could potentially result in site worker, construction worker, or recreational user/trespasser exposure to PFOA, PFOS, and PFBS via inhalation of dust. Off-facility residents may potentially be exposed to PFOA, PFOS, and PFBS via inhalation of dust caused by on-facility ground disturbing activities, though this pathway is likely insignificant. Ground-disturbing activities could also potentially result in site worker, construction worker, and trespasser exposure via ingestion of surface soil. Lasty, ground-disturbing activities could also potentially result in future construction worker exposure to PFOA,

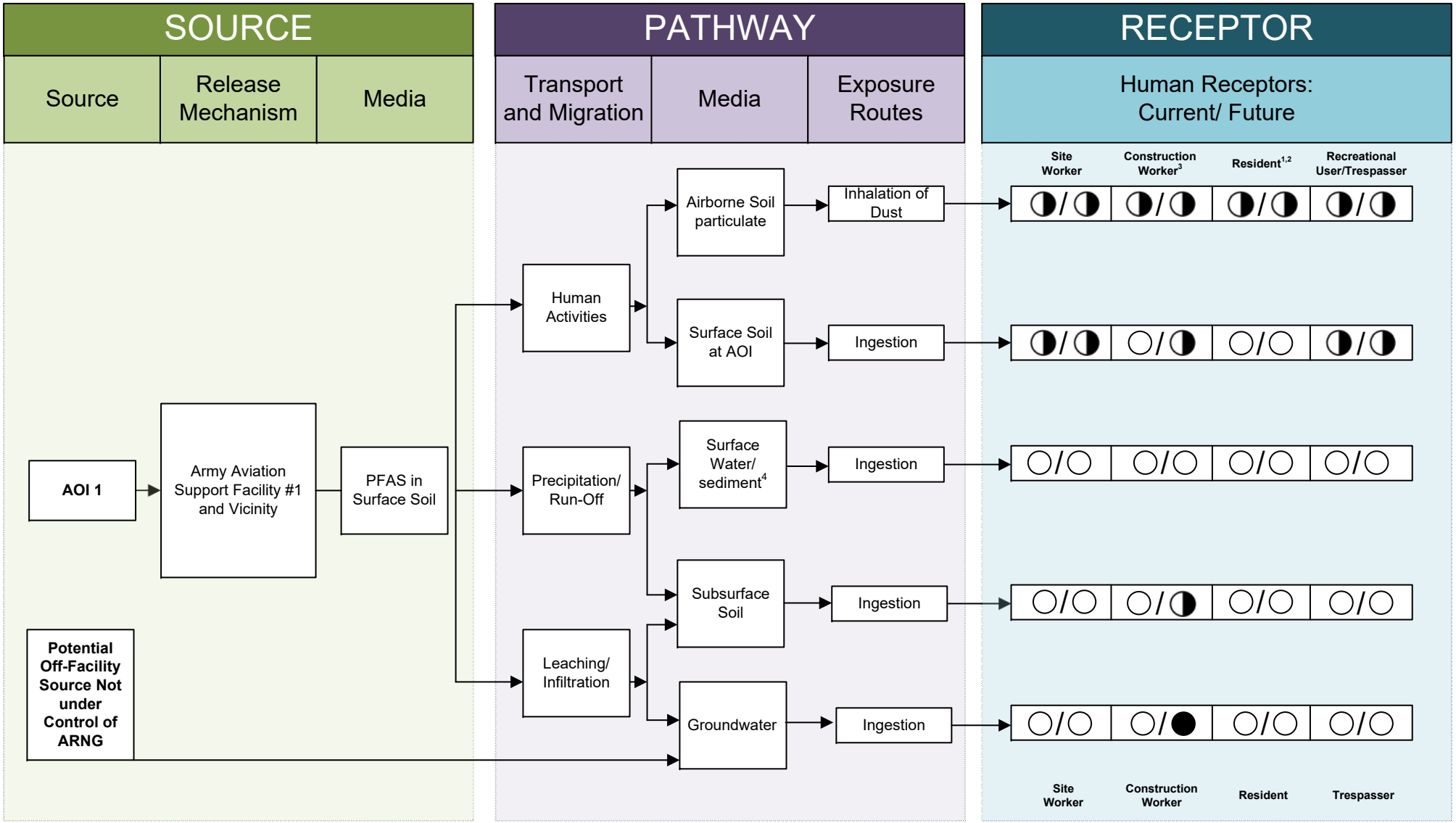
PFOS, and PFBS in subsurface soil via ingestion. No construction was occurring at the time of the SI field effort. The CSM is presented on **Figure 7-1**.

7.2 Groundwater Exposure Pathway

The SI results for PFOA, PFOS, and PFBS in groundwater were used to determine whether a potentially complete pathway exists between the source and potential receptors at the AOI based on the aforementioned criteria.

7.2.1 AOI 1

PFOA, PFOS, and PFBS were detected in groundwater collected from four existing monitoring wells downgradient of potential release areas and exceeded SLs for PFOA and PFOS. Drinking water at the facility is provided by the City of Phoenix and is sourced primarily from the SRP and CAP. Furthermore, no potable drinking water wells are located at or downgradient of the facility; therefore, the ingestion exposure pathway is incomplete for site workers, off-facility residents, and recreational users/trespassers. However, due to the depth to water in the shallow aquifer, the ingestion exposure pathway for future construction workers is considered potentially complete with an exceedance. No construction was occurring at the time of the SI field effort. The CSM is presented on **Figure 7-1**.



LEGEND

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

NOTES

1. The resident receptor refers to an off-site resident.
2. Inhalation of dust for off-site receptors is likely insignificant.
3. No current active construction at PPMR.
4. No surface water/sediment features exist onsite.

Figure 7-1
Conceptual Site Model
Papago Park Military Reservation, AZ

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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

SI field activities were conducted from 19 April to 22 April 2021 and consisted of utility clearance, surface soil sampling, and low-flow groundwater sampling. Field activities were conducted in accordance with the SI QAPP Addendum (AECOM, 2021a), except as noted in **Section 5.7**.

The following samples were collected during the SI and analyzed for a subset of 18 PFAS by LC/MS/MS compliant with QSM 5.3 Table B-15 to fulfill the project DQOs:

- 18 surface soil grab samples from 18 boring locations; and
- Four groundwater samples from four permanent monitoring wells.

The information gathered during this investigation was used to determine if PFOA, PFOS, and/or PFBS were present at or above SLs. Additionally, the CSM was refined to assess whether a potentially complete pathway exists between the source and potential receptors for potential exposure to PFOA, PFOS, and PFBS at the AOI, which is described in **Section 7**.

8.2 SI Goals Evaluation

As described in **Section 4.2**, the SI activities were designed to achieve six main goals or DQOs. This section describes the SI goals and the conclusions that can be made for each based on the data collected during this investigation.

1. *Determine the presence or absence of PFOA, PFOS, and PFBS at or above SLs.*

   PFOA, PFOS, and PFBS were detected at the facility in soil and groundwater. PFOA, PFOS, and PFBS were detected both at the source areas, as well as at the facility boundary. PFOA and PFOS in groundwater at the facility boundary exceeded the SL of 40 ng/L (individually). The detected concentrations of PFOA, PFOS, and PFBS in soil samples from AOI 1 were below their respective SLs.

2. *Develop information to potentially eliminate a release from further consideration because it is determined that it poses no significant threat to human health or the environment.*

   Due to the grouping of the potential release areas in AOI 1 and position of the sample locations, no one potential release area can be directly linked to the groundwater exceedances. Therefore, no release areas can be eliminated from further consideration at this time.

3. *Determine the potential need for a TCRA (applies to drinking water only). The primary actions that will be considered include provision of alternative water supplies or wellhead treatment.*

   Records from the AZDEMA indicate that there are no drinking water or irrigation wells present at or downgradient of the facility. Therefore, a TCRA is not needed.

4. *Collect data to better characterize the release areas for more effective and rapid initiation of a RI (if determined necessary).*

The geological data collected as part of the SI indicated a thin layer of unconsolidated soil exists over competent bedrock. The limited penetration depth of the soil borings did confirm that future RI-level sampling would be focused of surface soil sampling due to the bedrock surface being close to ground surface.

Depth to water ranged from 14 to 21 feet bgs in the existing monitoring wells sampled. The apparent groundwater flow direction was south-southeast; however, spatial coverage of the monitoring wells did not provide a representative understanding of groundwater flow across the AOI. A more detailed groundwater investigation may be performed as part of a future RI, which would evaluate the hydrogeologic conditions of the shallow aquifer, as well as, determine nature and extent of the PFOA and PFOS exceedances.

5. *If PFOA, PFOS, and PFBS are determined to be present, aim to evaluate whether the concentrations can be attributed to on-facility or off-facility sources that were identified within 4 miles of the installation as part of the PA (e.g., fire stations, major manufacturers, other DoD facilities).*

   Based on the evaluation of soil and groundwater data and the documented history and use of AFFF at PPMR, the results of the SI indicate that the source of PFOA, PFOS, and PFBS at the facility is likely attributable to ARNG activities.

6. *Determine whether a potentially complete pathway exists between the source and potential receptors and whether ARNG is the likely source of the contamination.*

   Detections of PFOA, PFOS, and PFBS in soil at and adjacent to the source area in combination with PFOA and PFOS exceedances in groundwater at the facility boundary indicate there is a potentially complete pathway between source and receptor.

8.3 Outcome

Based on the CSM updated with SI findings, there is potential for exposure to receptors on facility resulting from historical DoD activities. Detected concentrations of the three target PFAS were compared to the project SLs in soil and groundwater as listed in **Table 6-1**. The following bullets summarize the SI results:

- PFOA and PFOS were detected in groundwater at AOI 1 and exceeded the individual SL of 40 ng/L, with maximum concentrations of 292 ng/L and 170 ng/L at locations MW-25 and MW-26, respectively. PFBS was also detected in groundwater at AOI 1, but it did not exceed the SL. Based on the results of the SI, further evaluation of AOI 1 is warranted in an RI.
- The detected concentrations of PFOA, PFOS, and PFBS in soil samples from the AOI were below the SLs.

Table 8-1 summarizes the SI outcome for soil and groundwater. Based on the CSM developed and revised in light of the SI findings, there is a potential for exposure to receptors caused by DoD activities at or adjacent to the facility.

Table 8-2 summarizes the rationale used to determine if the AOI should be considered for further investigation under CERCLA and undergo an RI. Based on the results of this SI, further evaluation is warranted in an RI for AOI 1.

Table 8-1: Summary of Site Inspection Findings

AOI	Potential PFAS Release Area	Soil – Source Area	Groundwater – Source Area	Groundwater – Facility Boundary
1	Army Aviation and Support Facility #1 and Vicinity	◐	N/A	●

Legend:
N/A = Not applicable
● = detected; exceedance of the screening levels
◐ = detected; no exceedance of the screening levels
○ = not detected

Table 8-2: Site Inspection Recommendations

AOI	Description	Rationale	Future Action
1	Army Aviation and Support Facility #1 and Vicinity	Exceedances of SLs in groundwater within permanent monitoring wells at the facility boundary. No exceedances of SLs in soil.	Proceed to RI

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9. References

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