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

The National Training Center and Fort Irwin, California

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Preliminary Assessment and Site Inspection of Per- and Polyfluoroalkyl Substances

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CONTENTS

Executive Summary ES-1
1 Introduction 1
1.1 Project Background 1
1.2 PA/SI Objectives 2
1.2.1 PA Objectives 2
1.2.2 SI Objectives 2
1.3 PA/SI Process Description 2
1.3.1 Pre-Site Visit 2
1.3.2 Preliminary Assessment Site Visit 3
1.3.3 Post-Site Visit 4
1.3.4 Site Inspection Planning and Field Work 4
1.3.5 Data Analysis, Validation, and Reporting 5
2 Installation Overview 6
2.1 Site Location 6
2.2 Mission and Brief Site History 7
2.3 Current and Projected Land Use 7
2.4 Climate 8
2.5 Topography 8
2.6 Geology 9
2.7 Hydrogeology 10
2.8 Surface Water Hydrology 13
2.9 Relevant Utility Infrastructure 14
2.9.1 Stormwater Management System Description 14
2.9.2 Sewer System Description 14
2.10 Potable Water Supply and Drinking Water Receptors 14
2.11 Ecological Receptors 15
2.12 Previous PFAS Investigations 16
3 Summary of PA Activities 18
3.1 Records Review 18

3.2 Personnel Interviews 18
3.3 Site Reconnaissance 19
4 Potential PFAS Use, Storage, and/or Disposal Areas 20
4.1 AFFF Use, Storage, and Disposal Areas 20
4.2 Other PFAS Use, Storage, and/or Disposal Areas 22
4.3 Readily Identifiable Off-Post PFAS Sources 24
5 Summary and Discussion of PA Results 25
5.1 Areas Not Retained for Further Investigation 25
5.2 AOPIs 37
5.2.1 Active Recreational Ball Fields 37
5.2.2 AFFF Storage Shed (Building P358) 37
5.2.3 Area North of I Avenue Near Building P817 38
5.2.4 Bulk POL Containment Basins 38
5.2.5 Bulk POL Fire Tanker Response 38
5.2.6 DES Training Complex 39
5.2.7 Fire Hose Pressure-Testing Area 39
5.2.8 Fire Station 1 (Building P400) and Former AFFF Storage (Building P411) 40
5.2.9 Fire Station 2 (Building P6101) 40
5.2.10 Former Fire Station 41
5.2.11 Land Farm Drying Pits 41
5.2.12 FTIR-01 Sanitary Landfill 42
5.2.13 FTIR Helipad 42
5.2.14 Parking Lot South of Building P861 44
5.2.15 RUFMA Draining Basins 44
5.2.16 RUFMA Former Fire Training Area 44
5.2.17 RUFMA Wash-Rack 45
5.2.18 Bicycle Lake Army Airfield (BLAAF) Fire Extinguisher Training Area 46
5.2.19 BLAAF Helipad 46
5.2.20 BLAAF North Staging Area 47
5.2.21 BLAAF South Staging Area 47
5.2.22 FTIR-20 Former Fire Training Area 47

5.2.23 J Stand Fire Truck Pump Flush Area 48
5.2.24 FOB Miami 49
5.2.25 NASA Goldstone Former Microwave Test Facility 50
6 Summary of SI Activities 51
6.1 Data Quality Objectives 51
6.2 Sampling Design and Rationale 51
6.3 Sampling Methods and Procedures 57
6.3.1 Field Methods 58
6.3.2 Quality Assurance/Quality Control 58
6.3.3 Dedicated Equipment Background 59
6.3.4 Field Change Reports 59
6.3.5 Decontamination 61
6.3.6 Investigation-Derived Waste 61
6.4 Data Analysis 61
6.4.1 Laboratory Analytical Methods 61
6.4.2 Data Validation 62
6.4.3 Data Usability Assessment and Summary 62
6.5 Office of the Secretary of Defense Risk Screening Levels 63
7 Summary and Discussion of SI Results 65
7.1 Active Recreational Ball Fields 66
7.1.1 Soil 66
7.2 AFFF Storage Shed (Building P358) 67
7.2.1 Soil 67
7.3 Area North of I Avenue Near Building P817 67
7.3.1 Groundwater 67
7.4 Bulk POL Containment Basins 68
7.4.1 Soil 68
7.5 Bulk POL Tanker Fire Response 68
7.5.1 Soil 68
7.6 DES Training Complex 69

7.6.1 Groundwater 69
7.6.2 Soil 69
7.7 Fire Hose Pressure-Testing Area 69
7.7.1 Soil 70
7.8 Fire Station 1 (Building P400) and Former AFFF Storage (Building P411) 70
7.8.1 Soil 70
7.9 Fire Station 2 (Building P6101) 70
7.9.1 Soil 71
7.10 Former Fire Station 71
7.10.1 Soil 71
7.11 Land Farm Drying Pits 72
7.11.1 Groundwater 72
7.12 FTIR-01 Sanitary Landfill 72
7.12.1 Groundwater 72
7.13 FTIR Helipad 73
7.13.1 Soil 73
7.14 Parking Lot South of Building P861 73
7.14.1 Soil 73
7.15 RUFMA Drainage Basins 73
7.15.1 Soil 74
7.16 RUFMA Former Fire Training Area 74
7.16.1 Groundwater 74
7.16.2 Soil 74
7.17 RUFMA Wash-Rack 75
7.17.1 Sediment 75
7.18 BLAAF – Fire Extinguisher Training Area 75
7.18.1 Groundwater 75
7.18.2 Soil 76
7.19 BLAAF – Helipad 76
7.19.1 Groundwater 76

7.19.2 Soil 77
7.20 FTIR-20 Former Fire Training Area 77
7.20.1 Soil 77
7.21 J Stand Fire Truck Pump Flush Area 78
7.21.1 Soil 78
7.21.2 Sediment 79
7.22 FOB Miami 79
7.22.1 Soil 79
7.23 NASA Goldstone Former Microwave Test Facility 79
7.23.1 Soil 79
7.24 Dedicated Equipment Background Samples 80
7.25 Investigation Derived Waste 81
7.26 TOC, pH, and Grain Size 82
7.27 Blank Samples 82
7.28 Conceptual Site Models 82
8 Conclusions and Recommendations 88
9 References 94
Acronyms 98

TABLES

Table ES-1 Summary of AOPIs Identified During the PA, PFOS, PFOA, and PFBS Sampling at FTIR, and Recommendations (in text)
Table 2-1 On-Post Production Wells
Table 2-2 Historical PFOS, PFOA, and PFBS Analytical Results
Table 5-1 Installation Areas Not Retained for Further Investigation (in text)
Table 6-1 Monitoring Well Construction Details
Table 6-2 OSD Risk Screening Levels Calculated for PFOS, PFOA, and PFBS in Tap Water and Soil Using USEPA's Regional Screening Level Calculator (in text)
Table 7-1 Groundwater PFOS, PFOA, and PFBS Analytical Results
Table 7-2 Soil PFOS, PFOA, and PFBS Analytical Results
Table 7-3 Sediment PFOS, PFOA, and PFBS Analytical Results

Table 7-4 AOPIs and OSD Risk Screening Level Exceedances (in text)

Table 8-1 Summary of AOPIs Identified During the PA, PFOS, PFOA, and PFBS Sampling at FTIR, and Recommendations (in text)

FIGURES

Figure 2-1 Site Location

Figure 2-2 Site Layout

Figure 2-3a Topographic Map

Figure 2-3b Cantonment Area Topography

Figure 2-4 Groundwater Flow Map and Production Wells

Figure 2-5 Off-Post Potable Supply Wells

Figure 5-1 AOPI Decision Flowchart (in text)

Figure 5-2 AOPI Locations

Figure 5-3 Aerial Photo of Active Recreational Ball Fields AOPI

Figure 5-4 Aerial Photo of Former Fire Station and AFFF Storage Shed (Building 358) AOPIs

Figure 5-5 Aerial Photo of Area North of I Avenue Near Building P817 AOPI

Figure 5-6 Aerial Photo of Bulk POL Tanker Fire Response and Bulk POL Containment Basins AOPIs

Figure 5-7 Aerial Photo of DES Training Complex AOPI

Figure 5-8 Aerial Photo of Fire Hose Pressure-Testing Area AOPI

Figure 5-9 Aerial Photo of Fire Station 1 (Building P400) and Former AFFF Storage (Building P411) AOPI

Figure 5-10 Aerial Photo of Fire Station 2 (Building P6101) AOPI

Figure 5-11 Aerial Photo of FTIR-01 Sanitary Landfill and Land Farm Drying Pits AOPIs

Figure 5-12 Aerial Photo of FTIR Helipad AOPI

Figure 5-13 Aerial Photo of Parking Lot South of Building P861 AOPI

Figure 5-14 Aerial Photo of RUFMA AOPIs

Figure 5-15 Aerial Photo of Bicycle Lake Army Airfield AOPIs

Figure 5-16 Aerial Photo of FTIR-20 Former Fire Training Area and J Stand Fire Truck Pump Flush Area AOPIs

Figure 5-17 Aerial Photo of FOB Miami AOPI

Figure 5-18 Aerial Photo of NASA Goldstone Former Microwave Test Facility AOPI

Figure 6-1 AOPI Sampling Decision Tree (in text)

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

Figure 7-2 Active Recreational Ball Fields AOPI PFOS, PFOA, and PFBS Analytical Results

Figure 7-3 Former Fire Station and AFFF Storage Shed (Building 358) AOPIs PFOS, PFOA, and PFBS Analytical Results

Figure 7-4 Area North of I Avenue Near Building P817 AOPI PFOS, PFOA, and PFBS Analytical Results

Figure 7-5 Bulk POL Tanker Fire Response and Bulk POL Containment Basins AOPIs PFOS, PFOA, and PFBS Analytical Results

Figure 7-6 DES Training Complex AOPI PFOS, PFOA, and PFBS Analytical Results

Figure 7-7 Fire Hose Pressure-Testing Area AOPI PFOS, PFOA, and PFBS Analytical Results

Figure 7-8 Fire Station 1 (Building P400) and Former AFFF Storage (Building P411) AOPI PFOS, PFOA, and PFBS Analytical Results

Figure 7-9 Fire Station 2 (Building P6101) AOPI PFOS, PFOA, and PFBS Analytical Results

Figure 7-10 FTIR-01 Sanitary Landfill and Land Farm Drying Pits AOPIs PFOS, PFOA, and PFBS Analytical Results

Figure 7-11 FTIR Helipad AOPI PFOS, PFOA, and PFBS Analytical Results

Figure 7-12 Parking Lot South of Building P861 AOPI PFOS, PFOA, and PFBS Analytical Results

Figure 7-13 RUFMA AOPIs PFOS, PFOA, and PFBS Analytical Results

Figure 7-14 Bicycle Lake Army Airfield AOPIs PFOS, PFOA, and PFBS Analytical Results

Figure 7-15 FTIR-20 Former Fire Training Area and J Stand Fire Truck Pump Flush Area AOPIs PFOS, PFOA, and PFBS Analytical Results

Figure 7-16 FOB Miami AOPI PFOS, PFOA, and PFBS Analytical Results

Figure 7-17a/b NASA Goldstone Former Microwave Test Facility AOPI PFOS, PFOA, and PFBS Analytical Results

Figure 7-18 Conceptual Site Model for Active Recreational Ball Fields AOPI

Figure 7-19 Conceptual Site Model for 11 AOPIs Located within the Irwin Groundwater Basin

Figure 7-20 Conceptual Site Model for Area North of I Avenue near Building P817 and FTIR-01 Sanitary Landfill AOPIs

Figure 7-21 Conceptual Site Model for Land Farm Drying Pits AOPI

Figure 7-22 Conceptual Site Model for Parking Lot South of Building P861 and FOB Miami AOPIs

Figure 7-23 Conceptual Site Model for RUFMA Wash-Rack AOPI

Figure 7-24 Conceptual Site Model for 4 AOPIs Located within the Bicycle Groundwater Basin

Figure 7-25 Conceptual Site Model for BLAAF – North Staging Area and BLAAF – South Staging Area AOPIs

Figure 7-26 Conceptual Site Model for NASA Goldstone Former Microwave Test Facility AOPI

APPENDICES

Appendix A Office of the Secretary of Defense. 2021. Memorandum: Investigating Per- and Polyfluoroalkyl Substances within the Department of Defense Cleanup Program. September 15.

Appendix B Preliminary Assessment/Site Inspection Quality Control Checklist

Appendix C Antiterrorism/Operations Security Review Cover Sheet

Appendix D Not Used

Appendix E Installation EDR Survey Reports

Appendix F Research Log

Appendix G Compiled Interview Logs

Appendix H Site Reconnaissance Photo Log

Appendix I Compiled Site Reconnaissance Logs

Appendix J Site Inspection Field Notes

Appendix K Site Inspection Field Forms

Appendix L Site Inspection Photo Log

Appendix M Field Change Reports

Appendix N Data Usability Summary Report (Level IV analytical reports included)

Appendix O Site Inspection Laboratory Analytical Results

Appendix P Waste Manifest

EXECUTIVE SUMMARY

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

FTIR is located 39 miles northeast of the city of Barstow in San Bernardino County, California, and encompasses an area of approximately 760,000 acres in the Mojave Desert.[1] The installation is bordered by China Lake Naval Air Weapons Station to the west, by Death Valley National Park and a small strip of United States Bureau of Land Management (BLM) land to the north, by BLM wilderness study areas and by the Silurian Valley to the east, and by BLM land with small, interspersed parcels of private land to the south.[2] Fort Irwin Road is the only paved road that provides access to FTIR, intersecting with Interstate 15 approximately 37 miles to the south. Interstate 15 provides the major east-west travel route linking Los Angeles and Las Vegas.

The FTIR PA identified 25 AOPIs, with 23 of these AOPIs identified for investigation during the SI phase. SI sampling results from the 23 AOPIs were compared to risk-based screening levels calculated by the Office of the Secretary of Defense (OSD) for PFOS, PFOA, and PFBS. PFOS, PFOA, and/or PFBS were detected in soil and/or groundwater at 20 AOPIs; however, six of the 23 AOPIs had PFOS, PFOA, and/or PFBS present at concentrations greater than the risk-based screening levels. The FTIR PA/SI identified the need for further study in a CERCLA remedial investigation. **Table ES-1** below summarizes the PA/SI sampling results and provides recommendations for supplemental groundwater sampling (where PFOS, PFOA, and/or PFBS is present below OSD risk screening levels, but a potentially complete pathway to groundwater exists), further study in a remedial investigation, or no action at this time at each AOPI.

[1] FTIR. 2017b. Installation Action Plan. Army Defense Environmental Restoration Program. National Training Center and Fort Irwin, Fiscal Year 2016. June 2.
[2] FTIR. 2006. Integrated Natural Resources Management Plan and Environmental Assessment, 2006-2011. January

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

AOPI Name	PFOS, PFOA, and/or PFBS detected greater than OSD Risk Screening Levels? (Yes/No/ND/NS)			Recommendation
	GW	SO	SE	
Active Recreational Ball Fields	NS	No	NS	Supplemental groundwater sampling[1]
AFFF Storage Shed (Building P358)	NS	Yes	NS	Further study in a remedial investigation
Area North of I Avenue Near Building P817	No	NS	NS	No action at this time
Bulk POL Tanker Fire Response	NS	Yes	NS	Further study in a remedial investigation
Bulk POL Containment Basins	NS	No	NS	Supplemental groundwater sampling[1]
DES Training Complex	No	Yes	NS	Further study in a remedial investigation
Fire Hose Pressure-Testing Area	NS	No	NS	Supplemental groundwater sampling[1]
Fire Station 1 (Building P400) and Former AFFF Storage (Building P411)	NS	Yes	NS	Further study in a remedial investigation
Fire Station 2 (Building P6101)	NS	No	NS	Supplemental groundwater sampling[1]
Former Fire Station	NS	No	NS	Supplemental groundwater sampling[1]
FTIR-01 Sanitary Landfill	Yes	NS	NS	Further study in a remedial investigation
Land Farm Drying Pits	No	NS	NS	No action at this time
FTIR Helipad	NS	No	NS	Supplemental groundwater sampling[1]
Parking Lot South of Building P861	NS	ND	NS	No action at this time
RUFMA Drainage Basins	NS	No	NS	Supplemental groundwater sampling[1]
RUFMA Former Fire Training Area	No	No	NS	Supplemental groundwater sampling[1]
RUFMA Wash-Rack	NS	NS	Rejected[2]	Supplemental groundwater sampling[3]

AOPI Name	PFOS, PFOA, and/or PFBS detected greater than OSD Risk Screening Levels? (Yes/No/ND/NS)			Recommendation
	GW	SO	SE	
BLAAF - Fire Extinguisher Training Area	No[4]	No	NS	No action at this time
BLAAF - Helipad	No	No	NS	No action at this time
BLAAF - North Staging Area*	NS	NS	NS	No action at this time
BLAAF - South Staging Area*	NS	NS	NS	No action at this time
FTIR-20 Former Fire Training Area	NS	Yes	NS	Further study in a remedial investigation
J Stand Fire Truck Pump Flush Area	NS	No	No	Supplemental groundwater sampling[1]
FOB Miami	NS	ND	NS	No action at this time
NASA Goldstone Former Microwave Test Facility	NS	No	NS	Supplemental groundwater sampling[1]

Notes:

* AOPI not sampled in this SI.

1. If soil/sediment analytical data indicate PFOS, PFOA, and/or PFBS presence below OSD risk screening levels, but a potentially complete pathway to groundwater exists, then supplemental groundwater sampling will be recommended.

2. The laboratory inadvertently analyzed the supernatant (liquid) portion of the sediment sample and the duplicate sediment sample. As a result, the sample results (including non-detects) were affected by serious deficiencies in the ability to analyze the sample and to meet published method and project quality control criteria. The presence or absence of the analyte cannot be substantiated by the data provided. Rejection of the data was decided by the project team and the United States Army Corps of Engineers chemist.

3. As a result of the rejected sediment data, there are no PFOS, PFOA, and PFBS data available (i.e., a data gap). The RUFMA Wash-Rack AOPI is included in the group of AOPIs recommended for supplemental groundwater sampling due to the sediment data gap and its proximity to an active production well used for drinking water.

4. The BLAAF – Helipad AOPI groundwater samples are surrogate groundwater samples for the BLAAF - Fire Extinguisher Training Area AOPI, because no other existing well was available for sampling.

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

GW – groundwater

ND – non-detect

NS – not sampled

SE – sediment

SO – soil

1 INTRODUCTION

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

1.1 Project Background

PFAS are a class of compounds that have been used in a wide range of industrial applications and commercial products due to their unique surface tension/leveling properties. Due to industry and regulatory concerns about the potential health effects and adverse environmental impacts, there has been a reduction in the manufacture and use of PFAS worldwide. In the U.S., significant reductions in the production, importation, and use of PFOS and PFOA (two individual compounds in the PFAS class) occurred between 2001 and 2015 (Interstate Technology Regulatory Council 2020a). PFBS replaced PFOS in some applications and is currently used and manufactured in the U.S.

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

scenarios are 0.13 milligrams per kilogram (mg/kg) (residential) and 1.6 mg/kg (industrial/commercial). The soil screening levels for PFBS are 1.9 mg/kg (residential) and 25 mg/kg (industrial/commercial). These screening criteria are discussed further in **Section 6.5**.

1.2 PA/SI Objectives

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

1.2.1 PA Objectives

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

1.2.2 SI Objectives

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

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

1.3 PA/SI Process Description

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

1.3.1 Pre-Site Visit

First, an installation kickoff teleconference was held between applicable points of contact (POCs) from United States Army Environmental Command (USAEC), United States Army Corps of Engineers (USACE), FTIR, and Arcadis U.S., Inc. (Arcadis). The kickoff call occurred on 09 April 2018, 8 to 10 weeks before the site visit to discuss the goals and scope of the PA, project scheduling, installation access, timeline for the site visit, access to installation-specific databases, and to request available records.

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

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

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

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

1.3.2 Preliminary Assessment Site Visit

The site visit was conducted on 12 to 14 June 2018. An in-brief meeting was held to provide installation staff with the objectives of the site visit and team introductions. **Section 3** includes information regarding personnel interviewed.

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

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

An exit briefing was offered to installation personnel at the conclusion of the site visit to raise any items identified during the site visit, discuss any follow-up items, and review the schedule for submitting deliverables. The exit briefing was conducted on 14 June 2018 with the installation (Directorate of Public Works) to discuss preliminary findings of the PA site visit.

1.3.3 Post-Site Visit

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

1.3.4 Site Inspection Planning and Field Work

The SI process was initiated at the installation to evaluate PFOS, PFOA, and PFBS presence or absence at each AOPI and determine whether further investigation is warranted. First, a SI kickoff teleconference was held on 05 March 2020 between the Army PA team and FTIR.

The objectives of the SI kickoff teleconference were to:

- Discuss the AOPIs selected for sampling and the proposed sampling plan for each AOPI.
- Discuss additional available data.
- Discuss general SI deliverable and field work schedule information and logistics.
- Obtain additional information on AOPIs to support SI sampling technical approach design.

Following development of the SI sampling technical approach, a SI scoping teleconference was held on 16 and 17 June 2020 to obtain concurrence on the SI sampling plan from USAEC, USACE, and the installation. Additional discussion topics included:

- Discuss regulatory involvement requirements or preferences.
- Identify overlapping unexploded ordnance (UXO) or cultural resource areas (one AOPI is down range at a location with potential UXO).
- Confirm the plan for investigation-derived waste (IDW) handling and disposal.
- Identify specific installation access requirements and potential schedule conflicts.
- Provide an updated SI deliverable and field work schedule.

A Programmatic Uniform Federal Policy-Quality Assurance Project Plan (PQAPP) was developed and finalized in October 2019 for the USAEC PFAS PA/SI (Arcadis 2019). The PQAPP details general planning processes for collecting data and describes the implementation of quality assurance (QA) and quality control (QC) activities for the SI portion for Army installations nationwide. Additionally, an installation-specific QAPP Addendum was developed to define the DQOs, present the sampling design and rationale, and provide qualifications for project personnel. The SI field work was completed in accordance with the PQAPP (Arcadis 2019) and the approved installation-specific QAPP Addendum. A Site Safety and Health Plan (SSHP) was also developed as an attachment to the QAPP Addendum to identify specific health and safety hazards that may be encountered at the installation during sampling.

The SSHP was designed to supplement the Accident Prevention Plan (Arcadis 2018), which was developed for Army installations nationwide. The QAPP Addendum and SSHP were submitted to the installation and finalized before commencement of field work.

The DQOs, sampling design and rationale, and field methods employed for the SI are summarized from the QAPP Addendum developed for FTIR (Arcadis 2021a) in **Sections 6.1** through **6.3**.

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

1.3.5 Data Analysis, Validation, and Reporting

Environmental samples collected during the SI were submitted to a laboratory which is DoD Environmental Laboratory Accreditation Program (ELAP)-accredited for PFOS, PFOA, and PFBS analysis by liquid chromatography with tandem mass spectrometry and compliant with the DoD Quality Systems Manual (QSM) 5.3 (DoD and Department of Energy 2019). Laboratory analytical results were then validated and verified by a project chemist to assess the usability of the data collected. Validated analytical results were summarized in the context of OSD risk screening levels (defined in **Section 6.5**).

2 INSTALLATION OVERVIEW

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

2.1 Site Location

FTIR is located 39 miles northeast of the city of Barstow in San Bernardino County, California, and encompasses an area of approximately 760,000 acres in the Mojave Desert (FTIR 2017b). A site location map is provided as **Figure 2-1**; the site layout is presented on **Figure 2-2**.

The installation is bordered on the west by China Lake Naval Air Weapons Station; by Death Valley National Park and a small strip of United States Bureau of Land Management (BLM) land on the north; by BLM wilderness study areas and by the Silurian Valley on the east; and by the Alvord Mountains on the south. The land to the south is mostly BLM land with small, interspersed parcels of private land. Fort Irwin Road is the only paved road that provides access to FTIR, intersecting with Interstate 15 approximately 37 miles to the south. Interstate 15 provides the major east-west travel route linking Los Angeles and Las Vegas (FTIR 2006).

FTIR also owns a parcel of land to the northwest of Coyote Lake and approximately 2 miles south of the installation boundary (**Figure 2-2**). This land was purchased as a potential future water withdrawal site for the installation (FTIR 2006) and is currently undeveloped.

Tenants

Approximately 37 square miles of FTIR have been leased to the National Aeronautics and Space Administration (NASA) Jet Propulsion Laboratory (JPL) through a Use Permit. This area, known as the Goldstone Deep Space Communications Complex (Goldstone), is used for deep-space radio antennae and satellite tracking systems, and is part of NASA's Deep Space Network, a scientific telecommunications and radio navigation network (FTIR 2006; JPL 1992). The first antenna at Goldstone was constructed in 1958 (NASA no date). The airfield associated with Goldstone closed in 2010/2011, and in 2012, the Army took back the unused airfield, the associated hangar, and some additional land around the airfield (approximately 1,000 acres).

Approximately 350 square miles of the installation, along the northern boundary, are used by the U.S. Air Force as a gunnery range (Leach Lake Air-to-Air and Air-to-Ground Range [Tactics Range 24]) (FTIR 2006).

The Army National Guard maintains facilities within the FTIR cantonment, principally in the Old Maneuver Area Training Equipment Sites (MATES) and the New MATES areas. The U.S. Air Force maintains a few office buildings within the FTIR cantonment.

The Air Force has a minimal presence at FTIR. The Air Force occupies a few buildings. These buildings are used for administrative purposes (e.g., the Air Force has no buildings for vehicle services, photo labs).

Land/Facilities Formerly Leased by FTIR

FTIR formerly leased a portion of Southern California Logistics Airport (previously George Air Force Base) located northwest of Victorville and approximately 75 miles southwest of FTIR to use as a troop landing facility. This lease may have expired as recently as September 2017. FTIR's formerly leased facilities at the Southern California Logistics Airport were not visited, researched, or otherwise considered during this effort, and are not discussed further in this PA.

Due to the lack of adequate hangar space for maintenance at FTIR, the installation leases a portion of the Barstow-Daggett Airport (BDA) from the County of San Bernardino for military operation of a helicopter maintenance facility. BDA is located east of Barstow, and about 28 miles south of the installation cantonment area (FTIR 2006). The FTIR-Leased Property at BDA is addressed in a separate PA/SI report.

2.2 Mission and Brief Site History

FTIR was initially established as the Mojave Anti-aircraft Range on 640,000 acres in 1940, which accommodated uninterrupted training with anti-aircraft weapons. Mojave Anti-aircraft Range was renamed Camp Irwin in 1942. In addition to use by the regular Army, the California Institute of Technology used the area around Goldstone Dry Lake to test weapons for the Navy (i.e., Project Mousetrap, involving testing of an anti-submarine weapon). Camp Irwin was deactivated at the end of 1944, and later reactivated in 1951 to serve as a training ground for troops involved in the Korean Conflict. In 1961, the installation was upgraded to permanent status. At this point, Camp Irwin was renamed Fort Irwin and the Armor and Desert Training Center was established there. In 1971, FTIR was closed and was subsequently turned over to the state of California in 1972. From 1972 to 1980, the installation was used as a training area for troops of the California Army National Guard (ARNG) (FTIR 2001, 2017b).

In 1979, FTIR was selected as the site for the Army's National Training Center (NTC) and, in 1980, the NTC was activated with the mission of improving Forces Command unit readiness. The Army reactivated FTIR under Forces Command to support the NTC in 1981.

The current mission of FTIR is to:

- Improve Army unit readiness through a unique armored training experience for active Army units.
- Collect data on training exercises under near-battlefield conditions.
- Evaluate the performance and effectiveness of the Army's organization, equipment, doctrine, and training (FTIR 2017b).

As part of FTIR's mission, units from all over the U.S. come to FTIR to participate in simulated war games (FTIR 2017b).

2.3 Current and Projected Land Use

FTIR is divided into five general areas with the following land uses:

- Cantonment Area. The cantonment area is located in the southwestern portion of FTIR and is almost completely developed, including housing (residential and barracks), recreational facilities, and operational and administrative facilities (FTIR 2006).
- NTC Downrange Operations Area. The NTC downrange operations area is divided into various training corridors. (FTIR 2006).
- Leach Lake Gunnery Range. This area covers most of the northern portion of the installation. It is used by the U.S. Air Force (also the U.S. Navy and U.S. Marine Corps) for air-to-air and air-to-ground gunnery and as an east-west, low-level flight corridor (FTIR 2006).
- Goldstone. NASA Goldstone, located in the western portion of the installation, is operated by the JPL.
- Land Expansion Areas. The land expansion areas consist of two parcels, the western (Superior Valley) and eastern (East Gate) expansion areas. Jurisdiction of these parcels was transferred from the BLM to the Army in 2001. The purpose of these parcels is to provide additional staging and logistical support areas for ground and air training (FTIR 2006).

These land uses are anticipated to remain the same for the foreseeable future.

2.4 Climate

Hot summers, mild winters, infrequent rainfall, and moderate winds characterize the climate of FTIR. Rainfall averages 4.2 inches per year, and the annual evapotranspiration rate is greater than 70 inches per year (FTIR 2006).

Monthly mean temperatures at the installation, as determined from long-range climatic data at the BDA and Bicycle Lake Army Airfield (BLAAF) at FTIR, range from 48 to 89 degrees Fahrenheit (°F) with a maximum mean of 104° F and a minimum mean of 36° F (FTIR 2006).

Regional winds are primarily influenced by the Sierra Nevada and Transverse mountain ranges, the distance inland from coastal northwest winds, and inland winds that flow out across the high desert plains from the Los Angeles Basin. Regional winds are typically from the southwest with a yearly average speed of about 10 miles per hour (FTIR 2006).

Winds blowing across State Highway 127, east of the boundary of FTIR, show a dominant airflow to the east. During winter, strong turbulent winds sometimes occur, often accompanying frontal systems, and can reach speeds of 25 to 60 miles per hour. Dust storms often accompany these strong winds (FTIR 2006).

2.5 Topography

FTIR is located in the north-central part of the Mojave Desert (Buesch, ed. 2014). The geology and landscape of FTIR is typical of many parts of the Mojave Desert. It consists of rugged mountain peaks and ridges separated by broad, alluvial valleys (Aerostar SES, LLC [Aerostar] 2017). The average elevation of the Mojave Desert is approximately 2,500 feet above mean sea level. Individual peaks of isolated mountain areas on the training areas reach elevations of up to 6,153 feet above mean sea level (FTIR 2006). The installation topography is presented on **Figure 2-3a,** and the cantonment area topography is presented on **Figure 2-3b**.

2.6 Geology

FTIR sits within the Mojave Desert sub-province of the Basin and Range physiographic province. The area exhibits a fairly complex distribution of surficial deposits resulting from diverse rock sources and geomorphology that has been driven by topographic changes caused by recent and active faulting. Depositional environments span those typical of the Mojave Desert: alluvial fans on broad piedmonts, major intermittent or ephemeral streams along valley floors, eolian sand dunes and sheets, and playas in closed valleys that lack through-going washes. Erosional environments include steep mountains, smooth, gently sloping pediments, and badlands in readily eroded sediment (Aerostar 2017).

The alluvial deposits are generally heterogeneous, with coarse sands and gravels occurring in stringers and lenses, interbedded with finer grain sediments. Localized artesian conditions are present in areas where clay and silt lenses confine the layers of coarse-grained water-bearing sediments. In some areas, the alluvial material is highly sorted, resulting in clean sands and gravels that are prolific water-bearing units (FTIR 2006).

The alluvial fans extend into the valleys, where they merge either with the valley floor or extend across the valley to join fans from the other side and form alluvial divides. The alluvium is coarsest at the apex of the fans (proximal) and becomes progressively finer grained down slope. The thickness of individual beds decreases dramatically from the alluvial fan to the basin floor. Periodic runoff collects at the lowest elevations of the interior valleys creating playas (dry lakes). The playas in the interior basin characteristically contain cyclic deposits of relic ephemeral lakes (Montgomery Watson 1995).

Several playas occur within FTIR. Playa deposits accumulated from material in shallow bodies of water that covered lower portions of closed valleys during floods. The thickness of deposits underlying many of these dry lakes is unknown. However, playa deposits of the Mojave Desert range from a few feet to as much as 100 feet thick (Montgomery Watson 1995).

Seismicity

Principal faults bounding the Mojave Desert are the San Andreas Fault to the southwest and the Garlock Fault to the northwest. The internal wedge between these faults defines the Mojave Desert and is generally referred to as the “Mojave block.” The eastern part of the NTC is near the intersection of the Death Valley and Garlock fault zones. The Garlock Fault is one of the major east-west trending faults in southern California and has historically exhibited seismicity along its western extension where it displaces Holocene age alluvium. It is a strike-slip fault with left-lateral displacement and separates the Basin and Range Province from the Mojave Desert Province. Along the eastern portion of the fault, only minor seismicity has been observed. The Death Valley Fault is a right-lateral, strike-slip fault and extends along the northeastern Avawatz Mountains and eastern Soda Mountains. Segments of the Death Valley Fault have exhibited evidence of Holocene movement (FTIR 2006).

Fault traces in the vicinity of FTIR are generally parallel to the Garlock Fault Zone (east-west) or northwest-southeast. Local faults in the vicinity of FTIR include Bicycle Lake Fault, Garlic Spring Fault, and numerous unnamed faults. The Garlic Spring Fault is a northwest-striking fault located on the southeastern edge of the Irwin Groundwater Basin, in the vicinity of the wastewater treatment plant (WWTP) percolation ponds and extending into the cantonment area (Densmore 2003, Montgomery Watson 1995). Bicycle Lake Fault is an east-striking fault located immediately to the east of the FTIR

Sanitary Landfill. This fault is predominantly a left lateral fault that exhibits from 1.8 to 5 miles of offset (Montgomery Watson 1995).

2.7 Hydrogeology

The hydrogeology of this region is typified by isolated alluvial aquifers contained in intermontane valleys. Boundaries of groundwater basins generally correspond with surface water drainage divides. The bedrock forming the basement of the valleys and the intervening mountains is composed of relatively impervious indurated rocks (primarily igneous and metamorphic rocks). Locally, near-surface fractures in these indurated rocks may be able to transmit small amounts of water. Recharge to most of the groundwater basins is likely very small due to the low annual precipitation. What little recharge that does occur in these basins is primarily in the vicinity of coarser grained deposits around the basin margins and within washes that cross valley floors. Playa deposits mark the lowest points of internally drained basins (Miller et al. 2014). Surface water is directed to the playas. Fine-grained sediments in the basin centers generally inhibit infiltration so that water is primarily lost through evaporation (Parsons Engineering Science, Inc. [Parsons] 1998).

Groundwater elevations are typically higher at the margins of the basins, and the lowest elevations at the topographic lows. However, because there is relatively little recharge in these basins, groundwater gradients are likely very low. Exceptions to this generalization may be found in the vicinity of extraction wells where drawdown has increased the gradient (Parsons 1998).

FTIR is located in the South Lahontan Hydrologic Region. There are 16 groundwater basins and sub-basins that fall entirely or partly within the boundary of FTIR (**Figure 2-2**). These groundwater basins are Leach, Drinkwater, Riggs, Nelson, Goldstone, Superior, Central Corridor Area, Red Pass, Bicycle, Irwin, Langford, Cronise, and Coyote Lake Basins (Miller et al. 2014). There are three additional groundwater basins located along the northern border of FTIR that were not identified by Miller et al. These are Pilot Knob, Death, and Denning Spring Basins. The mapped boundaries of these basins are non-water-bearing deposits (e.g., bedrock or sediments with very low permeability) or a geologic structure (e.g., a fault) (Miller et al. 2014). In the FTIR area, groundwater basin boundaries are inferred to coincide with the contact of alluvium with plutonic and metamorphic rocks, as well as the presence of Miocene volcanic rocks (Miller et al. 2014).

The water supply for FTIR comes from groundwater extracted from three groundwater basins:

- Bicycle Groundwater Basin (located approximately 2 miles northeast of the cantonment area; the edge of the basin is adjacent to Barstow Road).
- Langford Groundwater Basin (located approximately 2 miles southeast of the cantonment area; the edge of the basin is adjacent to Langford Lake Road.
- Irwin Groundwater Basin (located underneath the cantonment area).

These three basins are all bowl-shaped aquifers/aquifer systems filled with water-bearing unconsolidated deposits. Depth to groundwater in each of these basins is generally between approximately 200 and 500 feet below ground surface (bgs) (FTIR 2006), with shallower groundwater present at limited locations (FTIR 2006). The three groundwater basins used for drinking water and their associated production well locations are presented on **Figure 2-4**.

Irwin Groundwater Basin

The Irwin Groundwater Basin is located between the Bicycle Groundwater Basin on the north and the Langford Groundwater Basin on the south and is overlain by the cantonment. The Irwin Groundwater Basin is isolated from Bicycle Groundwater Basin by a groundwater divide created by the subsurface occurrence of basement rocks. The Irwin Groundwater Basin appears to be partially connected to the Langford Groundwater Basin to the south through a narrow gap that contains Garlic Spring. However, under normal conditions, groundwater levels are below the bedrock in the gap and there is no outflow from the Irwin Groundwater Basin to the Langford Groundwater Basin (Parsons 1998).

The Irwin Groundwater Basin consists primarily of alluvial deposits composed of clay, silt, sand, and gravel lenses. The thickness of these deposits varies from 0.0 feet at the edges of the basin to a minimum of 950 feet near the center of the basin (Densmore and Londquist 1997). The maximum thickness of alluvium in the basin is unknown because wells drilled in the center of the basin did not encounter bedrock. The sand and gravel horizons comprise the primary water-yielding or aquifer materials and the fine-grained horizons comprise aquitards. The fine-grained horizons are more predominant in the central portion of the basin where the cantonment area is located (Parsons 1998).

The aquifer system in Irwin Groundwater Basin consists of an upper and a lower aquifer. The upper aquifer is contained in the saturated part of the younger alluvium and is unconfined. It is thickest (approximately 200 feet) in the west-central part of the basin (i.e., in the vicinity of the western edge of the non-residential portion of the cantonment). In 1994, the depth to groundwater in the upper aquifer ranged from approximately 380 feet bgs along the southwestern aquifer boundary to approximately 80 feet bgs north of the WWTP, and approximately 50 feet bgs at the southeastern aquifer boundary at or near the Garlic Spring Fault (Densmore 2003).The lower aquifer includes the older alluvium and the upper part of the basement complex that is weathered and fractured and, because of formation differences, is confined or partly confined throughout most of the basin. It is thickest (more than 600 feet) in the central part of the basin (i.e., in the center of the non-residential portion of the cantonment) (Densmore and Londquist 1997, Densmore 2003). The thickness of the upper and lower aquifers in the east-central and east parts of the basin is reduced due to the geologic effects of the Garlic Spring Fault and an unnamed parallel fault.

The source and relative age of groundwater in the Irwin Groundwater Basin were evaluated by the U.S. Geological Survey using stable isotopes of oxygen, hydrogen, tritium, and carbon-14. These isotopes indicate that present-day precipitation is an extremely minor source of recharge in the Irwin Groundwater Basin, and that water in undisturbed areas of the basin is 14,000 to more than 40,000 years in age (Densmore and Londquist 1997).

Groundwater flow in the cantonment area is generally centripetal (i.e., toward the center of Irwin Groundwater Basin). However, groundwater flow patterns are influenced by pumping activities (e.g., drinking water production wells I-7 and I-9) and aquifer recharge activities in the vicinity of the WWTP. In 1994, groundwater sampling indicated that a cone of depression had developed beneath the Irwin Groundwater Basin well field and that a groundwater mound had developed beneath the wastewater disposal sites (evaporation and percolation). High water levels and a steep groundwater gradient near the wastewater-effluent disposal sites may have resulted from several factors: (1) active recharge from wastewater effluent being disposed of in this area; (2) the aquifer in this area is primarily composed of older alluvium, which has a lower transmissivity than the younger alluvium in the central part of the basin; and (3) the barrier effect of the Garlic Spring Fault, which separates this area from the central part of the

basin. Water-level data from multiple well-monitoring sites indicate that a general downward vertical gradient exists between the upper and lower aquifer (Densmore and Londquist 1997).

Groundwater in the vicinity of the WWTP and sanitary landfill (FTIR-01) flows generally from south to north before gradually flowing westward toward the center of the basin at some point north of the sanitary landfill. The Garlic Spring Fault and an unnamed parallel fault may be impeding horizontal groundwater flow, primarily in the lower aquifer (Densmore and Londquist 1997, Densmore 2003). Vertical groundwater flow on the western side of the Garlic Spring Fault is also impeded due to lithologic differences between the younger alluvium and the lacustrine deposits of the older alluvium (Densmore and Londquist 1997, Densmore 2003).

The limited natural groundwater recharge that occurs to the Irwin Groundwater Basin is from direct percolation of rainfall and percolation along minor ephemeral stream courses. Within the cantonment area, engineered channels have been constructed to redirect any storm-event water flow in these ephemeral stream courses around the cantonment area (FTIR 2017a). Most natural recharge likely occurs in the western and southern portions of the basin where conditions are largely unconfined. Beginning in 1992, artificial recharge rates from percolation of treated wastewater to groundwater have exceeded pumping rates, stabilizing water-level declines in the Irwin Groundwater Basin (FTIR 2017a).

Bicycle Groundwater Basin

Bicycle Groundwater Basin is surrounded and partially filled with Quaternary-Tertiary deposits. The surface of the Bicycle Lake dry lakebed (playa), located in the southeastern part of the basin, consists of Quaternary playa deposits (clay, silt, and sand). These deposits may be up to 50 feet thick, intermix with the surrounding Quaternary younger alluvium, and lie above the water table. The Quaternary playa deposits tend to impede infiltration of ponding surface water following storm events (Densmore et al. 2018).

Groundwater flow in the Bicycle Groundwater Basin is generally centripetal. The aquifer system in the Bicycle Groundwater Basin consists of an upper and a lower aquifer. The upper aquifer is contained in the saturated part of younger and older Quaternary alluvium, Quaternary-Tertiary older alluvium, and lacustrine deposits and is primarily unconfined. It is thickest (approximately 300 feet) in the north-central part of the basin, and it thins at the margins of the basin (Densmore et al. 2018). As recently as 2010, the depth to groundwater in the upper aquifer ranges from approximately 175 feet bgs in the south to approximately 200 feet bgs in the north, and approximately 500 feet bgs in the southeast in the vicinity of an unnamed thrust fault (Densmore et al. 2018). The lower aquifer is composed of Tertiary younger sedimentary deposits and older sedimentary deposits, primarily is confined or partly confined, and is generally less permeable than the upper aquifer. It is thickest (up to 1,500 feet) in the central and north-central part of the basin (Densmore et al. 2018).

There are two unnamed sinistral strike-slip faults in the southwestern portion of Bicycle Groundwater Basin, identified as “unnamed fault 1” and “unnamed fault 2” (Densmore et al. 2018). Unnamed fault 1 trends northwest to southeast and is projected to cross Bicycle Lake playa approximately along the western edge of the runway that bisects the main runway. Unnamed fault 2 trends west-northwest to east-southeast and is projected to cross the Bicycle Lake playa approximately parallel to the taxiway connecting the Bicycle Lake Army Airfield (BLAAF) helipad and hangars to the main runway at the southwestern end of the playa (Densmore et al. 2018). Historical water levels in monitoring wells located

in the general vicinity of the FTIR-20 Former Fire Training Area (FTA) were more than 40 feet higher than water levels in wells north of unnamed fault 2 (these monitoring wells were destroyed in the late 1990s and 2000; Densmore et al. 2018). Historical groundwater elevation data collected from these monitoring wells (1993 to1997) demonstrate minimal or no water-level decline due to pumping in other parts of the basin. This indicated that these wells were isolated from pumping elsewhere in the basin by faults (i.e., unnamed faults 1 and 2) acting as barriers to groundwater flow or differences in lithology unrelated to faulting (Densmore et al. 2018).

Langford Groundwater Basin

The aquifer system in Langford Groundwater Basin consists of three aquifers: an upper aquifer, a middle aquifer, and a lower aquifer. The upper aquifer is composed of the saturated portions of the Quaternary younger and older alluvium and is generally unconfined (Voronin et al. 2013). In 1992, the depth to groundwater in the upper aquifer ranged from approximately 75 feet bgs at the northeastern aquifer boundary near the Garlic Spring Fault to approximately 300 feet bgs at the southwestern aquifer boundary, and approximately 850 feet bgs at the southeastern aquifer boundary (Voronin et al. 2013). The middle aquifer is composed of Tertiary younger sedimentary deposits, is confined or partly confined, and is generally less permeable that the upper aquifer. The lower aquifer is composed of Tertiary older sedimentary deposits (Voronin et al. 2013). There is an unnamed southeast-northwest-trending fault in the northern section of the basin, and two east-west-trending faults (Noble Dome Fault and Coyote Lake Fault) that bisect the approximate center of the basin and the southern portion of the basin, respectively. The Noble Dome Fault acts as a horizontal flow barrier (Voronin et al. 2013).

There are no AOPIs located within the limits of the Langford Groundwater Basin; therefore, discussion of this basin's hydrogeology is abbreviated.

2.8 Surface Water Hydrology

The basins of the Basin and Range physiographic province are typically characterized by centripetal drainage. Playa lakes, which contain water only following heavy rainfall, are frequently present within the alluvial basins. The largest basins and associated lakes in the vicinity of FTIR include Coyote Basin/Coyote Lake, Bicycle Basin/Bicycle Lake, and Langford Basin/Langford Lake (FTIR 2016).

Alluvial fans commonly are observed in and around FTIR. During heavy rainfall events, bedload material composed of sand, gravel, cobbles, and rocks is deposited which forms the fans. Significant subsurface flows might occur in the unconsolidated sand and gravel channel deposits found in washes and alluvial fans, even after surface flows have ceased (FTIR 2016).

Surface water resources are scarce in the region. Washes descending from mountains and other elevated landforms provide channels that route stormwater runoff to playas where ephemeral lakes are formed. Flow is evident only immediately during and after rains, with naturally occurring standing water present for only a short duration following heavy rains until evaporation or percolation occurs. Local groundwater recharge may occur along washes and in playas where water temporarily pools (FTIR 2016). Substantial water flow and accumulation only occurs following very significant rainfall events (generally once every several years) (FTIR 2017a).

Within the cantonment area, natural surface water flow is altered by the presence of channels and levees that protect the cantonment from floodwaters (FTIR 2017a). In the past, existing engineered

controls have been overwhelmed during extreme rain events.

Naturally occurring surface water resources on FTIR include six permanent springs. These resources produce meager quantities of water. Additionally, four springs produce little to no water during summer, depending on the amount of seasonal rainfall (FTIR 2016). Other surface water bodies in the area include the sewage treatment plant ponds located in the eastern-southeastern fringe of the cantonment area (Montgomery Watson 1995). Surface water is not used as a drinking water source.

There have been several flash-flood events in the cantonment area at FTIR, including an August 2013 flash flood that impacted many structures and some of the former landfills. The water from flash-flood events in the cantonment area tend to flow towards a playa (Bicycle Lake or Langford Lake). Storm water infrastructure has been implemented along the northern, western, and southern reaches of the cantonment area to facilitate movement of mountain runoff to these playas and reduce the risk of future flash floods within the cantonment area.

2.9 Relevant Utility Infrastructure

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

2.9.1 Stormwater Management System Description

Storm water in the cantonment area is managed through the use of engineered storm channels with culverts at road crossings. The majority of stormwater in the cantonment evaporates. However, some may infiltrate into the soil in localized depressions and open channels (FTIR 2017a). A very high evaporation rate and generally deep groundwater at FTIR suggests that it is unlikely that infiltrated water from storm events will percolate to groundwater. The engineered storm channels direct storm water around the cantonment area and towards Bicycle Lake and Langford Lake (playas).

2.9.2 Sewer System Description

An underground sanitary sewer system directs sewage from the cantonment to the WWTP. Treated wastewater is directed to either an evaporation pond or a series of percolation ponds. The percolation ponds are used for active recharge of the Irwin aquifer. Dried sewage sludge is taken to the FTIR Sanitary Landfill. Most of it is processed with food waste in the organics processing and composting area, with only a small portion disposed of in the landfill (Aerostar 2017).

2.10 Potable Water Supply and Drinking Water Receptors

There are 24 production wells, 10 of which are designated as drinking supply wells at FTIR. At the time of this PA/SI, seven of the 10 production wells designated for drinking water production (shown on **Figures 2-2** and **2-4** and presented on **Table 2-1**) were in active use for producing drinking water during the PA/SI.

- Irwin Groundwater Basin: I-7 and I-9

- Bicycle Groundwater Basin: B-4 and B-5
- Lanford Groundwater Basin: L-1, L-2, and L-3 (the status of production wells L-4 and L-5 was not available during the PA)

The NASA Goldstone facilities receive their drinking water from FTIR. There are no potable wells on the land leased by NASA. There are no production wells used for drinking water located in FTIR groundwater basins other than those in the three basins already identified.

An Environmental Data Resources, Inc. (EDR) report includes search results from a variety of environmental, state, city, and other publicly available databases for a referenced property. An EDR report was generated for FTIR, which along with state and county GIS provided by the installation identified several off-post public and private wells within 5 miles of the installation boundary (**Figure 2-5**). No off-post potable wells were identified within 5 miles of the FTIR cantonment area or of the any identified AOPIs.The EDR report providing well search results is provided as **Appendix E**.

2.11 Ecological Receptors

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

Nine vegetation community types have been identified on FTIR: Mojave Creosote Bush Scrub, Blackbrush Scrub, Mojave Mixed Woody Scrub, Mojave Desert Wash Scrub, Saltbush Scrub, Alkali Sink Scrub, Joshua Tree Woodland, and Juniper Woodland. The final vegetation community type at FTIR are “Seeps and Springs”, which consist of a varied assemblage of deep-rooted trees and shrubs, and low-growing herbs in the presence of permanently wet or moist soils in the vicinity of seeps and springs. If there is sufficient water, emergent aquatic species (e.g., cattails and sedges) may also be present (FTIR 2006).

The Lane Mountain milkvetch is the only federally listed plant species on the installation; it is identified as “endangered” by the U.S. Fish and Wildlife Services (FTIR 2006, 2016). Five separate populations of this perennial, herbaceous legume have been identified, encompassing at least 15,200 acres at FTIR. All or most of these areas have been fenced and marked with signage to indicate that they are off limits and designated conservation areas (FTIR 2006).

A diverse array of fauna can be found at FTIR. Historical inventories have confirmed the presence of 194 birds, 36 mammals, 32 reptiles, and 1 fish (introduced, non-native mosquitofish in Garlic Springs) species on the installation. A further 73 species of birds, as well as some other vertebrates, are thought to live on the installation for at least part of the year or use it as a migratory stop-over point (FTIR 2006). There are two federally listed bird species that are likely to be present at FTIR: the southwestern willow flycatcher and the least Bell’s Vireo. Almost all other bird species that can be found at FTIR are protected under the Migratory Bird Treaty Act (FTIR 2006).

The desert tortoise can be found throughout the installation in low numbers and is identified as “threatened” by the U.S. Fish and Wildlife Services and under the California Endangered Species Act (FTIR 2006, 2016). A small portion of FTIR (along its southern boundary, the western expansion area,

and a portion of Goldstone) is within a conservation area designated by the U.S. Fish and Wildlife Service to protect the west Mojave population of desert tortoise (FTIR 2016).

2.12 Previous PFAS Investigations

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

In response to the third Unregulated Contaminant Monitoring Rule and IMCOM Operations Order 16-088, FTIR drinking water was sampled in December 2015 and June 2016 at four locations: Irwin Well I-7, EP #101 (reverse osmosis treatment plant effluent [finished water]), Langford Lake Booster Station effluent (finished water), and Bicycle Lake Booster Station effluent (finished water). These samples were analyzed using USEPA Method 537 for PFOS, PFOA, and PFBS. PFOS, PFOA, and PFBS were not detected at concentrations above the minimum reportable level (20 ng/L, 90 ng/L, and 40 ng/L, respectively) in any of the samples (Babcock Laboratories, Inc. 2016a and 2016b, Army 2018a). No information was available on whether the analytical method was compliant with a version of the DoD QSM.

Between January 2017 and February 2017, as part of an IMCOM effort to sample all Army-owned water supply wells, FTIR drinking water was sampled at six wells: Irwin Wells I-7 and I-9; Bicycle Well B-4; Langford Wells L-1, L-2, and L-5; and a finished (post-treatment) water sample at Irwin Water Works. Analytical results for PFOA only were reported for these samples. PFOA was not detected at concentrations above the minimum reportable level (0.30 ng/L) in any of the samples (Army 2018a). No information was available on the analytical method employed or whether it was compliant with a version of the DoD QSM.

In September 2020, and January and April 2021, FTIR drinking water was sampled at six or seven wells: Irwin Wells I-7 (I-7 was offline during the January and April 2021 sampling events) and I-9; Bicycle Well B-4, and B-5; Langford Wells L-1, L-2, and L-5. Raw and finished (post treatment) water samples were also collected at Irwin Water Works. These samples were analyzed for PFOS, PFOA, and PFBS using USEPA Method 537.1, Version 1.0. PFOS and PFOA were not detected above the limit of detection (LOD) in the groundwater samples collected from the drinking water production wells and the raw and finished water samples collected from the Irwin Water Works. PFBS was detected at a concentration of 2.0 ng/L in groundwater sample I7 (Well I-7) collected in September 2020 (U.S. Army Public Health Center [USAPHC] 2020, 2021a, 2021b).[3] Groundwater production well I-7 was offline during the January and April 2021 drinking water sampling events.

Historical drinking water sampling results for PFOS, PFOA, and/or PFBS are provided in **Table 2-2**.

[3] Production well I-7 is located in the proximity of the center of the Irwin Groundwater Basin.

Off-post

One domestic well was identified approximately 1 mile south of the installation boundary and it is more than 5 miles from any of the identified AOPIs. This domestic well is located in the northern reaches of the Coyote Lake Groundwater Basin. Groundwater flow within the Coyote Lake Groundwater Basin is assumed to be centripetal toward the Coyote Lake (playa) located approximately 4 miles south. Therefore, this domestic well is located upgradient of the basin center.

The northeast boundary of Coyote Lake Groundwater Basin is adjacent and may be connected to the southwest boundary of the Langford Groundwater Basin more than 5 miles east of this domestic well (no AOPIs were identified within the limits of the Langford Groundwater Basin). Any groundwater inflow from the Langford Groundwater Basin will not affect this domestic well due to the well's location in the northern reach of the basin (effectively upgradient), and the presence of an east-west-trending fault (Noble Dome Fault) bisecting the approximate center of the Langford Groundwater Basin that acts as a barrier to horizontal flow (California Department of Water Resources 2003; Voronin et al. 2013).

3 SUMMARY OF PA ACTIVITIES

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

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

Preliminary locations of potential use, storage, and/or disposal of PFAS-containing materials were then evaluated in the PA (during records review, personnel interviews, and/or site reconnaissance) and were categorized as AOPIs or as areas not retained for further investigation at this time based on a combination of information collected (e.g., records reviewed, personnel interviews, internet searches). A summary of the observations made, and data collected through records reviews (**Appendix F**), installation personnel interviews (**Appendix G**), site reconnaissance photos (**Appendix H**), and site reconnaissance logs (**Appendix I**) during the PA process for FTIR is presented in **Section 4**. Further discussion regarding rationale for not retaining areas for further investigation is presented in **Section 5.1**, and further discussion regarding categorizing areas as AOPIs is presented in **Section 5.2**.

3.1 Records Review

The records reviewed for this PA included, but were not limited to, various Installation Restoration Program (IRP) administrative record documents, compliance documents, FTIR Fire Department documents, FTIR Directorate of Public Works (DPW) documents, and GIS files. Internet searches were also conducted to identify publicly available and other relevant information. A list of the specific documents reviewed for FTIR is provided in **Appendix F**.

3.2 Personnel Interviews

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

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

- Directorate of Public Works staff
  - Environmental Chief
  - Division Chief
  - Chief of Master Planning
  - Water Program Manager
- Bulk petroleum, oil, and lubricants (POL) staff

- Sergeant, C Company, 2916th Aviation Battalion 13N
- FTIR Fire Department
  - Fire Chief (APTIM/High Desert Support Services, LLC)[4]
  - Deputy Fire Chief (APTIM/High Desert Services)
  - Fire Captain (APTIM/High Desert Support Services, LLC)
  - Training Specialist (APTIM/High Desert Support Services, LLC)
- Chief Mechanic and Hazardous Materials Manager (Chenega Global Services [Young Support Services, Inc. during the PA site visit]; services all Fire Department vehicles)
- Base Operations Supervisor (Chenega Global Services)
- Air Traffic Control Maintenance Chief, Bicycle Lake Army Airfield (G3 Aviation)
- Contracting Officer, HAZMART (Technica, LLC)
- Direct Support Supply Activity Class IX manager (DynCorp International)
- Facilities and Energy Conservation Manager, Antenna/Facilities Engineering Department (NASA Goldstone/JPL)
- Fire Engineer (NASA Goldstone/JPL)
- Facility Manager, Rotational Unit Field Maintenance Area (RUFMA) (Chenega Global Services)
- Maintenance Supervisor (ARNG)
- Military Training Specialist, Safety Officer at Range Operations (Calibre Systems, Inc.)
- Supervisor, HAZMART (Technica, LLC)

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

3.3 Site Reconnaissance

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

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

[4] APTIM is the Lead Joint Venture Member of High Desert Support Services, LLC.

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

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

4.1 AFFF Use, Storage, and Disposal Areas

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

As identified during site visit interviews with FTIR Fire Department and BLAAF personnel and confirmed during site reconnaissance, when possible, AFFF is (or was) stored in several locations at FTIR:

- Fire Station 1 (Building P400) and Former AFFF Storage (Building P411)
- Fire Station 2 (Building P6101)
- AFFF Storage Shed (Building 358, fire department storage shed)
- Former AFFF Storage (former Building P411, Fire Station 1)
- BLAAF Helipad and the North and South Staging Areas (AFFF/film-forming fluoroprotein [FFFP] aviation fire extinguishers)
- FTIR Helipad (AFFF/FFFP aviation fire extinguishers)
- Directorate of Emergency Services (DES) Training Complex (empty containers of AFFF were observed during site reconnaissance)
- Forward Operating Base (FOB) Miami (AFFF/FFFP aviation fire extinguishers)
- Former Goldstone Airfield (an AFFF/FFFP aviation fire extinguisher; unconfirmed)

In addition to the above locations/facilities, AFFF was likely stored at the Former Fire Station (ceased operation in 1985).

For emergency preparedness, FTIR Fire Department personnel were trained to performed nozzle testing with AFFF to ensure optimal flow and use of the AFFF mixture. Nozzle testing involved spraying AFFF through fire equipment. Fire equipment training also included arc training to maximize the arc, reach, and distance covered by AFFF in an emergency response. Installation personnel at BLAAF were trained in the use of AFFF/FFFP aviation fire extinguishers (the aviation fire extinguishers were observed to contain FFFP during the PA site visit). Annual training of BLAAF staff with FFFP aviation fire extinguishers (BLAAF Fire Extinguisher Training Area AOPI) historically was conducted at BLAAF southwest of the BLAAF Helipad. Training with AFFF or FFFP is currently conducted at the DES Training Complex and BLAAF. Until 2016, it is confirmed that training with AFFF also was conducted at Fire Stations 1 and 2, as well as the RUFMA. Historically, several other locations on FTIR were used for training with water and potentially, on occasion, AFFF: Active Recreational Ball Fields, Area North of I Avenue Near Building P817, Bulk POL, and the Parking Lot South of Building P861. It is highly probable that training activities utilizing AFFF/FFFP were conducted at the Former Fire Station between the mid-1960s and 1985 when it ceased operation and was demolished.

Training with AFFF was also conducted monthly at the FTIR-20 Former FTA between 1982 and 1986 (approximately 58 training exercises). Training was conducted in an earthen pit where fuel was flowed on top of water and ignited. The fire was extinguished with either 10 gallons of AFFF (concentrate) or Purple K (Purple K does not have of PFAS-containing materials). It is not known if there was a designated FTA elsewhere at FTIR prior to 1982. According to the Fire Chief and Assistant Fire Chief, all training with AFFF was discontinued at FTIR in 2016 per an IMCOM directive; AFFF now can only be used during actual emergencies.

There are three known crash/fire responses at FTIR in which AFFF was utilized: a UH-60 Blackhawk Helicopter crash/fire in a remote, down-range training area (1998); a Cobra Helicopter crash/fire in a remote, down-range training area (late 1980s or early 1990s); and a fuel tank burn located in a down-range training area south of the cantonment, somewhere adjacent to the Langford Main Supply Route. There are no known off-post mutual-aid fire responses with AFFF by the FTIR Fire Department. However, the precise locations of these crash/fire responses with AFFF were not recorded. FTIR Fire Department personnel indicated that there are several other known, historical fire responses or training exercises conducted at burning cantonment structures; however, only water was used to extinguish these fires.

There is one other location with a potential use of AFFF: the former Fire Hose Pressure-Testing Area is a long parking lot used between approximately 2003 until 2012 by the FTIR Fire Department to test the integrity of the fire truck hoses. This annual testing may have resulted in the use (release) of residual AFFF in the fire hoses.

As a service to the FTIR and larger community, the FTIR Fire Department sponsors and runs a junior firefighter training program at FTIR each year. Only water is used during training exercises.

There are no known current or historical structures fitted with a fire-suppression system that utilizes (or utilized) AFFF or another PFAS-containing foam at FTIR.

NASA Goldstone

NASA Goldstone formerly had a fire brigade station. The NASA Goldstone Fire Engineer stated that the fire brigade closed sometime in the late 1980s or early 1990s. The location of this former fire brigade station, when it became operational, and whether the structure still exists were unknown to the NASA

Goldstone staff interviewed during the PA site visit and could not be determined during the PA records review. No specific evidence was identified confirming AFFF was used, stored, or disposed at this building.

The NASA Goldstone Facilities and Energy Conservation Manager indicated that Goldstone had a single fire truck in the 1970s through the 1990s. It is possible that a fire truck was present at the Goldstone airfield for JPL private aircraft shuttling JPL personnel into and out of NASA Goldstone.

The NASA Goldstone interviewees indicated that fire fighters currently are not employed at NASA Goldstone, and the primary mission of the existing Emergency Response Team is staff rescue, not extinguishing fires. The Emergency Response Team occasionally trains with FTIR Fire Department personnel and, when fire extinguishers are used in training activities, they are understood to contain only water or carbon dioxide. It was the interviewees' understanding that the historical focus and scope of training and responsibilities for the predecessor to the current Emergency Response Team was likely similar. However, a historical JPL report obtained in March 2022 documents that the NASA Goldstone fire brigade historically consisted of two full-time firefighter staff and 10 volunteer firefighters, two fire trucks, and one emergency vehicle (JPL 1988). It is not known whether AFFF or a foam containing perfluorinated surfactants and/or fluoroproteins was carried in the foam reservoir or in 5-gallon pails on these two fire trucks. This report confirmed information from the Fire Chief of the FTIR Fire Department that NASA Goldstone had an agreement with FTIR whereby FTIR would provide additional fire-protection services if requested by NASA Goldstone personnel (JPL 1988). A figure in this JPL report indicates that a fire truck(s) may have been staged in the northwest corner of a parking lot ("location of mobile fire-fighting equipment") located between what is identified as Building G-21 and Buildings G-25 and G-40 at Echo Station (JPL 1988).

According to another JPL report (JPL 1992), there had been a "Fire Training Area" at the Microwave Test Facility (specific location not indicated), and that training activities included putting out fires (JPL 1992). The Microwave Test Facility was constructed in 1963 (JPL 1992) and was dismantled in 2008. It is not known when the firefighter training area was constructed and when use began. It is also not known whether firefighter training at this location ceased and whether it was replaced by training at another location. This JPL report obtained in March 2022 included a figure of the Microwave Test Facility depicting the presence of a liquid propane aboveground storage tank north-northwest of the Microwave Test Facility; it also indicated a flammable liquid pit was part of the Fire Training Area (JPL 1988). The presence of this flammable liquid pit indicates that AFFF or a similar fluorine-containing foam may have been used in live-fire quenching training.

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

Following document research, personnel interviews, and site reconnaissance at FTIR, pesticide mixing and storage areas, photo- and x-ray-processing facilities, vehicle maintenance areas, a commercial car wash and various wash racks, the current and historical WWTPs and associated ponds, and current and historical landfills/dumps were also identified as preliminary locations for use, storage, and/or disposal of PFAS-containing materials. A summary of information gathered in the PA for each of these preliminary locations is described below. No current or historical metal-plating facilities that may have used PFAS-containing mist suppressants were identified at FTIR, including in the ARNG areas. Specific discussion

regarding areas not retained for further investigation is presented in **Section 5.1** and specific discussion regarding areas retained as AOPIs is presented in **Section 5.2**.

Wastewater Treatment Plants

The current WWTP has been operational since 1995. According to the Associate Project Manager (CH2MHill/Jacobs) of the WWTP, the active WWTP receives and treats, on average, 2 million gallons of wastewater per day and, at peak times receives and treats up to 4 million gallons per day. The WWTP consists of a primary treatment system (screens out large debris) and a secondary treatment system consisting of an extended aeration system, secondary clarification, and chlorine contact tanks (FTIR 2006). Following treatment, the WWTP formerly utilized a 22-acre clay-lined evaporation pond (not used for this purpose since 2017 and is retained for water storage) and currently utilizes 5 percolation ponds (for groundwater recharge), with one of these ponds kept empty at all times in case of emergency need.

The former WWTP operated from 1981 to 1995. It had a 2-million-gallons-per-day capacity (designed to support a daily population of 10,000) and serviced the cantonment, including the Former Fire Station and Fire Station 1, as well as portable field latrines (FTIR 2006). The system conveyed the wastewater to two primary clarifiers, a heated anaerobic sludge digester, and a grease pit. Wastewater solids were conveyed to a sludge drying area, and the liquid effluent was discharged to oxidation ponds for evaporation (FTIR 2006). When the current WWTP became operational, the former WWTP's two oxidation ponds were retained in a stand-by capacity in case needed to augment operations of the new WWTP (FTIR 2006). The Associate Project Manager of the WWTP indicated during the PA site visit that only one oxidation pond currently exists.

Pesticide Management

During a telephone interview with the IMCOM Pest Management Consultant, it was noted that products containing Sulfluramid (i.e., associated with insecticides) may have contained PFAS and were phased out in 1996. During the PA records review, the IMCOM Pest Management Consultant provided records of potentially PFAS-containing pesticides and insecticides used at and/or stored at Army installations and did not identify FTIR as an installation having used or stored PFAS-containing pesticides/insecticides. The Environmental Chief stated during the PA site visit that FTIR has utilized an outside vendor for pest control since at least 2008 and the pesticides are not mixed and/or stored at FTIR. Additionally, the PA team reviewed available pesticide use inventory documentation (dating back to fiscal year 2009) provided by the installation and did not identify any PFAS-containing pesticides.

NASA Goldstone historically did not purchase, store, and use pesticides directly. Pesticide application was generally limited to the interiors of buildings and services were provided by an outside contractor (JPL 1988). According to the NASA Goldstone Facilities and Energy Conservation Manager interviewed during the PA site visit, this this continues to be standard practice.

Other Activities/Facilities

Several other facilities and activities that currently and/or historically could have utilized PFAS-containing materials were identified at FTIR:

- Several current and former x-ray- and photo-processing facilities
- Current and historical vehicle maintenance facilities (including fire truck maintenance and California ARNG maintenance facilities)

- Hazardous waste storage area
- Current and historical landfills/dumps

4.3 Readily Identifiable Off-Post PFAS Sources

An exhaustive search to identify all potential off-post PFAS sources (i.e., not related to operations at FTIR) is not part of the PA/SI. However, potential off-post PFAS sources within a 5-mile radius of the installation were investigated but none were identified. FTIR is surrounded to the north, west, and south principally by government-owned land. The land to the south of FTIR is mostly owned by the Federal government (BLM) with small, interspersed parcels of private land. (Note that none of the identified AOPIs are located within 5 miles of the installation boundary.)

5 SUMMARY AND DISCUSSION OF PA RESULTS

The preliminary locations evaluated for potential use, storage, and/or disposal of PFAS-containing materials at FTIR were further refined during the PA process and identified either as an area not retained for further investigation or as an AOPI. In accordance with the established process for the PA/SI, 25 areas have been identified as AOPIs. The process used for refining these areas is presented on **Figure 5-1**.

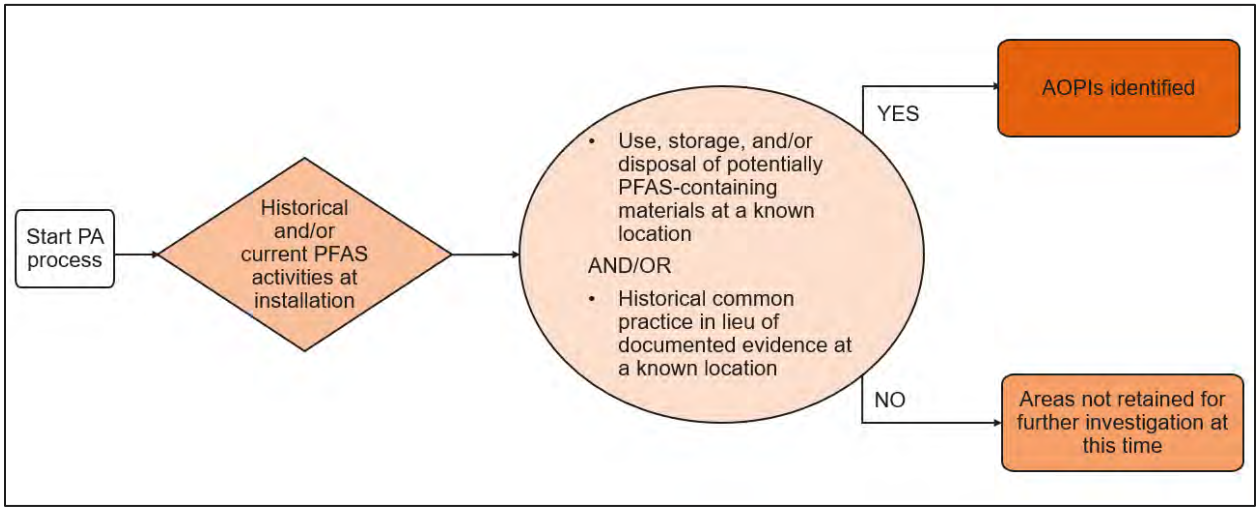

Figure 5-1: AOPI Decision Flowchart

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

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

5.1 Areas Not Retained for Further Investigation

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

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

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

Area Description	Dates of Operation	Relevant Site History	Rationale
Airfields (airstrips)	Unknown	According to the Chief of Master Planning, there are several current and historical airstrips: Red Pass airstrip (abandoned), Freedom landing strip at Nelson Lake (only used during rotations), and FOB Miami airstrip at Red Pass. None of these airstrips, except for FOB Miami, historically or currently have aviation fire extinguishers staged (stored) there. (Note that approximately eight aviation fire extinguishers are staged in two hangars at FOB Miami; these hangars are an AOPI.)	No evidence of PFOS, PFOA, or PFBS-containing materials used, stored, and/or disposed at these locations.
Hazardous Waste Storage Area	Unknown (likely 2002) to present	FTIR has a hazardous waste storage area located under an awning on the western side of the RUFMA. The PA team inquired during the PA site visit whether waste AFFF was ever stored here. The Facility Manager at the RUFMA, in this role since 2006, does not recall receiving AFFF since 2016 (the military specification for AFFF changed in 2016). However, they indicated that the FTIR Fire Department may have dropped off empty 5-gallon AFFF pales or containers of expired AFFF prior to 2016. The PA team attempted to obtain copies of the pre-2016 records but was informed these records are only available in hard copy and were in storage and, therefore, were not easily accessible.	No evidence of PFOS, PFOA, or PFBS-containing materials used, stored, and/or disposed at this location.
Landmark Inn Fire	2000	The Landmark Inn caught fire on 26 September 2000. Only water was used to douse the fire.	No evidence of PFOS, PFOA, or PFBS-containing materials used, stored, and/or disposed at these locations.
Intentionally Lit Building Fires for Fire Training	Late 1990s to early 2000s	Approximately 200 buildings in the cantonment were burned down to allow for new construction. The FTIR Fire Department used these opportunities to train staff (e.g., practice rescues). The buildings were allowed to burn completely.	No evidence of PFOS, PFOA, or PFBS-containing materials used, stored, and/or

Area Description	Dates of Operation	Relevant Site History	Rationale
			disposed at these locations.
Lithium-Ion Fire at the RUFMA	Unknown	There was a lithium-ion fire under the awning of the RUFMA (western end; likely in the domestic and hazardous waste storage area, though this is unconfirmed). No AFFF was used in the fire response.	No evidence of PFOS, PFOA, or PFBS-containing materials used, stored, and/or disposed at this location.
Young Explorers Academy Firefighter Training Area	Unknown to present	Approximately 180 to 200 children aged 14 to 19 years old participate in a junior firefighter training program held by the FTIR Fire Department at FTIR each year. Only water is used during training exercises.	No evidence of PFOS, PFOA, or PFBS-containing materials used, stored, and/or disposed at these locations.
UH-60 Blackhawk Helicopter Crash/Fire Response	22 July 1998	The FTIR Fire Chief reported that AFFF was used during a crash/fire response that occurred in an active training area on the back side of Granite Pass (grid N44 x E19) northwest of Lucky Fuse. This general area is not located in a groundwater basin used for drinking water supply. It is unknown whether structures exist in the area.	The precise location of PFOS, PFOA, or PFBS-containing materials use could not be confirmed.
Cobra Helicopter Crash/Fire Response	Late 1980s or early 1990s	The FTIR Fire Chief reported that approximately 200 gallons of AFFF were used during a crash/fire response near McLean Lake (located approximately 16 miles north-northwest of the cantonment area). Firefighting measures were ceased once it was discovered that magnesium was onboard the helicopter. This general area is located in the Nelson groundwater basin, which is not used for drinking water supply. It is unknown whether structures exist in the area.	The precise location of PFOS, PFOA, or PFBS-containing materials use could not be confirmed.
Fuel Tank Burn Fire Response	Unknown	The FTIR Fire Chief reported that a small volume of AFFF may have been used (they were uncertain) to extinguish a fuel tank fire. The fuel tank fire was located somewhere adjacent to Langford Main Supply Route (grid N96 x E37). This general area is located in the northern reach of the Langford Groundwater Basin; the Langford Groundwater Basin drinking	The precise location of PFOS, PFOA, or PFBS-containing materials use could not be confirmed.

Area Description	Dates of Operation	Relevant Site History	Rationale
		water production wells are considered to be upgradient (centripetal groundwater flow) of this fire response.	
Former Pesticide Mixing and Storage Areas	Prior to 1980s to 2008	Former Building H227 (IRP FTIR-10) was used for pesticide mixing and storage and was located within what is now Building 630's yard (exact building location is not known). The facility reportedly had extensive contamination from pesticide spillage and was demolished in 1980 (FTIR 2001). The Environmental Chief indicated that no pesticide mixing and no pesticide storage has taken place since 2008, and that it is possible that no pesticide mixing and storage at FTIR has taken place since Building H227 was demolished in 1980. The Environmental Chief also stated that FTIR utilizes an outside vendor for pest control and the pesticides are not mixed and/or stored at FTIR.	No evidence of PFOS, PFOA, or PFBS-containing materials used, stored, and/or disposed at these locations.
Photo-Processing Facility	Unknown	Photo processing was performed in Building 488 (photo and TV production building).	No evidence of PFOS, PFOA, or PFBS-containing materials used, stored, and/or disposed at this location.
X-ray-Processing Facilities	Various	X-ray processing facilities include Building P166 (former Weed Army Community Hospital; 1968 to 2017), Buildings 171 and 478 (dental clinics), and Building 977 (veterinary clinic). Potential x-ray processing facilities include Health Clinic Buildings 295, 170, 172, 174, 176, and 453.	No evidence of PFOS, PFOA, or PFBS-containing materials used, stored, and/or disposed at these locations.
Car Washes and Wash Racks	Various	The Exchange Car Wash is located in Building 911. Wash racks/platforms are located at Buildings WSHPL, 641, 638, 848, 824, 699, 870, 682, 876, 664, 652, NGWPL/19, 00636 (disposed) and 630 (disposed). A wash rack holding pond is located at Building 682 (FTIR-30).	No evidence of PFOS, PFOA, or PFBS-containing materials used, stored, and/or disposed at these locations.

Area Description	Dates of Operation	Relevant Site History	Rationale
Building 612 (fire truck maintenance)	1982 (estimate) to present	Lead fire truck mechanic and hazardous material (HAZMAT) manager indicated that no incidental spills of AFFF during fire truck maintenance activities have been observed. AFFF is not removed from fire trucks onsite prior to maintenance/repair activities or replaced onsite following maintenance/repair activities. No nozzle testing or hose flushing takes place at Building 612.	No evidence of PFOS, PFOA, or PFBS-containing materials used, stored, and/or disposed at this location.
Vehicle Maintenance Shops	Various	ARNG Combined Support Maintenance Shop/ Maneuver Area Training Equipment Sites (old MATES area) facilities include Buildings/Areas 00853, 00850, T-846, 00857, 00847, 850, 7740, 7741, 7742, and 7743. Army Reserves vehicle maintenance shops (old MATES area) include Buildings 884 and 0851C. The primary repair building in the Armored Vehicle Maintenance Complex is located at Building 830 (IRP FTIR-11); the site has a former drainage pit for chlorinated and non-chlorinated cleaning solvents. Building 837 has an abandoned concrete vault to collect oil and sediment.	No evidence of PFOS, PFOA, or PFBS-containing materials used, stored, and/or disposed at these locations.
Active WWTP	1995 to present	The current WWTP receives wastewater generated in cantonment facilities, including Fire Stations 1 and 2, and periodically receives excess liquid from the closed-loop recirculating wash rack system at the RUFMA via the sanitary sewer. According to the Associate Project Manager (CH2MHill/Jacobs) of the WWTP, the active WWTP receives and treats, on average, 2 million gallons of wastewater per day and, at peak times receives and treats up to 4 million gallons per day. The WWTP consists of a primary treatment system (screens out large debris) and a secondary treatment system consisting of an extended aeration system, secondary clarification, and chlorine contact tanks (FTIR 2006). It is not known what is done with the large debris removed in primary	Wastewater generated in cantonment facilities, including the Fire Stations 1 and 2, may be treated at the WWTP. However, Fire Department personnel did not indicate that AFFF-containing liquids were disposed to the sanitary sewer via floor drains, utility sinks, or laundry facilities. Excess liquid in the RUFMA closed-loop

Area Description	Dates of Operation	Relevant Site History	Rationale
		treatment. An installation report indicates that the sewage sludge is processed int the organics processing and composting area at the FTIR-01 Sanitary Landfill before being used as compost (Aerostar 2017). For an uncertain period of time (between 1995 and through at least 2006), the treated water was pumped and sent through sprinklers over a 40-acre site where the treated water could percolate through the soil (FTIR 2006). The location of this 40-acre irrigated site was not available to the PA team. The Associate Project Manager stated during the PA site visit that the WWTP produces 0.8 to 0.9 million gallons of treated wastewater per day, with approximately 0.6 million gallons directed to the percolation ponds (for groundwater recharge) and, since 2010 when FTIR began using recycled water, approximately 0.2 to 0.3 million gallons are used for irrigation. Thirteen of the 15 irrigated fields at FTIR utilize recycled water. At the time of the PA site visit, FTIR was in the process of expanding the recycled water distribution system in the cantonment to replace the need for extracting groundwater for some installation uses. (The locations of these 13 fields irrigated with recycled water, as well as any other locations that began utilizing recycled water for irrigation after the PA site visit, are unknown to the PA team.)	recirculating wash-rack system periodically is disposed to the WWTP via the sanitary sewer. No evidence of PFOS, PFOA, or PFBS-containing materials used, stored, and/or disposed at this location.
Organics Processing and Composting Area at the FTIR-01 Sanitary Landfill	Unknown	Dried sewage sludge is taken to the FTIR-01 Sanitary Landfill where most of it is processed in the organics processing and composting area. Only a small portion of the processed sewage sludge is disposed in the FTIR-01 Sanitary Landfill (Aerostar 2017). Therefore, the majority of the processed sewage sludge is used on installation as compost. The locations of land application are not known.	No evidence of PFOS, PFOA, or PFBS-containing materials used, stored, and/or disposed at this location.

Area Description	Dates of Operation	Relevant Site History	Rationale
Former WWTP	1981 to 1995	The former WWTP had a 2-million-gallons-per-day capacity (designed to support a daily population of 10,000) and serviced the cantonment as well as portable field latrines (FTIR 2006). The system conveyed the wastewater to two primary clarifiers, a heated anaerobic sludge digester, and a grease pit. Wastewater solids were conveyed to a sludge drying area (it is not known what was done with the sludge once it was dried), and the liquid effluent was discharged to oxidation ponds for evaporation (FTIR 2006). The liquid effluent was sometimes used as emergency fire water (FTIR 2006); the PA team received no information from Fire Department personnel about incidents/locations where this may have occurred. It is not known what historically was done with the dried sludge. The two oxidation ponds were retained in a stand-by capacity when the new (current) WWTP became operational in 1995 (FTIR 2006). However, the Associate Project Manager of the WWTP indicated that only one of the two oxidation pond currently exists.	Wastewater generated in cantonment facilities, including the Former Fire Station and Fire Station 1, were treated at the former WWTP via the sanitary sewer. However, Fire Department personnel did not indicate that AFFF-containing liquids were disposed to the sanitary sewer via floor drains, utility sinks, or laundry facilities. No evidence of PFOS, PFOA, or PFBS-containing materials used, stored, and/or disposed at this location.
Abandoned Sewage Oxidation Ponds	1940 to 1954	The Abandoned Sewage Oxidation Ponds (IRP FTIR-18) consisted of two oxidation ponds, each approximately 150 feet by 300 feet, and were associated with the former sewage plant that operated between 1940 and 1954. None of the original, associated built structures remain. There is no information on the types of waste discharged to these ponds or whether the sludge was removed when the ponds were abandoned (FTIR 2001). The location was used as a picnic and recreational area in the early 1980s and, in the mid-1980s, was used for truck and trailer storage (FTIR 2001). In 1999, at least part of the area formerly occupied by the two oxidation ponds was paved over with reinforced concrete to create the	No evidence of PFOS, PFOA, or PFBS-containing materials used, stored, and/or disposed at this location.

Area Description	Dates of Operation	Relevant Site History	Rationale
		RUFMA and the large recirculating wash-rack system and associated wash-rack bays along the northeast edge of the paved RUFMA.	
Abandoned Sanitary Landfill 2	1940 to 1945	The Abandoned Sanitary Landfill (IRP FTIR-02) is located northwest of the active sanitary landfill (IRP FTIR-01), and it encompassed approximately 16 acres (FTIR 2017b) or 30 to 40 acres (Montgomery Watson 1997). This landfill was operated as a land disposal and open burning facility from 1940 to 1945 (FTIR 2017b).	No evidence of PFOS, PFOA, or PFBS-containing materials used, stored, and/or disposed at this location.
Abandoned Sanitary Landfill 4	1950 to 1980	The Abandoned Sanitary Landfill 4 (IRP FTIR-04) is located just west of and adjacent to the active sanitary landfill (IRP FTIR-01) and it encompasses a total of approximately 20 acres split between a northern burial area and a western burial area. The landfill was reportedly operated as a land disposal and open burning facility from 1940 to 1950. Sections of the abandoned landfill areas were operated and abandoned at different times between 1940 and 1981. It was reported that open burning of refuse and solid wastes occurred prior to 1981 (Montgomery Watson 1997).	No evidence of PFOS, PFOA, or PFBS-containing materials used, stored, and/or disposed at this location.
Troop Landfill Disposal Site	Unknown	Troop Landfill Disposal Site (IRP FTIR-06) encompasses 2.3 acres and is located in Red Pass Valley approximately 15 miles northeast of the cantonment (FTIR 2017b).	No evidence of PFOS, PFOA, or PFBS-containing materials used, stored, and/or disposed at this location.
Lucky Fuse Impact Disposal Site and Avawatz Valley Disposal Area	Various	Lucky Fuse Impact Disposal Site (IRP FTIR-07) and Avawatz Valley Disposal Area (IRP FTIR-08) received 13.6 metric tons of hazardous waste from Edwards Air Force Base, as well as from other sources, until possibly as late as 1980 (FTIR 2017b, Montgomery Watson Harza 2005).	No evidence of PFOS, PFOA, or PFBS-containing materials used, stored, and/or disposed at these locations.
Lower Goat Landfill	1940s to mid-1980s	The Lower Goat Landfill (IRP FTIR-32A) may have been used as an open pit dump from the 1940s through the mid-1980s. A	No evidence of PFOS, PFOA, or PFBS-containing

Area Description	Dates of Operation	Relevant Site History	Rationale
		records search indicated that the site was used as an unauthorized open pit dump in 1986. The site was found to contain 55-gallon drums, 5-gallon oil and anti-freeze cans, targets, ammunition boxes, and ration containers (FTIR 2017b). Soil samples collected in 1997 indicated "no significant contamination" (FTIR 2001).	materials used, stored, and/or disposed at this location.
Upper Goat Mountain Landfill	Unknown	The Upper Goat Mountain Landfill (IRP FTIR-32B) was located northeast of the Technical Operations Center and encompassed approximately 30 feet by 100 feet. Debris disposed in this landfill included paint cans and empty oil cans (FTIR 2001). Soil samples collected in 1997 indicated no hazardous waste was in the landfill and debris was removed in 1999 (FTIR 2001).	No evidence of PFOS, PFOA, or PFBS-containing materials used, stored, and/or disposed at this location.
Former NASA Goldstone Airfield	1960s to 2010	The Former NASA Goldstone Airfield consists of an asphalt airstrip, a hangar (roof and two side walls) that could shelter a single aircraft, and an adjacent fire hydrant. The airfield was constructed in 1963 and there was further construction in 1970 (JPL 1988). A section of Goldstone Road located northwest of the airfield facilities functioned as an auxiliary runway when necessary (JPL 1988). Historical documentation indicates that the existing airfield may have been preceded by another, adjacent airfield with structures located approximately 1.13 miles to the north-northwest on Goldstone Road. This potential predecessor airfield consisted of two buildings (G-70 constructed in 1973 and G-71 constructed in 1958; not in use in 1988), an area for aircraft to turn around, a fire hose, and a fuel storage tank. There was also an unpaved, abandoned runway that began at the pad where aircraft could turn around and continued to the south-southwest across the Goldstone Lake Playa (JPL 1988). The NASA Goldstone airfield was used by NASA to fly staff into and out of Goldstone a couple times a week in a small private	No evidence of PFOS, PFOA, or PFBS-containing materials used, stored, and/or disposed at this location.

Area Description	Dates of Operation	Relevant Site History	Rationale
		Lear jet. This continued until approximately 2010, when NASA added a requirement that a crash truck with fire-fighting capabilities was required for aircraft landings/takeoffs. All flights ceased and the airfield was left vacant. The Facilities and Energy Conservation Manager for NASA Goldstone was unaware of any fire/crash responses at the airfield during NASA control. The Fire Department Chief was unaware of any crashes at the former airfield since he began working at FTIR in 1983. According to the FTIR Chief of Master Planning, FTIR took back the airfield and surrounding land "as is" in 2012. FTIR personnel indicated that the airfield is used for unmanned aircraft systems operation (B Company, 229th Aviation Regiment) and there is no fixed-wing aircraft flying into or out of this airfield. Construction to improve the airfield began in 2015 and was almost completed as of the PA site visit in June 2018. The Air Traffic Control Maintenance Chief at BLAAF indicated that ownership of three 33-pound FFFP fire extinguishers located at BLAAF was transferred to the Goldstone airfield (ownership likely transferred to B Company, 229th Aviation Regiment) in February 2015. It was not confirmed whether these three aviation fire extinguishers were relocated to the Goldstone Airfield (and, if so, where they are stored/staged).	
NASA Goldstone Former Fire Brigade Station	1950s to late 1980s or early 1990s	AFFF was potentially stored and used at a former fire brigade station. The location of this former fire brigade station is unknown to the NASA Goldstone personnel interviewed, but it was likely situated at either Echo Station or Mars Station. The construction and features of this former fire station are also unknown to the interviewed personnel. Available information did not identify use or storage of AFFF.	No evidence of PFOS, PFOA, or PFBS-containing materials used, stored, and/or disposed at this location. The location of the station could not be confirmed.

Area Description	Dates of Operation	Relevant Site History	Rationale
		According to NASA Goldstone personnel, NASA Goldstone had one fire truck during the 1970s through the 1990s; however, a historical document obtained in March 2022 states that NASA Goldstone had two fire trucks and a staff complement of two full-time firefighters and 10 volunteer firefighters up until at least 1988 (JPL 1988). It is not known whether both fire trucks were staged at the former fire brigade station. NASA Goldstone and FTIR personnel interviews did not indicate any fire responses were conducted by the NASA Goldstone Fire Brigade or the FTIR Fire Department at NASA Goldstone. The area occupied by NASA Goldstone is located in the Goldstone Groundwater Basin. This basin is not used for drinking water supply. Drinking water is supplied by FTIR.	
Echo Station Mobile Fire-Fighting Equipment Staging Location	1950s to late 1980s or early 1990s	A figure in the historical *Environmental Projects: Volume 4, Asbestos Survey. Goldstone Deep Space Communications Complex* report obtained in March 2022indicates that fire equipment may have been staged at Echo Station in the northwest corner of a parking lot ("location of mobile fire-fighting equipment") located between what is identified as Building G-21 and Buildings G-25 and G-40 (JPL 1988).	No evidence of PFOS, PFOA, or PFBS-containing materials used, stored, and/or disposed at this location. The staging location could not be confirmed.
NASA Goldstone Photo-Processing Facility	1960s to early 1970s	A former photo lab was housed in a building (building number is not known) at NASA Goldstone Echo Station. The former photo lab functioned as a meeting room during the PA site visit.	No evidence of PFOS, PFOA, or PFBS-containing materials used, stored, and/or disposed at this location.
NASA Goldstone Wastewater Treatment	Unknown to present	Echo Station and Mars Station have wastewater evaporation ponds. Septic tanks are used to catch solids before the liquids are discharged to the ponds. Septic tanks are vacuumed out occasionally and the solids are disposed in a Barstow landfill.	

Area Description	Dates of Operation	Relevant Site History	Rationale
		In the 1990s, there were four evaporative ponds at Echo Station and two at Mars Station. Two additional ponds were built at Mars Station sometime in the 1990s. Pond sediments are cleaned out every 15 to 20 years. It is likely that the material cleaned out of the ponds prior to 1998 was disposed in the either of the two former waste disposal sites located at Echo Station. Two other stations (not identified) utilize septic systems with leach fields. According to the NASA Goldstone Facilities and Energy Conservation Manager, these septic systems are cleaned out periodically (frequency is not known). Wastewater treatment facilities were identified because the location of the NASA Goldstone Former Fire Brigade Station is unknown, and if AFFF was used or stored at the station, then there is the potential for AFFF-containing liquids to be discharged to the wastewater evaporation ponds.	
NASA Goldstone Former Echo Station Landfill	1951 to 1975	The Goldstone Former Echo Station Landfill (IRP FTIR-34) encompassed 2.3 acres (FTIR 2017b). Solid waste is presently disposed in the FTIR Sanitary Landfill (IRP FTIR-01).	No evidence of PFOS, PFOA, or PFBS-containing materials used, stored, and/or disposed at this location.
NASA Goldstone Former Echo Solid Waste Disposal Site	1975 to 1998	The Goldstone Former Echo Solid Waste Disposal Site replaced the Goldstone Former Echo Station Landfill and was located 1,000 feet west of the former landfill. Materials reportedly disposed at the site consisted primarily of paper, food waste, cables, wire, and possibly solvents. However, the landfill may have received waste from industrial activities (e.g., machine-shop work, operation of electrical equipment, and vehicle maintenance). All materials were reportedly burned prior to burial. Solid waste is presently disposed in the FTIR Sanitary Landfill (IRP FTIR-01).	No evidence of PFOS, PFOA, or PFBS-containing materials used, stored, and/or disposed at this location.

5.2 AOPIs

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

The AOPI locations are shown on **Figure 5-2**. Aerial photographs of each AOPI that also show the approximate extent of AFFF use (if applicable) are presented on **Figures 5-3** through **5-18** and, where present, include active monitoring wells in the vicinity of each AOPI.

5.2.1 Active Recreational Ball Fields

The Active Recreational Ball Fields are identified as an AOPI following records review, personnel interviews, and site reconnaissance due to their historical, occasional use for firefighter training activities with water and potentially AFFF. The FTIR Fire Captain indicated that the Active Recreational Ball Fields were used on limited occasions for firefighter training since at least 1989 (the year they joined the Fire Department) until 2012 when all firefighter training activities transferred to the newly operational DES Training Complex. Water and possibly AFFF were sprayed at the fields. The specific spray areas and spray directions within the ball fields are unknown.

An aerial photograph of the Active Recreational Ball Fields AOPI is provided on **Figure 5-3**.

Note that when drinking water production well I-7 (approximately 1 mile to the east-northeast) is actively extracting groundwater, it may influence the groundwater flow direction at the Active Recreational Ball Fields AOPI.

5.2.2 AFFF Storage Shed (Building P358)

The AFFF Storage Shed is identified as an AOPI following records review, personnel interviews, and site reconnaissance due to its use as the primary storage location for the Fire Department's stock of AFFF. Building 358 is currently used to store AFFF for the Fire Department. Whether AFFF was transferred to fire truck reservoirs adjacent to the building or whether AFFF was spilled there are unknown. During the PA site visit (June 2018), the shed's inventory included eight 55-gallon drums of 3% AFFF and five 5-gallon containers of 3% and 6% AFFF. Fire Department interviewees indicated that there have been no previous reports from personnel of AFFF leaks or spills (i.e., use) in the immediate vicinity of the Building P358. (Note that during the SI event, the SI team looked inside Building P358 and observed AFFF concentrate on the floor of the shed; see **Appendix L**.)

An aerial photograph of the AFFF Storage Shed AOPI is provided on **Figure 5-4**.

Note that when drinking water production well I-7 is actively extracting groundwater, it may influence the groundwater flow direction at the AFFF Storage Shed (Building P358) AOPI.

5.2.3 Area North of I Avenue Near Building P817

The Area North of I Avenue Near Building P817 is identified as an AOPI following records review, personnel interviews, and site reconnaissance due to its use for occasional firefighter training activities with water and potentially AFFF. The FTIR Fire Captain indicated that the Area North of I Avenue Near Building P817 was used as an occasional FTA since at least 1989 (the year the Fire Captain joined the Fire Department) until approximately 2002 (based on historical satellite imagery) when grading activities for construction of Building P817 and a large, paved parking surface began. The area represented by this AOPI encompasses approximately 36 acres and was formerly an unpaved soil surface used for vehicle/equipment storage or staging. Building 817 and I Avenue did not exist at the time that this area was used for training exercises. During training, water and possibly AFFF were used. The entirety of this AOPI is occupied by Building P817 and a large, reinforced concrete pad used for storing and staging heavy vehicles and equipment.

An aerial photograph of the Area North of I Avenue Near Building P817 AOPI is provided on **Figure 5-5**.

Note that Area North of I Avenue Near Building P817 AOPI is approximately 0.34 mile cross-gradient of drinking water production well I-9.

5.2.4 Bulk POL Containment Basins

The Bulk POL Containment Basins are identified as an AOPI following records review, personnel interviews, and site reconnaissance due to their use for occasional firefighter training activities with water and potentially AFFF. The three Bulk POL fuel secondary containment basins (P7706, P7707, P7708) are large, contiguous concrete basins, each with a large fuel tank within it. The basins are designed so that a drain can be opened in each basin to allow leaking fuel or any other liquid in the secondary containment basin to flow to an adjacent, subsurface holding tank from which the collected liquid can be vacuumed out by the FTIR Directorate of Public Works and disposed offsite as hazardous waste.

The FTIR Fire Captain indicated that the Bulk POL fuel secondary containment basins were used infrequently as an FTA since at least 1989 (the year he joined the Fire Department) until 2012 when all firefighting training activities transferred to the newly operational DES Training Complex. Training involved flowing significant volumes of water and occasionally AFFF into the concrete secondary containment basins. Liquid evaporated in place or was vacuumed out by the FTIR Directorate of Public Works.

An aerial photograph of the Bulk POL Containment Basins AOPI is provided on **Figure 5-6**.

Note that Bulk POL Containment Basins AOPI is approximately 1.1 miles upgradient of drinking water production well I-9.

5.2.5 Bulk POL Fire Tanker Response

The Bulk POL Tanker Fire Response is identified as an AOPI following records review, personnel interviews, and site reconnaissance due to the confirmed use of AFFF to extinguish the fire. A 10,000-gallon fuel tanker truck caught fire at the Bulk POL Tanker Fire Response during a fuel transfer in approximately 1993. The ground surface was believed to be compacted soil at the time of this incident.

According to Fire Department personnel, a significant volume of AFFF and water were used in the fire response.

Surface runoff likely flowed northeast to and beyond the fenced POL boundary. There is an abandoned oil-water separator (formerly part of the POL operations) located just northeast and downhill (immediately outside the fence) of the fire location, and it may have received runoff from the fire response. The existing POL fueling assets, including the canopy over the fueling bays and the paved ground surface were installed at some point after the 1993 fire. Therefore, some of the AFFF used to extinguish the fire may be under paved or built features.

An aerial photograph of the Bulk POL Tanker Fire Response AOPI is provided on **Figure 5-6**.

Note that Bulk POL Tanker Fire Response AOPI is approximately 1.1 miles upgradient of drinking water production well I-9.

5.2.6 DES Training Complex

The DES Training Complex is identified as an AOPI following records review, personnel interviews, and site reconnaissance due to the use of AFFF during firefighter training activities. The DES Training Complex has been the installation's principal FTA and annual fire hose pressure-testing area since 2012. Historical AFFF use at the DES was reportedly limited to the onsite airplane training prop (utilizes propane-generated flames) that sits inside a low-bermed, circular, concrete "pit" filled with gravel. AFFF was sprayed east towards the nose of the prop from a 45-degree angle, keeping the spray away from the propane jets; the liquid in the pit was allowed to evaporate in place. No AFFF has been used in training since 2016.

Empty AFFF containers were observed in Conex boxes in the west-central portion of the DES during the PA site visit. In addition to being used to store empty AFFF containers, it is unknown whether 55-gallon drums and/or 5-gallon pails of AFFF were historically stored in the Conex boxes, or whether fire truck AFFF reservoirs were refilled in the vicinity of these Conex boxes.

An aerial photograph of the DES Training Complex AOPI is provided on **Figure 5-7**.

Note that DES Training Complex is approximately 0.73-mile upgradient of drinking water production well I-7.

5.2.7 Fire Hose Pressure-Testing Area

The Fire Hose Pressure-Testing Area is identified as an AOPI following records review, personnel interviews, and site reconnaissance due to its historical use for pressure testing fire hoses. From approximately 2003 until 2012, annual fire hose pressure testing took place in the in the easternmost portion of the parking lot located at the corner of Langford Lake Road and G Avenue.

A fire truck pump was used to conduct the annual testing of all the fire hoses between 2003 and 2008, and a portable pump was used between 2008 and 2012. The hoses were connected to the fire hydrant adjacent to the southeastern corner of the parking lot on G Avenue. At the completion of testing, the hoses were emptied onto the paved area at the southeastern corner of the parking lot where there is a gap in the curb that allows runoff flowing southeast down the parking lot to drain into G Avenue. The fluid released from hoses at the conclusion of the pressure test, and which may have contained residual AFFF

from the hoses, would flow northeast along the northern curb of G Avenue. The fluid would have evaporated in the road because there are no exits for surface water flow in G Avenue in the vicinity of this location.

An aerial photograph of the Fire Hose Pressure-Testing Area AOPI is provided on **Figure 5-8**.

Note that when drinking water production well I-7 (approximately 0.63 mile to the north-northeast) is actively extracting groundwater, it may influence the groundwater flow direction at the Fire Hose Pressure-Testing Area AOPI.

5.2.8 Fire Station 1 (Building P400) and Former AFFF Storage (Building P411)

The Fire Station 1 (Building P400) and Former AFFF Storage (Building P411) are identified as an AOPI following records review, personnel interviews, and site reconnaissance due to the use and storage of AFFF. Fire Station 1 (Building P400) opened in 1985 and principally supports the cantonment area. Until 2001, when Fire Station 2 became operational, Fire Station 1 was the only fire station at FTIR. Fire Station 1 has a front apron that connects to Langford Lake Road and a back apron with access to Langford Lake Road and F Avenue.

Occasional nozzle testing and annual concentration testing were conducted with AFFF on the paved back apron prior to 2016, and was sprayed towards the paved, adjacent parking area (separated from the fire station property by a curb and a narrow strip of landscaping) to the southeast. Fire trucks are washed on the back apron. Occasional fire hose flushing may have allowed AFFF residue in hoses to be released onto the paved back apron (the perimeter of which has curbs), where liquid evaporated in place. Incidental AFFF spills and leaks are believed to have occurred but none of the Fire Department interviewees indicated observing such incidents.

AFFF historically was stored in former Building P411 (located to the east-northeast of the back apron beyond the curbed station property perimeter). The former Building P411 footprint and its surroundings are an unpaved soil surface; the details of the building's structure and the year in which the building was torn down are unknown. Based on interviews with Fire Department personnel, there were no known leaks or spills at this former building.

An aerial photograph of the Fire Station 1 and Former AFFF Storage AOPI is provided on **Figure 5-9**.

Note that when drinking water production well I-7 (approximately 0.55 mile to the northeast) is actively extracting groundwater, it may influence the groundwater flow direction at the Fire Station 1 (Building P400) and Former AFFF Storage (Building P411) AOPI.

5.2.9 Fire Station 2 (Building P6101)

The Fire Station 2 (Building P6101) is identified as an AOPI following records review, personnel interviews, and site reconnaissance due to the use and storage of AFFF. Fire Station 2 (Building P6101) became operational in 2001 and principally supports Bicycle Lake Airfield and down-range military training exercises. (Prior to 2016, Fire Department trucks supporting for down-range military training exercises generally carried and used, if necessary, Class B [AFFF] foam. However, since 2016, generally only Class A foam has been carried.) Fire Station 2 has a concrete and asphalt front apron that slopes down to connect with South Loop Road and a concrete and asphalt back apron that has access to Camp

Irwin Road. The concrete and asphalt back apron slopes down to a large gravel parking area for station vehicles; this parking area is covered by a ramada. Any runoff generated from activities on the back apron flows to the gravel; there is no curb or berm located along the back side of the ramada. The station has two crash trucks, and each crash truck carries 200 gallons of AFFF in its reservoir as well as an additional 150-gallon container of AFFF.

Occasional nozzle testing and annual concentration testing were conducted with AFFF on the paved front apron prior to 2016. Spray was directed to the east-northeast to/toward the far side of South Loop Road (a compacted soil surface sloping down to a drainage channel), and to the southeast of the front apron (down a short, steep slope and onto the adjacent vacant unpaved area).

Fire trucks are washed on the back apron. Occasional fire hose washing conducted immediately adjacent to the back apron may also have allowed AFFF residue in hoses to drain onto the unpaved ground surface or the back apron. Incidental AFFF spills and leaks are believed to have occurred but none of the Fire Department interviewees indicated observing any.

An aerial photograph of the Fire Station 2 AOPI is provided on **Figure 5-10**.

Note that Fire Station 2 is approximately 0.52-mile upgradient of drinking water production well I-7.

5.2.10 Former Fire Station

The Former Fire Station is identified as an AOPI following records review, personnel interviews, and site reconnaissance due to its suspected historical use and storage of AFFF. The Former Fire Station was established in the 1940s; it ceased operation and was demolished in 1985 when Fire Station 1 became operational. The Former Fire Station was located along 3rd Street between Camp Irwin Road and D Avenue. All that remains is portions of a concrete apron alongside Camp Irwin Road. No historical records were available on the fire station layout, fire station activities, fire training, or fire responses, nor were there any available interviewees with knowledge of historical fire station activities. However, activities were likely similar to those of the active fire stations.

An aerial photograph of the Former Fire Station AOPI is provided on **Figure 5-4**.

Note that when drinking water production well I-7 (approximately 0.32 mile to the east-northeast) is actively extracting groundwater, it may influence the groundwater flow direction at the Former Fire Station AOPI.

5.2.11 Land Farm Drying Pits

The Land Farm Drying Pits are identified as an AOPI following records review, personnel interviews, and site reconnaissance due to their use to hold and dry the sediments removed from the RUFMA Wash-Rack AOPI trench drain/basin. The Land Farm at the FTIR Sanitary Landfill (FTIR-01) is a fenced area adjacent to the closed sanitary landfill area and encompasses approximately 5.1 acres. Within the Land Farm are two lined treatment cells (“pits”), contained within an engineered earthen berm. There is a liquid under-drain sump that appears to collect any liquid that leaches through or around the liner, and a cell is shut down if contamination is ever detected below the liner at a depth of 5 feet or greater (Aerostar 2017). (Note that the PA site visit team was unable to obtain documentation and engineer drawings detailing the precise construction of the drying pits.) These pits are used for drying and treating petroleum-impacted

installation soils/sediments via bioremediation prior to utilizing them in the active Sanitary Landfill cells as daily cover material (Aerostar 2017).

According the RUFMA Facility Manager, since 2006, the drying pits at the Land Farm receive sediment removed from the RUFMA Wash-Rack AOPI bi-annually. The RUFMA wash-rack received water potentially containing AFFF from firefighting training activities conducted on the adjacent portion of the RUFMA between 2002 and 2016.

Groundwater in the vicinity of the Land Farm Drying Pits flows from south (from the groundwater mound at the WWTP due to groundwater recharge activities) to north before gradually flowing westward toward the center of the basin at some point north of the sanitary landfill. The Garlic Spring Fault and an unnamed parallel fault may be impeding horizontal groundwater flow, primarily in the lower aquifer (Densmore and Londquist 1997, Densmore 2003).

An aerial photograph of the Land Farm Drying Pits AOPI is provided on **Figure 5-11.**

5.2.12 FTIR-01 Sanitary Landfill

The FTIR-01 Sanitary Landfill is identified as an AOPI following records review, personnel interviews, and site reconnaissance due to the use of sediments removed from the RUFMA Wash-Rack AOPI (following remediation for petroleum contaminants at the Land Farm Drying Pits) as daily landfill cover. The FTIR-01 Sanitary Landfill (FTIR-01, 06225.1061 and 06225.1001) encompasses approximately 467 acres and is comprised of both inactive (operating from the 1940s to 1980s) and active (operating from 1990 to present) waste disposal cells, a POL stockpile area, and a POL Land Farm (referred to as the Land Farm Drying Pits in this report and treated as a separate AOPI). The inactive cell occupies 38 acres and is unlined (Aerostar 2017). The older 18-acre active cell is unlined (operational since 1990), and the newer 25-acre active landfill area (operational since 1993 and known as “Module 1”) consists of three cells, is lined, and has a leachate collection system (Aerostar 2017). The sanitary landfill leachate collection system is not connected to the WWTP.

Since 2006, sediment material that is potentially impacted with AFFF is removed from the RUFMA Wash-Rack AOPI bi-annually and bio-remediated at the Land Farm Drying Pits (HQAES 06225.1061 and 06225.1001) prior to being used as daily landfill cover. AFFF has not been used during firefighting training activities at FTIR since 2016, including at the portion of the RUFMA that drains to/into the RUFMA Wash Rack AOPI.

Groundwater in the vicinity of the FTIR-01 Sanitary Landfill flows from south (from the groundwater mound at the WWTP due to groundwater recharge activities) to north before gradually flowing westward toward the center of the basin at some point north of the sanitary landfill. The Garlic Spring Fault and an unnamed parallel fault may be impeding horizontal groundwater flow, primarily in the lower aquifer (Densmore and Londquist 1997, Densmore 2003).

An aerial photograph of the FTIR-01 Sanitary Landfill AOPI is provided on **Figure 5-11**.

5.2.13 FTIR Helipad

The FTIR Helipad is identified as an AOPI following records review, personnel interviews, and site reconnaissance due to the storage of FFFP-containing aviation fire extinguishers on the helipad, as well

as pilot “washdowns” (spraying a pilot with water from a fire truck hose) historically conducted on the helipad. The helipad is located within the cantonment and encompasses almost 9.4 acres. The helipad slopes downward slightly from northwest to southeast. There is an approximately 8-inch curb along the length of the southeastern (down-slope) helipad boundary, and there is a large, long ramada located adjacent to the southeast edge of the helipad. The northeastern edge of the helipad does not have a curb and vehicles can access the helipad easily from adjacent 5th Street. The eastern corner is the lowest-lying section of the helipad and runoff may exit the helipad at this location and flow southeast down 5th Street. However, historically there have been instances when stormwater has flowed across the entirety of the helipad, overflowed the curb along the southeastern end of the helipad and flowed underneath and beyond the helipad support buildings. The PA site visit team observed three large metal grates, each covering a deep, concrete-lined catchment basin, located on the northwestern (upslope) perimeter of the helipad surface along Inner Loop Road. The purpose of these recently installed catchment basins is to capture sheet flow during significant rain events, thereby reducing the volume of liquid flowing across the helipad and potentially causing flooding and building damage downslope. It is not known whether these catchment basins are connected to the sanitary sewer system or the stormwater management system ditches that direct stormwater around and away from the cantonment.

According to a Sergeant associated with the 2916th Aviation Battalion based at the FTIR Helipad, there are always at least three air ambulance helicopters stationed at the helipad. The Sergeant indicated that there were two 6-pound fire extinguishers on each air ambulance helicopter. The PA site visit team observed one of these extinguishers; it contained Halon 1301 (CF_3Br).

Five 33-pound hand-cart type FFFP aviation fire extinguishers were stationed around the perimeter of the helipad during the PA site visit, with two along the northwestern perimeter and three under the ramada on the southeastern end of the helipad. It is unknown whether the aviation fire extinguisher staging locations are static or change over time. The Fire Department is responsible for inspecting the aviation fire extinguishers but is not responsible for servicing them. The Fire Department personnel stated there have been no known leaks or discharges from the extinguishers staged on the helipad. However, during the PA site visit, one of the FFFP aviation fire extinguishers under the ramada was out of service because it was found to have no pressure and was offline, indicating the extinguisher had been discharged. The Fire Chief noted that there are also three 2-gallon high-pressure water fire extinguishers equipped with AFFF that are kept at air ambulance AR-1 (Building 154) and AR-2 (Building 156); these extinguishers were reportedly purchased in 2010 or 2011.

Until approximately 2013, the Fire Department conducted infrequent pilot "washdowns" on the helipad using water from fire truck hoses to celebrate pilots’ final helicopter flight at FTIR. Residual AFFF in the fire truck pumps or hoses may have been released onto the helipad pavement during this activity. Spray was typically from the west towards the east.

An aerial photograph of the FTIR Helipad is provided on **Figure 5-12**.

Note that when drinking water production well I-7 (approximately 0.31 mile to the east-southeast) is actively extracting groundwater, it may influence the groundwater flow direction at the FTIR Helipad AOPI.

5.2.14 Parking Lot South of Building P861

The Parking Lot South of Building P861 is identified as an AOPI following records review, personnel interviews, and site reconnaissance due to its occasional use for firefighter training activities with water and potentially AFFF. The parking lot on the south side of Building P861 is located on property leased by the ARNG (the area is referred to as “New MATES”). According to the Deputy Fire Chief, this parking lot was used for occasional training between approximately 2003 and 2005 (according to the Maintenance Supervisor with the California ARNG, the New MATES area was constructed in 2003). The Deputy Fire Chief oversaw a single instance of training in this parking lot in 2005. During this particular training event, only water was sprayed. It is possible that AFFF may have been sprayed in addition to water during other training events conducted in this parking lot between 2003 and 2005.

An aerial photograph of the Parking Lot South of Building P861 AOPI is provided on **Figure 5-13**.

Note that Parking Lot South of Building P861 AOPI is approximately 0.45 mile upgradient of drinking water production well I-9.

5.2.15 RUFMA Draining Basins

The RUFMA Drainage Basins are identified as an AOPI following records review, personnel interviews, and site reconnaissance due to the basins receiving AFFF runoff from firefighter training activities on the RUFMA. The RUFMA, as it currently exists, was constructed in 2002. The approximately 44-acre RUFMA is constructed with reinforced concrete to accommodate staging of heavy military equipment prior to or following down-range training exercises. At the same time the RUFMA was constructed, two drainage basins were constructed along the southeastern edge of the RUFMA to collect stormwater runoff from the RUFMA. The bottom of these two drainage basins is earthen and the earthen sides are lined with riprap. The western-most basin has an above-ground concrete structure that likely contains an overflow drain; however, this feature was not inspected during the PA site visit. According to the RUFMA Facility Manger, debris is periodically collected from the basins and the basin floors are cleaned out with a bulldozer.

AFFF was historically used during firefighting training activities on the section of the paved RUFMA adjacent to the drainage basins (2002 through 2016). (RUFMA’s history as an FTA and the use of AFFF is detailed in **Section 5.2.16**.) Water and AFFF would run off the RUFMA surface and into the drainage basin(s). After training with AFFF, if any foam remained on the RUFMA surface, water was used to dilute and rinse the foam from the paved surface to the riprap-covered earthen berm of the drainage basin(s).

An aerial photograph of the RUFMA Drainage Basins AOPI is provided on **Figure 5-14**.

Note that when drinking water production well I-7 (approximately 0.53 mile to the northwest) is actively extracting groundwater, it may influence the groundwater flow direction at the RUFMA Drainage Basins AOPI.

5.2.16 RUFMA Former Fire Training Area

The RUFMA Former Fire Training Area is identified as an AOPI following records review, personnel interviews, and site reconnaissance due to its historical use for firefighter training with AFFF. The original RUFMA was constructed in 1985 or 1986, and consisted of a large, compacted soil surface that, according to the DPW Environmental Chief, drained to the east. At least part of this compacted soil at the

RUFMA overlapped with the Abandoned Sewage Oxidation Ponds (two ponds; FTIR-18, 06225.1018), which were part of the former WWTP that operated from 1940 until 1954 (see **Table 5-1**; FTIR 2001). The compacted soil at RUFMA was used for staging and storing trucks and other heavy military vehicles and equipment. The footprint of the original RUFMA is not known. The RUFMA, as it currently exists, was constructed in 2002. The approximately 44-acre RUFMA is constructed with reinforced concrete to accommodate staging of heavy military equipment prior to or following down-range training exercises.

The RUFMA Former Fire Training Area was the primary FTA for the Fire Department from 1986 until 2012 when the DES Training Area became operational; however, the RUFMA continued to be used as an occasional FTA until 2016. Fire Department interviewees indicated AFFF was used during training until 2016 when use of AFFF during training was discontinued. The frequency and volume of AFFF used during training at the RUFMA are unknown. It is possible that AFFF was used monthly during training exercises between 1986 and 2012. The historical training location(s), foam spray directions, and slope/drainage of compacted soil area(s) used for firefighter training (between 1986 and 2002) on the compacted soil RUFMA are unknown. Historical training with AFFF on the current RUFMA (between 2002 and 2012 and continuing occasionally until 2016) was conducted in two areas: the northeast portion adjacent to a series of wash racks (see RUFMA Wash Rack AOPI in **Section 5.2.17**) and the southeast portion adjacent to two drainage basins (see RUFMA Drainage Basins AOPI in **Section 5.2.15**). According to Fire Department personnel, water and foam used in training in the northeast portion of the RUFMA flowed to the adjacent wash racks; and in the southeast portion, to the adjacent drainage basin(s). Any AFFF that remained on the RUFMA surface at the completion of training was washed into the wash racks or the drainage basin(s) using the fire hoses. The DPW Environmental Chief indicated that he has observed on more than one occasion Fire Department personnel spraying AFFF onto soil beyond the northwest and northeast edges of the paved RUFMA.

An aerial photograph of the RUFMA Former Fire Training Area AOPI is provided on **Figure 5-14.**

Note that when drinking water production well I-7 (approximately 0.23 mile to the west-northwest) is actively extracting groundwater, it may influence the groundwater flow direction at the RUFMA Former Fire Training AOPI.

5.2.17 RUFMA Wash-Rack

The RUFMA Wash-Rack is identified as an AOPI following records review, personnel interviews, and site reconnaissance due to the basins receiving AFFF runoff from firefighter training activities on the RUFMA. There is a large closed-loop, recirculating wash-rack system that includes 25 wash-rack bays, located along the northeast edge of the RUFMA. This system and the associated bays were constructed in 2002 at the same time as the RUFMA's reinforced concrete surface. There is a large trench drain/basin that bisects the 25 wash-rack bays, which collects used water and sediments washed off the vehicles. The used water passes through an oil-water separator and several clarifying/filtration steps before it is returned to the clear water holding tank pending its reuse in the wash-rack bays.

According to the RUFMA Facility Manager during the PA site visit, the closed-loop recirculating wash-rack system works but not very well. They also stated that the oil in the oil-water separator is pumped into an oil tank, and the waste oil tank is cleaned out approximately bi-annually (prior to 2006, it was removed and disposed off post by a contractor, but it is not known where and how the waste oil is currently disposed); the clear water basin is cleaned out approximately bi-annually (prior to 2006, it was removed

and disposed off post by a contractor); the carbon filters were last changed out in approximately 2011 or 2012; and, since 2006, the sediment in the trench drain/basin is removed bi-annually, sampled (analyzed for total petroleum hydrocarbons, benzene, toluene, ethylbenzene, and xylenes), and then sent to the Land Farm Drying Pits for bioremediation prior to use as daily cover at the FTIR-01 Sanitary Landfill or elsewhere at FTIR. According the DPW Environmental Chief, excess recirculated water is purged from the system during bi-annual maintenance (and more frequently if there are significant rain events) and may be discharged to the WWTP (FTIR-02; 06225.1017) via the sanitary sewer. (Note that information regarding the design and operation of the evaporation/percolation ponds that receive discharge from the RUFMA Wash-Rack was not available during the PA; therefore, no sampling was planned for [Arcadis 2021a] or undertaken in the SI.)

AFFF historically was used during firefighting training activities on the paved RUFMA from 2002 through 2016. (RUFMA's history as an FTA and the use of AFFF are detailed in **Section 5.2.16** above.) One of the two identified sections of the RUFMA used in training is adjacent to the RUFMA Wash-Rack AOPI. Runoff from these training events would flow to the RUFMA Wash-Rack trench drain/basin bisecting the wash-rack bays. After training with AFFF, if any foam remained on the RUFMA, water was used to dilute and rinse the foam from the paved surface and into the RUFMA Wash-Rack trench drain/basin.

An aerial photograph of the RUFMA Wash-Rack AOPI is provided on **Figure 5-14**.

Note that when drinking water production well I-7 (approximately 0.32 mile to the west-northwest) is actively extracting groundwater, it may influence the groundwater flow direction at the RUFMA Wash-Rack AOPI.

5.2.18 Bicycle Lake Army Airfield (BLAAF) Fire Extinguisher Training Area

The BLAAF Fire Extinguisher Training Area is identified as an AOPI following records review, personnel interviews, and site reconnaissance due to its use for annual training with AFFF/FFFP aviation fire extinguishers. BLAAF Fire Extinguisher Training Area was used to conduct annual fire extinguisher training with AFFF and FFFP aviation extinguishers since at least 2004 through 2013. Training occurred in a gravel area adjacent to the asphalt apron. One or two 33-pound, wheeled fire extinguishers were used (and emptied) during each training event. The annual trainings were staged such that the spray direction(s) avoided an electrical transformer in the immediate area.

Note that the hydrogeology in the vicinity of BLAAF differs from hydrogeology farther north in the Bicycle Groundwater Basin/Bicycle Lake playa, due to the presence of unnamed faults which serve as at least a partial barrier to lateral groundwater flow (see **Section 2.7**).

An aerial photograph of the Bicycle Lake Airfield Fire Extinguisher Training Area AOPI is provided on **Figure 5-15**.

5.2.19 BLAAF Helipad

The BLAAF Helipad is identified as an AOPI following records review, personnel interviews, and site reconnaissance due to the storage (staging) of FFFP-containing aviation fire extinguishers on the helipad. Several 33-gallon, wheeled FFFP aviation fire extinguishers are staged on and around the paved, main helicopter parking area (helipad) at BLAAF and, according to recent satellite imagery, do not appear be moved over time. There are no known historical uses (fire responses or leaks) of AFFF/FFFP.

Note that the hydrogeology in the vicinity of BLAAF differs from hydrogeology farther north in the Bicycle Groundwater Basin/Bicycle Lake playa, due to the presence of unnamed faults which serve as at least a partial barrier to lateral groundwater flow (see **Section 2.7**).

An aerial photograph of the BLAAF Helipad AOPI is provided on **Figure 5-15**.

5.2.20 BLAAF North Staging Area

The BLAAF North Staging Area is identified as an AOPI following records review, personnel interviews, and site reconnaissance due to the storage (staging) of FFFP-containing aviation fire extinguishers at locations within the staging area. The BLAAF North Staging Area encompasses approximately 14.5 acres of compacted soil and is used for staging helicopters. Several 33-gallon, wheeled FFFP aviation fire extinguishers are staged in the BLAAF North Staging Area. The number of extinguishers and their staging locations for these extinguishers are change as needed, and satellite imagery confirms that staging has shifted over time. There are no known historical uses (fire responses or leaks) of these extinguishers.

No sampling of this AOPI was undertaken during the SI due to its large area, changing placements of the aviation fire extinguishers, lack of evidence of historical AFFF/FFFP use (intentional/inadvertent deployment or leaks).

Note that the hydrogeology in the vicinity of BLAAF differs from hydrogeology farther north in the Bicycle Groundwater Basin/Bicycle Lake playa, due to the presence of unnamed faults which serve as at least a partial barrier to lateral groundwater flow (see **Section 2.7**).

An aerial photograph of the BLAAF North Staging Area AOPI is provided on **Figure 5-15.**

5.2.21 BLAAF South Staging Area

The BLAAF South Staging Area is identified as an AOPI following records review, personnel interviews, and site reconnaissance due to the storage (staging) of FFFP-containing aviation fire extinguishers at locations within the staging area. The BLAAF North Staging Area encompasses approximately 10 acres of compacted soil and is used for staging helicopters. Several 33-gallon, wheeled FFFP aviation fire extinguishers are staged in the BLAAF South Staging Area. The staging locations for these extinguishers can change as needed, and satellite imagery confirms that staging has shifted over time. There are no known historical uses (fire responses or leaks).

No sampling of this AOPI was undertaken during the SI due to its large area, changing placements of the aviation fire extinguishers, and lack of evidence of historical AFFF/FFFP use.

Note that the hydrogeology in the vicinity of BLAAF differs from hydrogeology farther north in the Bicycle Groundwater Basin/Bicycle Lake playa, due to the presence of unnamed faults which serve as at least a partial barrier to lateral groundwater flow (see **Section 2.7**).

An aerial photograph of the BLAAF South Staging Area AOPI is provided on **Figure 5-15.**

5.2.22 FTIR-20 Former Fire Training Area

The FTIR-20 Former Fire Training Area is identified as an AOPI following records review, personnel interviews, and site reconnaissance due to its historical use as an FTA. The FTIR-20 Former Fire Training

Area (FTIR-20, HQAES 06225.1020) is located approximately 2 miles northeast of the cantonment on Barstow Road near the intersection with Westbrook Road, and adjacent to a booster station (large tank containing potable water) that supplies water to BLAAF. It consisted of an unlined “pit” that was enclosed by a short earthen berm that was approximately 66 feet long, 55 feet wide, and 3 feet tall (Greiner, Inc. 1991, USACE 1993). Fuel used in training was stored in elevated fuel tanks installed beyond the western edge of the pit where a chain-link fence currently stands. There was no visual evidence of the FTIR-20 Former Fire Training Area (e.g., the former fuel tank and earthen berms) during the PA site visit. The FTIR-20 Former Fire Training Area was used monthly for firefighting training with active fire from 1982 to October 1986 (approximately 58 training exercises in total).

During each training exercise, approximately 3,000 gallons of water was used to flood the pit. One hundred to 150 gallons of a 1:5 gasoline/diesel mixture was then poured into the pit and ignited. The fire was allowed to build to its maximum intensity before being extinguished using approximately 10 gallons of undiluted Ansulite™ AFFF or Purple K (Purple K does not contain PFAS-containing materials) (Greiner, Inc. 1991, USACE 1993).

In 1989, a partial excavation of the northeastern boundary to 16 feet bgs was conducted to determine the depth of hydrocarbon contamination; however, the excavated soils were used to backfill the excavation (Greiner, Inc. 1991, FTIR 2001). Backfilling with the excavated soils altered the soil profile in the excavated area and potentially redistributed impacted soils (Greiner, Inc. 1991). There have been other investigations at FTIR-20 for hydrocarbons, metals, and volatile organic compounds, including the installation of one side-gradient monitoring well (MW-11) and three downgradient monitoring wells (MW-12 through MW-14 and MW-21) (USACE 1993). However, with the exception of one of the downgradient monitoring well, all the monitoring wells were destroyed prior to the PA site visit. The above-ground construction (in very degraded condition) of an unidentified monitoring well was observed during reconnaissance of the area during the PA site visit. The PA team was unable to obtain additional information from FTIR about this well and it is assumed that the above-ground well features were left in place after the monitoring well was abandoned. There has been no remediation of this site.

Note that groundwater generally flows towards BLAAF. The hydrogeology in the vicinity of this AOPI and BLAAF differs from hydrogeology farther north in the Bicycle Groundwater Basin/Bicycle Lake playa, due to the presence of unnamed faults which serve as at least a partial barrier to lateral groundwater flow (see **Section 2.7**). Historical water levels (1993 to 1997) in monitoring wells located in the general vicinity of the FTIR-20 Former Fire Training Area AOPI were more than 40 feet higher than water levels in wells north of unnamed fault 2 and indicated minimal or no water-level decline due to pumping in other parts of the basin (these monitoring wells were destroyed in the late 1990s and 2000). This indicated that these wells were isolated from pumping elsewhere in the basin by faults (unnamed faults 1 and 2) acting as barriers to groundwater flow or differences in lithology unrelated to faulting (Densmore et al. 2018).

An aerial photograph of the FTIR-20 Former Fire Training Area AOPI is provided on **Figure 5-16**.

5.2.23 J Stand Fire Truck Pump Flush Area

The J Stand Fire Truck Pump Flush Area is identified as an AOPI following records review, personnel interviews, and site reconnaissance due its use for flushing AFFF residue from fire truck plumbing and hoses. A J stand is located on Westbrook Road near the intersection with Barstow Road and adjacent to the down-range guard post, the potable water booster station that supplies water to BLAAF, and the

FTIR-20 Former Fire Training Area AOPI. There is a fire hydrant located between the J stand and the booster station tank. The J stand is attached to a large potable water tank (likely the booster station tank) and its overhead construction is used to fill water reservoirs on fire trucks and tanker trucks from the top. During the PA site visit, an area of saturated soil was observed emanating from the vicinity of the adjacent booster station water tank and bisecting the J Stand Fire Truck Pump Flush Area AOPI.

According to the FTIR Deputy Fire Chief, the Training Specialist, and the Fire Captain, the J stand was historically and is currently used when fire trucks carrying AFFF returned from down-range training support and/or fire-response activities. The fire truck is parked somewhere between the J stand and the fire hydrant with the front of the fire truck pointed east towards FTIR-20 Former Fire Training Area AOPI, and the fire truck pump and lines are flushed with water in the fire truck's water tank to clear out any AFFF (AFFF can damage the plumbing if not flushed out). The fire truck crew then fills up the truck's water reservoir from the J stand if needed, and then uses the water in the truck's water reservoir to flow water through the lines under some degree of pressure until the water coming out the hose is no longer white (i.e., no more foam was visible flowing out of the hose). The fire hose generally is be aimed east-northeast toward the FTIR-20 Former Fire Training Area AOPI and, depending on the pressure used, water from the nozzle can reach the fence on the near (east) side of FTIR-20 south of the booster station water tank. The amount of water used to flush the lines depends on the size of the truck, the water pressure flowed through the lines, and the amount of foam to clear. Once the lines are flushed, the fire truck crew refills the fire truck's water reservoir at the J stand prior to returning to the fire station.

The J stand has been used to flush AFFF from fire truck lines since at least 1989. However, given the J stand's close proximity to the FTIR-20 Former Fire Training Area AOPI (used from 1982 through October 1986), it is likely that the FTIR Fire Department used the J stand to flush fire truck lines following monthly training exercises at the FTIR-20 Former Fire Training Area AOPI.

Note that groundwater generally flows towards BLAAF. The hydrogeology in the vicinity of this AOPI and BLAAF differs from hydrogeology farther north in the Bicycle Groundwater Basin/Bicycle Lake playa, due to the presence of unnamed faults which serve as at least a partial barrier to lateral groundwater flow (see **Section 2.7**). Historical water levels (1993-1997) in monitoring wells located in the general vicinity of the J Stand Fire Truck Pump Flush Area AOPI were more than 40 feet higher than water levels in wells north of unnamed fault 2 and demonstrated minimal or no water-level decline due to pumping in other parts of basin (these monitoring wells were destroyed in the late 1990s and 2000). This indicated that these wells were isolated from pumping elsewhere in the basin by faults (unnamed faults 1 and 2) acting as barriers to groundwater flow or differences in lithology unrelated to faulting (Densmore et al. 2018).

An aerial photograph of the J Stand Fire Truck Pump Flush Area AOPI is provided on **Figure 5-16**.

5.2.24 FOB Miami

FOB Miami is located in a remote down-range area and consists of an airstrip, helicopter landing pads, and several buildings. There is the potential to encounter UXO at FOB Miami. Two hangars at FOB Miami are identified as an AOPI following records review, personnel interviews, and site reconnaissance due to the storage of aviation fire extinguishers that may have PFAS-containing materials inside two hangars. According to the Chief of Master Planning and the Safety Officer at Range Operations, approximately eight to twelve 33-pound aviation extinguishers are located inside Hangars 10072 and 10073 at FOB Miami. These extinguishers are serviced every three years by an outside contractor. The current and

historical contents of these fire extinguishers are unknown, but it is possible that they contain AFFF or FFFP. According to the Safety Officer at Range Operations, the extinguishers' contents are emptied onto the ground outside the hangars during servicing. During the fire extinguisher servicing event in August 2017 (the most recent servicing event prior to the PA site visit), the aviation fire extinguishers were reported to contain a blood-based fire suppression chemical. It is possible that the aviation fire extinguishers contain FFFP, but this is unconfirmed.

An aerial photograph of the FOB Miami AOPI is provided on **Figure 5-17**.

5.2.25 NASA Goldstone Former Microwave Test Facility

The NASA Goldstone Former Microwave Test Facility is identified as an AOPI following records review and personnel interviews due to its identification in a historical report as the location of fire-related training of NASA Goldstone staff. NASA Goldstone's former fire training area was located at or adjacent to the Microwave Test Facility (JPL 1992). The Microwave Test Facility was located approximately 0.75 mile northwest of Echo Station (the closest Goldstone station to the cantonment). The Microwave Test Facility was constructed in 1963 and, according to the NASA Goldstone Facilities and Energy Conservation Manager, was destroyed in 2008. It is not known when the co-located fire training area became operational, how frequently it was used, and when operation ceased. The NASA Goldstone Fire Engineer noted that any fire-related training likely would have taken place prior to the late 1980s or early 1990s.

Fire training activities included putting out fires and conducting rescues, but the use of AFFF or FFFP could not be confirmed through the PA records review or personnel interviews. A historical JPL report (JPL 1988) obtained in March 2022 indicated that the NASA Goldstone fire brigade consisted of two full-time firefighter staff, 10 volunteer firefighters, and two fire trucks as recently as 1988, which is more robust than what was understood during the PA to have existed. This report also includes details about the fire training area at the Former Microwave Test Facility. It included a liquid propane gas (LPG) above-ground storage tank (AST) that was connected to an LPG burner and control valve, as well as a flammable liquid pit (JPL 1988). The presence of a flammable liquid pit indicates that AFFF use in quenching active fires was likely.

An aerial photograph of the NASA Goldstone Former Microwave Test Facility AOPI is provided on **Figure 5-18**.

6 SUMMARY OF SI ACTIVITIES

Based on the results of the PA at FTIR, an SI for PFOS, PFOA, and PFBS was conducted in accordance with CERCLA. SI sampling was completed at FTIR at 23 of the 25 AOPIs to evaluate presence or absence of PFOS, PFOA, and PFBS in comparison with the OSD risk screening levels. The two AOPIs at which no SI sampling was conducted (BLAAF North Staging Area AOPI and the BLAAF South Staging Area AOPI) was due to their large areas (14.5 and 10 acres, respectively), changing placements of the aviation fire extinguishers, and lack of evidence of historical AFFF/FFFP use. An installation-specific QAPP Addendum (Arcadis 2021a) was developed to supplement the general information provided in the PQAPP (Arcadis 2019) and to detail the site-specific proposed scopes of work for the SI. A preliminary CSM was prepared for each of the installation's AOPIs in accordance with the USACE Engineer Manual on Conceptual Site Models, EM 200-1-12 (USACE 2012). The preliminary CSMs identified potential human receptors and chemical exposure pathways based on current and/or reasonably anticipated future land uses. The preliminary CSMs identified three soil, groundwater, and/or sediment pathways as potentially complete, which guided the SI sampling. The QAPP Addendum details the sampling design and rationale based on each AOPI's preliminary CSM. The SI scope of work was completed in May 2021 through the collection of field data and analytical samples.

The SI field work was completed in accordance with the standard operating procedures (SOPs), technical guidance instructions (TGIs), sampling design, and QA/QC requirements as detailed in the QAPP Addendum (Arcadis 2021a) and PQAPP (Arcadis 2019). The subsections below summarize the DQOs, sampling design and rationale, sampling activities and methods, and data analyses procedures for the SI phase at FTIR. Non-conformances to the prescribed procedures in the PQAPP and QAPP Addendum are described in **Section 6.3.4**. Analytical results obtained through SI field activities are summarized in **Section 7**.

6.1 Data Quality Objectives

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

6.2 Sampling Design and Rationale

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

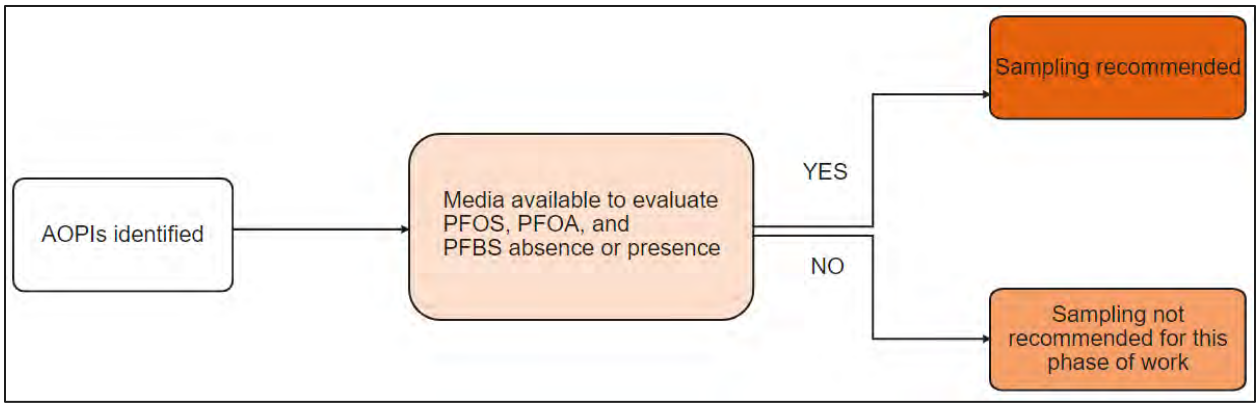

Figure 6-1: AOPI Sampling Decision Tree

The sampling design for SI activities at FTIR is detailed in Worksheet #17 of the QAPP Addendum (Arcadis 2021a). Briefly, the areas of focus for this SI are those related to the use, storage, and disposal of AFFF/FFFP, as well as secondary source areas related to the disposal of AFFF/FFFP. A summary of the sampling design for each medium is provided below.

As documented in the approved QAPP Addendum (Arcadis 2021a), no sampling was conducted during the SI at the BLAAF – North Staging Area AOPI and the BLAAF – South Staging Area AOPI. The BLAAF – North Staging Area AOPI encompasses 14.5 acres and the BLAAF – South Staging Area AOPI encompasses 10 acres. Both AOPIs are used periodically to stage helicopters and, therefore, large, mobile, FFFP aviation fire extinguishers are positioned at various locations within each staging area. There are no known intentional uses of the aviation extinguishers within the boundaries of these two AOPIs. A review of historical satellite imagery of these two AOPIs indicates that the locations at which the FFFP aviation fire extinguishers are positioned within each staging area are not fixed and are changed periodically. Given the size of these two AOPIs, their orientation relative to the approximate groundwater flow direction, the uncertainty about the historical extinguisher storage locations within each of these two AOPIs, and the potential for wind erosion and deposition of desert soils, it was determined that the number of soil and groundwater samples necessary to determine PFOS, PFOA, and/or PFBS presence or absence with any confidence at these two AOPIs is unfeasible at this time.

Groundwater

Groundwater samples were collected at six of the 23 AOPIs included in the SI (Area North of I Avenue, DES Training Complex, FTIR-01 Sanitary Landfill, Land Farm Drying Pits, BLAAF Helipad, and RUFMA) to identify the presence/absence of PFOS, PFOA, and/or PFBS at known or potential use, storage, and disposal areas, and update the individual AOPI CSMs. Due to deep groundwater, low precipitation (approximately 4.2 inches per year), and high evapotranspiration (greater than 70 inches per year) at FTIR (FTIR 2018), groundwater sampling was limited to existing wells located downgradient, within, or upgradient of AOPIs. Samples were collected from 13 existing monitoring wells (RI-8, RI-5, RI-12, MW-2, MW-4, MW-5, MW-9, MW-10, IX-1, STP-16A, STP-17A, W-3, and BLA5-3). The location of each well sampled relative to the associated AOPI is listed below.

- Area North of I Avenue Near Building P817 AOPI:
    - STP-17A is located approximately 580 feet cross-/downgradient of the nearest edge of the AOPI.
- DES Training Complex AOPI:
    - IX-1 is located approximately 713 feet side-/downgradient of the nearest edge of the AOPI.
- Land Farm Drying Pits AOPI:
    - RI-8 is located approximately 240 feet downgradient of the AOPI.
- FTIR-01 Sanitary Landfill AOPI:
    - RI-5, RI-12, and MW-2 are located 1,165 to 1,858 feet downgradient, and MW-4 and MW-5 are located 61 to 67 feet downgradient, of the AOPI.
    - FTIR-MW9 is located approximately 110 feet cross-/downgradient of the AOPI.
    - FTIR-MW10 is located approximately 324 feet cross-/upgradient (adjacent to the leachate collection pond) of the AOPI.
- RUFMA Former Fire Training Area AOPI:
    - STP-16A is located approximately 38 feet cross-/upgradient of the nearest edge of the AOPI, though its close proximity to the AOPI makes it useful to assess any historical AFFF uses in the eastern corner of the RUFMA.
- BLAAF – Helipad AOPI:
    - W-3 is located approximately 200 feet upgradient of the AOPI (it is also located upgradient of the BLAAF - Fire Extinguisher Training Area AOPI).
    - BLA5-3 is located 2,825 feet (0.54 mile) downgradient of the AOPI (it is also located downgradient of the BLAAF - Fire Extinguisher Training Area AOPI).

Table 6-1 includes the available monitoring well construction details for the wells sampled during the SI.

Soil Sampling

Soil samples were collected at 89 discrete sample points at 19 of the 23 AOPIs included in the SI to identify the presence/absence of PFOS, PFOA, and/or PFBS at known or potential use, storage, and disposal areas; to evaluate the potential for those areas to be sources of PFOS, PFOA, and/or PFBS to surface water and groundwater as an influence to drinking water; and to update the individual AOPI CSMs for the AOPIs at which soil sampling was conducted. Generally, sampling points were positioned at locations of known or suspected AFFF releases and, where appropriate, within surface water runoff areas. If the specific, potential release location(s) within an AOPI was uncertain (i.e., Active Recreational Ball Fields, Former Fire Station, Parking Lot South of Building P861, BLAAF Helipad, and NASA Goldstone Former Microwave Test Facility), then soil samples were collected at multiple locations throughout the AOPI where releases were considered most likely (e.g., due to access, slope). In most instances, composite shallow soil samples generally were collected from the top 2 feet of native soil. However, soil historically has been removed or disturbed at two AOPIs (i.e., periodic maintenance of the

RUFMA Drainage Basins AOPI and a partial excavation to approximately 16 feet bgs and replacement of excavated soil at the FTIR-20 Former Firefighter Training Area AOPI). At these two AOPIs, soil samples are collected at deeper and/or multiple 2-foot intervals at depths up to 15 feet bgs. The soil sampling approach at each AOPI is summarized below.

- Active Recreational Ball Fields AOPI:

  Six shallow soil samples were collected within the top 2 feet of native soil. The specific locations of suspected training with water and AFFF are unknown, and the sample locations were selected based on the most likely truck staging locations for training.

- AFFF Storage Shed (Building P358) AOPI:

  One shallow soil sample was collected within the top 2 feet of native soil adjacent to the shed door.

- Bulk POL Containment Basins AOPI:

  Five shallow soil samples were collected within the top 2 feet of native soil adjacent to two of the three contiguous concrete secondary containment basins used for occasional training with water and AFFF.

- Bulk POL Tanker Fire Response AOPI:
  - Two shallow soil samples were collected within the top 2 feet of native soil within the known AFFF release area.
  - Two shallow soil samples were collected within the top 2 feet of native soil within the assumed surface runoff area.

- DES Training Complex AOPI:
  - Five shallow soil samples were collected within the top 2 feet of native soil within the known release area (within or adjacent to the lined pit used for training with water and AFFF).
  - Two shallow soil samples were collected within the top 2 feet of native soil adjacent to the doors of a Conex box used for AFFF storage (and/or storage of empty AFFF containers).

- Fire Hose Pressure-Testing Area AOPI:

  One shallow soil sample was within the top 2 feet of native soil from within the suspected release area.

- Fire Station 1 (Building P400) and Former AFFF Storage (Building P411) AOPI:
  - Three shallow soil samples were collected within the top 2 feet of native soil within the assumed surface water runoff areas for the suspected Fire Station 1 AFFF release locations.
  - Two shallow soil samples were collected within the top 2 feet of native soil located adjacent to the likely footprint of former Building P411 (used for AFFF storage).

- Fire Station 2 (Building P6101) AOPI:
  - Five shallow soil samples were collected within the top 2 feet of native soil from within suspected release areas. Two of these samples are also within the surface runoff area from

the front apron. One of these samples is from within the surface runoff area for the back apron.

  - One shallow soil sample was collected within the top 2 feet of native soil at a location adjacent to the back apron at which fire hoses are cleaned.

- Former Fire Station AOPI:
  - Two shallow soil samples were collected within the top 2 feet of native soil adjacent to where the apron is believed to have been located.
  - Three shallow soil samples were collected within the top 2 feet of native soil footprint at locations that are believed to be behind the former station building.
- FTIR Helipad AOPI:

  Four shallow soil samples were collected within the top 2 feet of native soil within likely surface runoff areas adjacent to the helipad curb.
- Parking Lot South of Building P861 AOPI:

  Four shallow soil samples were collected within the top 2 feet of native soil at locations selected to provide reasonable coverage of the AOPI footprint based on the likely locations of fire truck staging.
- RUFMA Drainage Basins AOPI:

  Three soil samples were collected at 12 to 14 feet bgs or 13 to 15 feet bgs within these surface runoff collection basins that received AFFF from the RUFMA Former Fire Training Area AOPI. Deeper sampling was undertaken because the basins are maintained periodically through removal of soil, and the specifics of this maintenance is unknown.
- RUFMA Former Fire Training Area AOPI:

  Four shallow soil samples were collected within the top 2 feet of native soil from within or adjacent to suspected release areas.
- BLAAF – Fire Extinguisher Training Area AOPI:

  Four shallow soil samples were collected within the top 2 feet of native soil from within suspected release areas.
- BLAAF – Helipad AOPI:

  Four shallow soil samples were collected within the top 2 feet of native soil from within surface runoff areas for FFFP aircraft extinguishers staged on the helipad.
- FTIR-20 Former Fire Training Area AOPI:
  - Five shallow soil samples were collected within the top 2 feet of native soil, and a further five soil samples were collected at approximately 3 to 5 feet bgs from five borings located within the suspected release area (10 samples total).
  - Two borings were advanced to 15 feet bgs via direct-push technology (DPT) within or adjacent to the suspected release area and six samples were collected. Samples were

collected at approximately 3 to 5 feet bgs, 8 to 10 feet bgs, and 13 to 15 feet bgs (six samples total). The deeper samples were collected because this portion of the AOPI was previously excavated to a depth of approximately 16 feet bgs and then backfilled with the excavated material.

- J Stand Fire Truck Pump Flush Area AOPI:

  Three shallow soil samples were collected within the top 2 feet of native soil from within the suspected release area.

- FOB Miami AOPI:
  Four shallow soil samples were collected within the top 2 feet of native soil from within the suspected release areas.

- NASA Goldstone Former Microwave Test Facility AOPI:
  Three shallow soil samples were collected within the top 2 feet of native soil at locations selected based on possible truck staging locations given the former footprint of known constructed site features.

No soil samples were collected at four of the 23 AOPIs included in the SI (Area North of I Avenue Near Building P817, Land Farm Drying Pits, FTIR-01 Sanitary Landfill, and the RUFMA Wash-Rack) due to uncertainty about or lack of access to locations where PFOS, PFOA, and/or PFBS may have been used, stored, or disposed. Soil samples were not collected at the Area North of I Avenue Near Building P817 AOPI because the entirety of the 36-acre unpaved area in which occasional instances of firefighting training with water and potentially AFFF took place (the specific locations of training are unknown) is now occupied by Building P817 and a large, reinforced concrete pad used for storing and staging heavy vehicles and equipment. Soil samples were not collected from the Land Farm Drying Pits AOPI (a secondary source area) because engineer drawings detailing the precise construction of the lined drying pits could not be obtained from FTIR prior to the SI to ensure the soil sampling approach would not compromise the pit linings. Soil samples were not collected from the FTIR-01 Sanitary Landfill (a secondary source area) because there is no way of knowing where in the sanitary landfill (and at what depth[s]) sediments removed from the RUFMA Wash-Rack AOPI and bioremediated at the Land Farm Drying Pits AOPI was applied as cover. Soil samples were not collected from the RUFMA Wash-Rack AOPI because the entirety of the AOPI surface to which AFFF was released is paved with reinforced concrete. Soil sampling at the 44-acre RUFMA Former Fire Training Area was limited to locations beyond the boundary of the paved surface due to a lack of access to soils beneath the reinforced-concrete RUFMA.

Sediment Sampling

A sediment sample was collected at two of the 23 AOPIs included in the SI (RUFMA Wash-Rack [large trench drain/basin] and the J Stand Fire Truck Pump Flush Area) to identify the presence/absence of PFOS, PFOA, and/or PFBS at known use areas and, associated with the RUFMA Wash-Rack AOPI; the potential for secondary source areas to evaluate the potential for those areas to be sources of PFAS to surface drainages and groundwater as an influence to drinking water; and to update the individual AOPI CSMs for these two AOPIs.

- RUFMA Wash-Rack AOPI:

  One sediment sample and a duplicate sample were collected from the wash-rack trench drain/basin. The trench drain/basin received surface runoff from a confirmed AFFF release area at the RUFMA Former Fire Training Area AOPI.

- J Stand Fire Truck Pump Flush Area AOPI:

  One sediment sample was collected from a surface water runoff drainage area adjacent to and down-slope of the suspected release area.

Surface Water Sampling

Naturally occurring surface water resources on FTIR are limited to six permanent springs that produce very small quantities of water and four ephemeral springs that, depending on seasonal rainfall, produce little to no water during the summer months (FTIR 2016). None of these springs are located in the vicinity of an AOPI. The only other surface water bodies at FTIR are the WWTP ponds located in the eastern-southeastern fringe of the cantonment area (Montgomery Watson 1995). The WWTP occasionally receives discharges of excess water from the RUFMA Wash-Rack; these discharges could contain concentrations of PFOS, PFOA, and/or PFBS. The PA site visit team was unable to obtain information from the installation on the location of the WWTP outfall to the primary percolation pond (as well as the ground conditions to ensure safe access); therefore, a surface water sample could not be collected in the vicinity of the WWTP outfall. However, since the WWTP also receives wastewater from the two active FTIR fire stations, any detection of PFOS, PFOA, and/or PFBS cannot be tied definitively to any particular AOPI without further characterization of the AOPIs that discharge wastewater to the WWTP.

6.3 Sampling Methods and Procedures

Environmental data were collected and analyzed in accordance with the PQAPP (Arcadis 2019), the SOPs and TGIs included as Appendix A to the PQAPP, the QA/QC requirements identified in Worksheet #20 of the PQAPP, the approved scope and sampling methods outlined in the site-specific QAPP Addendum (Arcadis 2021a), and the safety procedures specified in the Accident Prevention Plan (Arcadis 2018) and SSHP (Arcadis 2021b). The sampling methods described in the SOPs and TGIs establish equipment requirements, procedures for preparing equipment and containers before sampling, sampling procedures under various conditions, and procedures for storing samples to ensure that sample contamination does not occur during collection, and transport. In general, sampling techniques used in the SI were consistent with conventional sampling techniques used in the environmental industry, but special considerations were made regarding PFAS-containing materials and equipment and cross-contamination potential.

The sampling methods employed during the SI are detailed in the PQAPP (Arcadis 2019) and QAPP Addendum (Arcadis 2021a). The subsections below provide a summary of the field methods and procedures utilized to complete the SI scope of work. Field notes and field forms (i.e., soil boring logs, groundwater purging logs, tailgate health and safety forms, and sample collection logs) documenting the SI sampling activities are included in **Appendices J** and **K**, respectively. Photographs of the sampling activities are included in **Appendix L**.

6.3.1 Field Methods

Groundwater samples were collected using low-flow purging methods from approximately the center of the saturated screened interval at existing monitoring wells. Depending on field conditions, either a peristaltic pump or portable bladder pump with PFAS-free disposable high-density polyethylene tubing was used to collect groundwater samples through a screen-point sampler. Field parameters (temperature, pH, specific conductivity, dissolved oxygen, turbidity, and oxidation-reduction potential) were measured during purging to stabilize in accordance with the TGI for PFAS Sampling Procedures and Low-Flow Groundwater Purging for Monitoring Wells (P-11 in Appendix A to the PQAPP; Arcadis 2019) (or purged for a maximum of 20 minutes, whichever occurs first) before collecting groundwater samples to ensure a representative sample was collected and, potentially, to inform the interpretation of analytical data.

Soil at each sampled interval was composited in a decontaminated stainless-steel bowl with a new PFAS-free liner before being placed in bottles for laboratory analysis. Shallow soil samples were collected, generally from the top two feet of native soil, using a decontaminated hand auger. Soil samples at deeper intervals were collected using a decontaminated hand auger or a DPT drill rig casing utilizing PFAS-free acetate liners.

Sediment samples were collected from the upper 10 centimeters using a reusable, decontaminated, small plastic cup attached to a pole or a decontaminated hand auger. Sediment samples were then composited in a decontaminated stainless-steel bowl with a new PFAS-free liner before being placed in bottles for laboratory analysis. Sediment samples were not decanted before bottling for laboratory analysis (see **Section 6.3.4**).

Decontamination procedures for non-dedicated equipment used during sampling are described in **Section 6.3.5**.

6.3.2 Quality Assurance/Quality Control

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

QA/QC samples were collected at the frequencies specified in the QAPP Addendum (Arcadis 2021a), typically at a rate of 1 per 20 parent samples. Field duplicates and matrix spike/matrix spike duplicate samples were collected for media sampled for PFOS, PFOA, PFBS, and total organic carbon (TOC) only. EBs were collected for media sampled for PFOS, PFOA, and PFBS, at a frequency of one per piece of relevant equipment for each sampling event, as specified in the QAPP Addendum (Arcadis 2021a). The decontaminated reusable equipment from which EBs were collected include tubing, groundwater pump, drill casing and cutting shoes, hand auger, water-level meter, acetate liners, bowl liner, and stainless-steel bowls as applicable to the sampled media. A source blank was collected from the water used to pressure-wash drill tooling. Analytical results for blank samples are discussed in **Section 7.27**.

6.3.3 Dedicated Equipment Background

Dedicated equipment background (DEB) samples were collected at a frequency of one DEB per AOPI at AOPIs where groundwater sampling was conducted at existing monitoring wells that contained dedicated, down-hole equipment (an additional DEB sample inadvertently collected at the FTIR-01 Sanitary Landfill AOPI). When collecting samples from monitoring wells with dedicated, down-hole equipment, two water samples were taken from one monitoring well at each AOPI. One DEB sample was collected from the first water produced through the pump and tubing and was used to evaluate whether the dedicated equipment may be impacting the PFOS, PFOA, and/or PFBS results, as it is unknown if the dedicated equipment was comprised of PFAS-containing components. PFOS, PFOA, and/or PFBS concentrations in the DEBs reflect concentrations in stagnant groundwater, and they may be biased high by contributions from equipment that contains PFOS, PFOA, and/or PFBS components. The parent sample was collected after the well was purged until the field parameters stabilized. Further DEB analysis is included in **Section 7.24**.

6.3.4 Field Change Reports

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

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

- Equipment Blank Samples
    - FCR-FTIR-01: The ID for the EB sample collected from the water level meter was incorrectly identified as “FTIR-EB-10-MMDDYY” in the QAPP Addendum. The ID for the EB sample collected from the water level meter was corrected in the field to “FTIR-EB-01-MMDDYY.”
    - FCR-FTIR-03: The EB samples FTIR-EB-03 (tubing weight), FTIR-EB-05 (bailer), and FTIR-EB-06 (stainless-steel trowel) were not collected because the associated equipment were not utilized during sampling activities.

      Due to an error in the field, the unplanned EB sample collected from the bowl liner was identified as “FTIR-EB-07-MMDDYY.” Therefore, the EB sample collected from the acetate liner used in conjunction with the DPT drilling rig (identified in the QAPP Addendum as FTIR-EB-07) was recorded as “FTIR-EB-12-050421.”

      Two different bowls were used to composite soil samples during sampling activities. Therefore, two EB samples were collected. The EB sample collected from the second bowl (FTIR-EB-11-050521) used was erroneously identified with the same sample ID as the EB sample collected from the first bowl (FTIR-EB-11-050221). However, the two EB samples are distinguishable from each other because they were collected on different dates.

  - FCR-FTIR-05: An EB sample was not collected from the reusable, small plastic cup (attached to the end of a long pole) used to collect a sediment sample (FTIR-RUFMAWR-01-SE-050421) and a field duplicate sample (FTIR-RUFMA-FD-01-SE-050421) from the trench drain/basin at the RUFMA Wash-Rack AOPI. As it is confirmed that the RUFMA Wash-Rack AOPI received regular inputs of water and AFFF between 2002 and 2016, any detections of PFOS, PFOA, and/or PFBS in the sediment sample (and duplicate sample) collected from the trench drain/basin at the RUFMA Wash-Rack AOPI are unlikely to be the result of any potential PFOS, PFOA, and/or PFBS that may be part of the HDX cup's composition.

- Source Blank Sample

  FCR-FTIR-02: The subcontractor secured to purge each existing groundwater monitoring well and facilitate collection of the groundwater samples brought its own source of water for decontamination activities. The subcontractor's decontamination water reservoir on its groundwater sampling truck had been filled with deionized water at its office location prior to mobilizing to FTIR. Since the contractor did not use FTIR's drinking water to decontaminate equipment used during groundwater sampling, a second source blank sample (FTIR-SB-01-042921) was collected for analysis.

- FCR-FTIR-04

  In some of the AOPI references to the Parking Lot South of Building P861 AOPI in Worksheets #18 and #20, and on Figures 3 and 17 of the QAPP Addendum, the building number was inadvertently transposed to "P681" (Arcadis 2021a). The sample IDs for the four soil samples collected in the Parking Lot South of Building P861 AOPI were corrected in the field.

- DEB Samples

  FCR-FTIR-06: At the FTIR-01 Sanitary Landfill AOPI, an extra, unplanned DEB sample (FTIR-FTIR01-DEB-01-042721) was collected from the dedicated down-hole equipment in groundwater monitoring well MW-10 on 27 April 2021 and was given a similar ID as the planned DEB sample (FTIR-FTIR01-DEB-01-042621) collected from the dedicated down-hole equipment in groundwater monitoring well MW-2 on 26 April 2021. However, the two DEB samples are distinguishable from each other because they were collected on different days.

  An extra, unplanned DEB sample (FTIR-BLA-DEB-01-042921) was collected from groundwater purged from U.S. Geological Survey (USGS) monitoring well W-3 (the DEB sample was not collected prior to purging the well). This well was sampled as part of the SI for the BLAAF – Helipad AOPI. Well W-3 does not contain dedicated down-hole equipment. Therefore, this DEB sample is effectively a duplicate sample (FTIR-BLA-DEB-01-042921 is not included in **Table 7-1** as a duplicate sample).

- FCR-FTIR-07

  One of the three borings from which a soil sample was planned to be collected at 13 to 15 feet bgs in the RUFMA Drainage Basins AOPI encountered refusal at 14 feet. Therefore, the associated soil sample (FTIR-RUFMADB-01-14-SO-050421) was collected at an interval of 12 to 14 feet bgs.

- FCR-FTIR-08

  A sediment sample (FTIR-RUFMAWR-01-SE-050421) and field duplicate sample (FTIR-RUFMA-FD-01-SE-050421 / FTIR-RUFMAWR-01-SE-050421) were collected from the RUFMA Wash-Rack AOPI

trench drain/basin. When the SI field team collected the sediment sample and field duplicate from the RUFMA Wash-Rack AOPI trench drain/basin, the team did not decant them prior to bottling the samples for laboratory analysis, and then marked the sample matrix for these two sediment samples on the chain of custody as both “aqueous” and “solid.” The laboratory inadvertently analyzed the supernatant (liquid) portion of the samples rather than the solids as intended. As a result, the analytical results for the supernatant portion of the sediment sample are reported in ng/L. As the primary objective of the SI is to determine presence/absence of PFOS, PFOA, and/or PFBS, the analytical results are sufficient to confirm their presence in the RUFMA Wash-Rack AOPI sediment sample and duplicate field sample.

6.3.5 Decontamination

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

6.3.6 Investigation-Derived Waste

Liquid IDW, including groundwater and decontamination fluids, were placed in two Department of Transportation-approved 55-gallon drums, labeled as non-hazardous, and transported to Building 606, outside of which the drums were staged pending analysis and pickup for off-post disposal. The Waste Manifest is included as **Appendix P**. (Note that the manifest includes one drum of liquid IDW generated at the FTIR-Leased Property at Barstow-Daggett Airport which is addressed in a separate PA/SI report.) Soil IDW, including soil cuttings and excess sediment, were disposed on the ground at the point of collection per instructions from FTIR. Equipment IDW includes personal protective equipment and other disposable materials (e.g., gloves, plastic sheeting, and high-density polyethylene and silicon tubing) that may come in contact with sampling media. Analytical results for IDW samples collected during the SI are discussed in **Section 7.25**.

6.4 Data Analysis

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

6.4.1 Laboratory Analytical Methods

Analytical samples collected during the SI were submitted to Pace South Carolina (formerly Shealy Environmental Services, Inc.), an ELAP-accredited laboratory for PFAS analysis, including PFOS, PFOA, and PFBS, by liquid chromatography with tandem mass spectrometry. Laboratory analyses associated with the SI were completed in accordance with Worksheets #12.1 through #12.5 in the PQAPP (Arcadis 2019). Eighteen PFAS-related compounds, including PFOS, PFOA, and PFBS, were analyzed for in

groundwater, soil, and sediment samples using an analytical method that is ELAP-accredited and compliant with QSM 5.3 (DoD and Department of Energy 2019), Table B-15.

Additionally, the following general chemistry and physical characteristic analyses were completed for select soil and sediment samples in accordance with Worksheet #18 of the QAPP Addendum (Arcadis 2021a) by the analytical method noted:

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

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

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

6.4.2 Data Validation

All analytical data generated during the SI, except grain size and data generated from IDW profiling, were verified and validated in accordance with the data verification procedures described in Worksheets #34 through #36 of the PQAPP (Arcadis 2019). Each laboratory data package/sample delivery group underwent Stage 3 data validation in accordance with DoD General Data Validation Guidelines (November 2019) and DoD Final Data Validation Guidelines Module 3: PFAS (May 2020). Additionally, 10% of the data underwent Stage 4 data validation. Copies of the data validation reports for each sample delivery group are included as attachments to the DUSR in **Appendix N**. The Level IV analytical reports are included within **Appendix N** in the final electronic deliverable only.

6.4.3 Data Usability Assessment and Summary

The data for the 2021 sampling event was reviewed in terms of precision, accuracy, completeness, representativeness, comparability, and sensitivity. A statement of overall data usability is included in the DUSR (**Appendix N**). The associated data validation reports are in an appendix to the DUSR.

Based on the final data usability assessment, the environmental data collected from all but one AOPI at FTIR during the SI were found to be acceptable and usable for this SI evaluation with the qualifications documented in the DUSR and its associated data validation reports (**Appendix N**), and as indicated in

the full analytical tables (**Appendix O**) provided for the SI results.[5] These data are of sufficient quality to meet the objectives and requirements of the PQAPP (Arcadis 2019) and FTIR QAPP Addendum (Arcadis 2021a). Data qualifiers applied to laboratory analytical results for samples collected during the SI at FTIR are provided in the data tables, data validation reports, and the Data Usability Summary Table located at the in the DUSR. Qualifiers for data shown on figures are defined in the notes of figures.

6.5 Office of the Secretary of Defense Risk Screening Levels

The OSD risk screening levels for PFOS, PFOA, and PFBS in groundwater (tap water) and soil were calculated using the USEPA's RSL calculator for residential and industrial/commercial worker receptor scenarios and current toxicity values. These risk screening levels are shown in **Table 6-2**.

Table 6-2 OSD Risk Screening Levels Calculated for PFOS, PFOA, and PFBS in Tap Water and Soil Using USEPA's Regional Screening Level Calculator

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

Notes:
1. Risk screening levels for tap water and soil provided by the OSD. 2021. Memorandum: Investigating Per- and Polyfluoroalkyl Substances within the Department of Defense Cleanup Program. September 15 (**Appendix A**). The risk screening levels for PFBS in tap water and soil were updated in April 2021 based on the updated toxicity values published by the USEPA (USEPA 2021).
2. All soil and/or sediment data (except for the sediment sample collected from the RUFMA Wash-Rack AOPI) will be screened against both the Residential Scenario and Industrial/Commercial risk screening levels (if collected from less than 2 feet bgs), regardless of the current and projected land use of the AOPI. Soil samples collected from greater than 2 feet but less than 15 feet bgs will be compared to the industrial/commercial risk screening levels only.
mg/kg = milligram per kilogram
ng/L = nanograms per liter
ppm = parts per million
ppt = parts per trillion

The OSD residential tap water risk screening levels will be used to compare all groundwater for this Army PFAS PA/SI. While the current and most likely future land uses of the AOPIs at FTIR are

[5] The analytical quantitative results for the sediment sample and duplicate sample collected from the RUFMA Wash-Rack AOPI were rejected.

industrial/commercial, both residential and industrial/commercial soil risk screening levels for PFOS, PFOA, and PFBS will be used to evaluate detected soil and/or sediment (if sediment comparisons are appropriate e.g., if the sediment was collected from a dry streambed or a drainage way) concentrations. The data from the SI sampling event are compared to the OSD risk screening levels in **Section 7**. If concentrations of PFOS, PFOA, or PFBS are detected greater than the applicable OSD risk screening levels, then further study in a remedial investigation is recommended in **Section 8**.

7 SUMMARY AND DISCUSSION OF SI RESULTS

This section summarizes the analytical results obtained from samples collected during the SI at FTIR (field duplicate results are provided in the associated tables). Sampled media and QA/QC samples were analyzed for the constituents prescribed per Worksheet #18 of the QAPP Addendum (Arcadis 2021a). The sample results discussion below focuses on the PFOS, PFOA, and PFBS analytical results because they have OSD risk screening levels. The Army will make subsequent investigation decisions based on these constituents' concentrations relative to the OSD risk screening levels.

Tables 7-1 through **7-3** provide a summary of the groundwater, soil, and sediment analytical results for PFOS, PFOA, and PFBS. **Table 7-4** summarizes AOPIs and whether their SI results exceed the OSD risk screening levels. **Appendix O** includes the full suite of analytical results for these media, as well as for the QA/QC samples. An overview of AOPIs at FTIR with OSD risk screening level exceedances is depicted on **Figure 7-1**. **Figures 7-2** through **7-17a and b** show the PFOS, PFOA, and PFBS analytical results in groundwater, soil, and sediment for each AOPI. Non-detected results are reported as less than the LOQ. Detections of PFOS, PFOA, and/or PFBS greater than the applicable OSD risk screening levels are highlighted in summary tables and on figures. Final qualifiers applied to the data by the laboratory and the project chemist (as defined in **Section 6.4.3**) are presented on the analytical tables. Groundwater data collected during the SI are reported in ng/L, or parts per trillion, and soil and sediment data are reported in mg/kg, or parts per million.[6]

Field parameters measured for groundwater during low-flow purging and sample collection are provided on the field forms in **Appendix K**. Soil and sediment descriptions are provided on the field forms in **Appendix K**. The results of the SI are grouped by AOPI and discussed for each medium as applicable. Groundwater was generally first encountered at depths of approximately 101 to 132.3 feet bgs in the cantonment, 65.4 to 108.2 feet bgs at the Sanitary Landfill (FTIR-01), and 194 feet bgs at BLAAF.

Table 7-4 AOPIs and OSD Risk Screening Level Exceedances

AOPI Name	OSD Exceedances (Yes/No)
Active Recreational Ball Fields	No
AFFF Storage Shed (Building 358)	Yes
Area North of I Avenue Near Building P817	No
Bulk POL Containment Basins	No
Bulk POL Tanker Fire Response	Yes
DES Training Area	Yes
Fire Hose Pressure-Testing Area	No

[6] The laboratory inadvertently analyzed the supernatant (liquid) portion of the sediment sample and the duplicate sediment sample collected from the RUFMA Wash-Rack AOPI trench drain/basin. As a result, the analytical results for the supernatant portion of the sediment sample are reported in ng/L. The analytical quantitative results for the RUFMA Wash-Rack AOPI sediment sample and duplicate sample subsequently were rejected.

AOPI Name	OSD Exceedances (Yes/No)
Fire Station 1 (Building P400) and Former AFFF Storage (Building P411)	Yes
Fire Station 2 (Building P6101)	No
Former Fire Station	No
Land Farm Drying Pits	No
FTIR-01 Sanitary Landfill	Yes
FTIR Helipad	No
Parking Lot South of Building P861	No
RUFMA Drainage Basins	No
RUFMA Former Fire Training Area	No
RUFMA Wash-Rack	N/A
BLAAF - Fire Extinguisher Training Area	No
BLAAF - Helipad	No
FTIR-20 Former Fire Training Area	Yes
J Stand Fire Truck Pump Flush Area	No
FOB Miami	No
NASA Goldstone Former Microwave Test Facility	No

Note:
N/A = Not applicable (The analytical quantitative results for the sediment sample and duplicate sample collected from the RUFMA Wash-Rack AOPI were rejected.)

7.1 Active Recreational Ball Fields

The subsection below summarizes the soil PFOS, PFOA, and PFBS analytical results associated with the Active Recreational Ball Fields AOPI. The sampling locations and analytical results are presented on **Figure 7-2**. The soil analytical results are presented in **Table 7-2.**

7.1.1 Soil

Six soil samples (FTIR-BALL-01-SO-050121, FTIR-BALL-02-SO-050121, FTIR-BALL-03-SO-050121, FTIR-BALL-04-SO-050121, FTIR-BALL-05-SO-050121, and FTIR-BALL-06-SO-050121), three from each ballfield, and one duplicate sample (FTIR-FD-01-SO-050121 / FTIR-BALL-04-SO-050121) were collected from native soil via hand auger at an interval of 0 to 2 feet bgs.

- PFOS was detected in four of the six soil samples and the duplicate sample at concentrations ranging from 0.00056 J (J indicates the analyte was positively identified; however, the associated numerical value is an estimated concentration only) mg/kg (FTIR-BALL-02-SO-050121) to 0.025 mg/kg (FTIR-BALL-06-SO-050121). The detected concentrations do not exceed the OSD residential risk screening level (0.13 mg/kg) or the industrial/commercial risk screening level (1.6 mg/kg).

- PFOA was not detected in any of the six soil samples or the duplicate soil sample.
- PFBS was not detected in any of the six soil samples or the duplicate soil sample.

7.2 AFFF Storage Shed (Building P358)

The subsection below summarizes the soil PFOS, PFOA, and PFBS analytical results associated with the AFFF Storage Shed (Building P358) AOPI. The sampling location and analytical results are presented on **Figure 7-3**. The soil analytical results are presented in **Table 7-2**.

7.2.1 Soil

One soil sample (FTIR-AFFF-01-SO-050221) was collected from native soil via hand auger at an interval of 0 to 2 feet bgs.

- PFOS was detected at concentration of 1.4 J mg/kg. The detected concentration exceeds the OSD residential risk screening level (0.13 mg/kg) but not the industrial/commercial risk screening level (1.6 mg/kg).
- PFOA was detected at a concentration of 0.036 mg/kg. The detected concentration does not exceed the OSD residential risk screening level (0.13 mg/kg) or the industrial/commercial risk screening level (1.6 mg/kg).
- PFBS was detected at a concentration of 0.00084 J mg/kg. The detected concentration does not exceed the OSD residential risk screening level (1.9 mg/kg) or the industrial/commercial risk screening level (25 mg/kg).

7.3 Area North of I Avenue Near Building P817

The subsection below summarizes the groundwater PFOS, PFOA, and PFBS analytical results associated with the Area North of I Ave. Near Building 817 AOPI. The sampling location and analytical results are presented on **Figure 7-4**. The groundwater analytical results are presented in **Table 7-1**.

Production well I-10 (not used for drinking water), located near and cross-gradient of the AOPI, was part of the sampling approach, but was found to be out of service or abandoned and capped during the SI and could not be sampled.

7.3.1 Groundwater

One grab groundwater sample (FTIR-STP17A-042821) was collected from an existing monitoring well (STP-17A) located west-northwest and downgradient of the AOPI following low-flow purging with a portable bladder pump. The depth to static groundwater was 132.3 feet below top of casing (btoc).

- PFOS was not detected in the groundwater sample.
- PFOA was not detected in the groundwater sample.
- PFBS was detected at a concentration of 6.0 ng/L. The detected concentration does not exceed the OSD tap water risk screening level (600 ng/L).

7.4 Bulk POL Containment Basins

The subsection below summarizes the soil PFOS, PFOA, and PFBS analytical results associated with the Bulk POL Containment Basins AOPI. The sampling locations and analytical results are presented on **Figure 7-5**. The soil analytical results are presented in **Table 7-2**.

7.4.1 Soil

Five soil samples (FTIR-POL-FTA-01-SO-042921, FTIR-POL-FTA-02-SO-042921, FTIR-POL-FTA-03-SO-042921, FTIR-POL-FTA-04-SO-042921, and FTIR-POL-FTA-05-SO-042921) were collected from native soil via hand auger at an interval of 0 to 2 feet bgs.

- PFOS was detected two of the five soil samples at concentrations of 0.025 mg/kg (FTIR-POL-FTA-01-SO-042921) and 0.0051 mg/kg (FTIR-POL-FTA-02-SO-042921). The detected concentrations do not exceed the OSD residential risk screening level (0.13 mg/kg) or the industrial/commercial risk screening level (1.6 mg/kg).
- PFOA was not detected in any of the five soil samples.
- PFBS was detected in one of the soil samples at a concentration of 0.00063 J mg/kg (FTIR-POL-FTA-04-SO-042921). The detected concentration does not exceed the OSD residential risk screening level (1.9 mg/kg) or the OSD industrial/commercial risk screening level (25 mg/kg).

7.5 Bulk POL Tanker Fire Response

The subsection below summarizes the soil PFOS, PFOA, and PFBS analytical results associated with the Bulk POL Tanker Fire Response AOPI. The sampling locations and analytical results are presented on **Figure 7-5**. The soil analytical results are presented in **Table 7-2**.

7.5.1 Soil

Four soil samples (FTIR-POLFIRE-01-SO-042921, FTIR-POLFIRE-02-SO-042921, FTIR-POLFIRE-03-SO-042921, and FTIR-POLFIRE-04-SO-042921) were collected from native soil via hand auger at an interval of 0 to 2 feet bgs.

- PFOS was detected in all four soil samples at concentrations ranging from 0.0036 mg/kg (FTIR-POLFIRE-04-SO-042921) to 1.7 J mg/kg (FTIR-POLFIRE-01-SO-042921). The detected concentration in one of the four soil samples (FTIR-POLFIRE-01-SO-042921) exceeds the OSD residential risk screening level (0.13 mg/kg) and the industrial/commercial risk screening level (1.6 mg/kg).
- PFOA was detected three of the four soil samples at concentrations ranging from 0.00082 J mg/kg (FTIR-POLFIRE-03-SO-042921) to 0.0021 (FTIR-POLFIRE-01-SO-042921). The detected concentrations do not exceed the OSD residential risk screening level (0.13 mg/kg) or the industrial/commercial risk screening level (1.6 mg/kg).
- PFBS was not detected in any of the four soil samples.

7.6 DES Training Complex

The subsections below summarize the groundwater and soil PFOS, PFOA, and PFBS analytical results associated with the DES Training Complex AOPI. The sampling locations and analytical results are presented on **Figure 7-6**. The groundwater and soil analytical results are presented in **Tables 7-1** and **7-2**, respectively.

7.6.1 Groundwater

One grab groundwater sample (FTIR-IX1-042821) was collected from an existing monitoring well (IX-1) located west-northwest (cross-/downgradient) of the DES Training Complex AOPI following low-flow purging with a portable bladder pump. The depth to static water was 102.72 feet btoc.

- PFOS was detected in the groundwater sample at a concentration of 6.2 ng/L. The detected concentration does not exceed the OSD tap water risk screening level (40 ng/L).
- PFOA was detected in the groundwater sample at a concentration of 6.0 ng/L. The detected concentration does not exceed the OSD tap water risk screening level (40 ng/L).
- PFBS was not detected in the groundwater sample.

7.6.2 Soil

Seven soil samples (FTIR-DES-01-SO-050521, FTIR-DES-02-SO-050521, FTIR-DES-03-SO-050521, FTIR-DES-04-SO-050521, FTIR-DES-05-SO-050521, FTIR-DES-06-SO-050521, and FTIR-DES-07-SO-050521) were collected from native soil via hand auger at an interval of 0 to 2 feet bgs. The first five samples were collected from within or adjacent to the fire training pit, and the latter two samples were collected adjacent to the Conex box in which empty AFFF containers were observed during the PA site visit.

- PFOS was detected in five of the seven soil samples at concentrations ranging from 0.017 mg/kg (FTIR-DES-01-SO-050521) to 0.23 J mg/kg (FTIR-DES-04-SO-050521). The detected concentration in one of the seven soil samples (FTIR-DES-04-SO-050521) exceeds the OSD residential risk screening level (0.13 mg/kg) but not the industrial/commercial risk screening level (1.6 mg/kg).
- PFOA was detected in five of the seven soil samples at concentrations ranging from 0.0041 mg/kg (FTIR-DES-05-SO-050521) to 0.021 mg/kg (FTIR-DES-02-SO-050521). The detected concentrations do not exceed the OSD residential risk screening level (0.13 mg/kg). The detected concentrations do not exceed the OSD industrial/commercial risk screening level (1.6 mg/kg).
- PFBS was not detected in any of the seven soil samples.

7.7 Fire Hose Pressure-Testing Area

The subsection below summarizes the soil PFOS, PFOA, and PFBS analytical results associated with the Fire Hose Pressure-Testing Area AOPI. The sampling locations and analytical results are presented on **Figure 7-7**. The soil analytical results are presented in **Table 7-2.**

7.7.1 Soil

One soil sample (FTIR-HOSE-01-SO-043021) was collected from native soil via hand auger at an interval of 0 to 2 feet bgs.

- PFOS was detected in the soil sample at a concentration of 0.057 mg/kg. The detected concentration does not exceed the OSD residential risk screening level (0.13 mg/kg) or the industrial/commercial risk screening level (1.6 mg/kg).
- PFOA was detected in the soil sample at a concentration of 0.036 mg/kg. The detected concentration does not exceed the OSD residential risk screening level (0.13 mg/kg) or the industrial/commercial risk screening level (1.6 mg/kg).
- PFBS was not detected in the soil sample.

7.8 Fire Station 1 (Building P400) and Former AFFF Storage (Building P411)

The subsection below summarizes the soil PFOS, PFOA, and PFBS analytical results associated with the Fire Station 1 (Building P400) and Former AFFF Storage (Building P411) AOPI. The sampling locations and analytical results are presented on **Figure 7-8**. The soil analytical results are presented in **Table 7-2**.

7.8.1 Soil

Five soil samples (FTIR-FS1-01-SO-043021, FTIR-FS1-02-SO-043021, FTIR-FS1-03-SO-043021, FTIR-FS1-04-SO-043021, and FTIR-FS1-05-SO-043021) were collected from native soil via hand auger at an interval of 0 to 2 feet bgs.

- PFOS was detected in all five soil samples at concentrations ranging from 0.066 mg/kg (FTIR-FS1-05-SO-043021) to 1.2 J mg/kg (FTIR-FS1-02-SO-043021). Two of the five detected concentrations (FTIR-FS1-02-SO-043021 and FTIR-FS1-03-SO-043021) exceed the OSD residential risk screening level (0.13 mg/kg), but not the industrial/commercial risk screening level (1.6 mg/kg).
- PFOA was detected in all five soil samples at concentrations ranging from 0.0027 mg/kg (FTIR-FS1-05-SO-043021) to 0.15 mg/kg (FTIR-FS1-03-SO-043021). One of the five detected concentrations (FTIR-FS1-03-SO-043021) exceeds the OSD residential risk screening level (0.13 mg/kg) but not the industrial/commercial risk screening level (1.6 mg/kg).
- PFBS was detected in three of the five soil samples at concentrations ranging from 0.00075 J mg/kg (FTIR-FS1-02-SO-043021) to 0.021 mg/kg (FTIR-FS1-03-SO-043021). None of the detected concentrations exceed the OSD residential risk screening level (0.13 mg/kg) or the industrial/commercial risk screening level (1.6 mg/kg).

7.9 Fire Station 2 (Building P6101)

The subsections below summarize the soil PFOS, PFOA, and PFBS analytical results associated with Fire Station 2 (Building P6101) AOPI. The sampling locations and analytical results are presented on **Figure 7-9**. The soil analytical results are presented in **Table 7-2.**

7.9.1 Soil

Six soil samples (FTIR-FS2-01-SO-050521, FTIR-FS2-02-SO-050521, FTIR-FS2-03-SO-050521, FTIR-FS2-04-SO-050521, FTIR-FS2-05-SO-050521, and FTIR-FS2-06-SO-050521) were collected native soil via hand auger at an interval of 0 to 2 feet bgs.

- PFOS was detected five of the six soil samples at concentrations ranging from 0.00058 mg/kg (FTIR-FS2-01-SO-050521) to 0.032 mg/kg (FTIR-FS2-04-SO-050521). The detected concentrations do not exceed the OSD residential risk screening level (0.13 mg/kg) or the industrial/commercial risk screening level (1.6 mg/kg).
- PFOA was detected five of the six soil samples at concentrations ranging from 0.00075 J mg/kg (FTIR-FS2-02-SO-050521) to 0.016 mg/kg (FTIR-FS2-04-SO-050521). The detected concentrations do not exceed the OSD residential risk screening level (0.13 mg/kg) or the industrial/commercial risk screening level (1.6 mg/kg).
- PFBS was not detected in any of the six soil samples.

7.10 Former Fire Station

The subsection below summarizes the soil PFOS, PFOA, and PFBS analytical results associated with the Former Fire Station. The sampling locations and analytical results are presented on **Figure 7-3**. The soil analytical results are presented in **Table 7-2**.

7.10.1 Soil

Five soil samples (FTIR-FFS-01-SO-050221, FTIR-FFS-02-SO-050221, FTIR-FFS-03-SO-050221, FTIR-FFS-04-SO-052521, and FTIR-FFS-05-SO-050221) and one duplicate soil sample (FTIR-FD-02-SO-050221 / FTIR-FFS-05-SO-050221) were collected from native soil via hand auger at an interval of 0 to 2 feet bgs.

- PFOS was detected in all five soil samples and the duplicate sample at concentrations ranging from 0.01 mg/kg (FTIR-FFS-05-SO-050221) to 0.070 mg/kg (FTIR-FFS-02-SO-050221). The detected concentrations do not exceed the OSD residential risk screening level (0.13 mg/kg) or the industrial/commercial risk screening level (1.6 mg/kg).
- PFOA was detected in all five soil samples and the duplicate sample at concentrations ranging from 0.00055 J mg/kg (FTIR-FFS-02-SO-050221) to 0.0040 mg/kg (FTIR-FD-02-SO-050221 / FTIR-FFS-05-SO-050221). The detected concentrations do not exceed the OSD residential risk screening level (0.13 mg/kg) or the industrial/commercial risk screening level (1.6 mg/kg).
- PFBS was detected in one of the five soil samples at a concentration of 0.00054 J mg/kg (FTIR-FFS-01-SO-050221). The detected concentration does not exceed the OSD residential risk screening level (1.9 mg/kg) or the OSD industrial/commercial risk screening level (25 mg/kg).

7.11 Land Farm Drying Pits

The subsection below summarizes the groundwater PFOS, PFOA, and PFBS analytical results associated with the Land Farm Drying Pits AOPI. The sampling locations and analytical results are presented in **Figure 7-10**. The groundwater analytical results are presented in **Table 7-1**.

7.11.1 Groundwater

One groundwater sample (FTIR-RI8-042721) was collected from an existing monitoring well (RI-8), located adjacent to, and downgradient of, the Land Farm Drying Pits AOPI, following low-flow purging with a portable bladder pump. The depth to static water was 81.66 feet btoc.

- PFOS was not detected in the groundwater sample.
- PFOA was not detected in the groundwater sample.
- PFBS was not detected in the groundwater sample.

7.12 FTIR-01 Sanitary Landfill

The subsection below summarizes the groundwater PFOS, PFOA, and PFBS analytical results associated with the FTIR-01 Sanitary Landfill AOPI. The sampling locations and analytical results are presented on **Figure 7-10**. The groundwater analytical results are presented in **Table 7-1**.

7.12.1 Groundwater

Seven groundwater samples (FTIR-RI5-042621, FTIR-RI12-042621, FTIR-MW2-042621, FTIR-MW4-042721, FTIR- MW5-042721, FTIR-MW9-042721, and FTIR-MW10-042721) and one duplicate sample (FTIR-FD-01-GW-042621 / FTIR-RI12-042621) were collected from seven existing monitoring wells at the FTIR-01 Sanitary Landfill AOPI following low-flow purging with a portable bladder pump. The depth to static water ranged from 65.38 (FTIR-MW9-042721) to 108.17 feet btoc (FTIR-RI12-042621).

- PFOS was detected in four of the seven groundwater samples at concentrations ranging from 10 ng/L (FTIR-MW4-042721) to 78 ng/L (FTIR-MW5-042721). Three of the four detected concentrations (FTIR-MW5-042721, FTIR-MW9-042721, and FTIR-MW10-042721) exceed the OSD tap water risk screening level (40 ng/L).
- PFOA was detected in six of the seven groundwater samples at concentrations ranging from 2.0 J ng/L (FTIR-MW2-042621) to 43 ng/L (FTIR-MW5-042721). One of the detected concentrations (FTIR-MW5-042721) exceeds the OSD tap water risk screening level (40 ng/L).
- PFBS was detected in three of the seven groundwater samples at concentrations ranging from 3.6 ng/L (FTIR-MW9-042721) to 9.7 ng/L (FTIR-MW10-042721). The detected concentrations do not exceed the OSD tap water risk screening level (600 ng/L).

7.13 FTIR Helipad

The subsection below summarizes the soil PFOS, PFOA, and PFBS analytical results associated with the FTIR Helipad AOPI. The sampling locations and analytical results are presented on **Figure 7-11**. The soil analytical results are presented in **Table 7-2.**

7.13.1 Soil

Four soil samples (FTIR-HELO-01-SO-050121, FTIR-HELO-02-SO-050121, FTIR-HELO-03-SO-050121, and FTIR-HELO-04-SO-050121) were collected from native soil via hand auger at an interval of 0 to 2 feet bgs.

- PFOS was detected in all four soil samples at concentrations ranging from 0.0026 mg/kg (FTIR-HELO-01-SO-050121) to 0.039 mg/kg (FTIR-HELO-04-SO-050121). The detected concentrations do not exceed the OSD residential risk screening level (0.13 mg/kg) or the industrial/commercial risk screening level (1.6 mg/kg).
- PFOA was detected in two of the four soil samples at concentrations of 0.00053 J mg/kg (FTIR-HELO-02-SO-050121) to 0.00088 J mg/kg (FTIR-HELO-04-SO-050121). The detected concentrations do not exceed the OSD residential risk screening level (0.13 mg/kg) or the industrial/commercial risk screening level (1.6 mg/kg).
- PFBS was not detected in any of the four soil samples.

7.14 Parking Lot South of Building P861

The subsection below summarizes the soil PFOS, PFOA, and PFBS analytical results associated with the Area North of I Avenue Near Building P861 AOPI. The sampling locations and analytical results are presented on **Figure 7-12**. The soil analytical results are presented in **Table 7-2**.

7.14.1 Soil

Four soil samples (FTIR-P861-01-SO-043021, FTIR-P861-02-SO-043021, FTIR-P861-03-SO-043021, and FTIR-P861-04-SO-043021) were collected from native soil via hand auger at an interval of 0 to 2 feet bgs.

- PFOS was not detected in any of the four soil samples.
- PFOA was not detected in any of the four soil samples.
- PFBS was not detected in any of the four soil samples.

7.15 RUFMA Drainage Basins

The subsection below summarizes the soil PFOS, PFOA, and PFBS analytical results associated with the RUFMA Drainage Basins AOPI. The sampling locations and analytical results are presented on **Figure 7-13**. The soil analytical results are presented in **Table 7-2**.

7.15.1 Soil

One soil sample (FTIR-RUFMADB-01-14-SO-050421) was collected from native soil in a boring via hand auger at an interval of 13 to 14 feet bgs, and two soil samples (FTIR-RUFMADB-02-15-SO-050421 and FTIR-RUFMADB-03-15-SO-050421) were collected from native soil in two borings via a DPT rig drill rod at an interval of 13 to 15 feet bgs. These three soil samples were collected at a deeper depth in an effort to lessen the potential influence of periodic maintenance performed at the drainage basins.

- PFOS was detected in one of the three soil samples (FTIR-RUFMADB-01-15-SO-050421) at a concentration of 0.0019 mg/kg. The detected concentration does not exceed the OSD industrial/commercial risk screening level (1.6 mg/kg).
- PFOA was detected in one of the three soil samples (FTIR-RUFMADB-01-15-SO-050421) at a concentration of 0.0014 mg/kg. The detected concentration does not exceed the OSD industrial/commercial risk screening level (1.6 mg/kg).
- PFBS was not detected in any of the three soil samples.

7.16 RUFMA Former Fire Training Area

The subsections below summarize the groundwater and soil PFOS, PFOA, and PFBS analytical results associated with the RUFMA Former Fire Training Area AOPI. The sampling locations and analytical results are presented on **Figure 7-13**. The groundwater and soil analytical results are presented in **Tables 7-1** and **7-2**, respectively.

7.16.1 Groundwater

One groundwater sample (FTIR-STP16A-042821) was collected from an existing monitoring well (STP-16A) following low-flow purging with a bladder pump. The depth to static water was 101.00 feet btoc.

- PFOS was not detected in the groundwater sample.
- PFOA was not detected in the groundwater sample.
- PFBS was not detected in the groundwater sample.

7.16.2 Soil

Four soil samples (FTIR-RUFMA-01-SO-050121, FTIR-RUFMA-02-SO-050121, FTIR-RUFMA-03-SO-050121, and FTIR-RUFMA-04-SO-050121) were collected from native soil via hand auger at an interval of 0 to 2 feet bgs.

- PFOS was detected in two of the four soil samples at concentrations of 0.00092 J mg/kg (FTIR-RUFMA-04-SO-050121) to 0.0031 mg/kg (FTIR-RUFMA-02-SO-050121). The detected concentrations do not exceed the OSD residential risk screening level (0.13 mg/kg) or the industrial/commercial risk screening level (1.6 mg/kg).

- PFOA was detected in one of the four soil samples at a concentration of 0.00067 J mg/kg (FTIR-RUFMA-04-SO-050121). The detected concentration does not exceed the OSD residential risk screening level (0.13 mg/kg) or the industrial/commercial risk screening level (1.6 mg/kg).
- PFBS was not detected in any of the four soil samples.

7.17 RUFMA Wash-Rack

The subsection below summarizes the sediment PFOS, PFOA, and PFBS analytical results associated with the RUFMA Wash-Rack AOPI. The sampling location and analytical results are presented on **Figure 7-13**. The sediment analytical results are presented in **Table 7-3.**

7.17.1 Sediment

One sediment sample and a duplicate sample were collected from the 1- to 2-inch-thick (2.5 to 5.0 centimeters) layer of sediment in the 8-feet deep trench drain/basin via a reusable, decontaminated, small plastic cup attached to a sampling pole. The samples were not decanted prior to placing the saturated sediment in the laboratory bottles. The laboratory inadvertently analyzed the supernatant (liquid) portion of the sediment sample and the duplicate sediment sample, and the analytical results for the supernatant portion of the sediment samples were reported in ng/L (see FCR-FTIR-08 summarized in **Section 6.3.4** and provided in Appendix M for more information).

As a result, the sample results (including non-detects) were affected by serious deficiencies in the ability to analyze the sample and meet published method and project quality control criteria. The presence or absence of the analyte cannot be substantiated by the data provided. Rejection of the data was decided by the project team and the USACE chemist.

7.18 BLAAF – Fire Extinguisher Training Area

The subsection below summarizes the soil PFOS, PFOA, and PFBS analytical results associated with the BLAAF – Fire Extinguisher Training Area AOPI. The sampling locations and analytical results are presented on **Figure 7-14**. The soil analytical results are presented in **Table 7-2.**

7.18.1 Groundwater

A groundwater sample was not collected within the AOPI limits. However, two grab groundwater samples (FTIR-BLA5-3-042921 and FTIR-W3-042921) were collected from existing monitoring wells BLA 5-3 (located approximately 0.6 mile downgradient) and W-3 (located approximately 265 feet cross-/upgradient) as part of the SI approach for the adjacent BLAAF – Helipad AOPI (see **Section 7.19**). The groundwater samples collected from these two wells are considered surrogate groundwater samples for the BLAAF – Fire Extinguisher Training Area AOPI because the BLAAF – Fire Extinguisher Training Area and the BLAAF – Helipad AOPIs are adjacent to each other and there was no separate, existing well(s) that could be sampled. The groundwater PFOS, PFOA, and PFBS analytical results associated with these downgradient and cross-/upgradient surrogate groundwater sampling locations are presented below.

- PFOS was detected in one of the two groundwater samples (FTIR-BLA5-3-042921) at a concentration of 4.8 ng/L. The detected concentration does not exceed the OSD tap water risk screening level (40 ng/L).
- PFOA was not detected in either of the two groundwater samples.
- PFBS was not detected in either of the two groundwater samples.

7.18.2 Soil

Four soil samples (FTIR-BLAAF-EXT-01-SO-042921, FTIR-BLAAF-EXT-02-SO-042921, FTIR-BLAAF-EXT-03-SO-042921, and FTIR-BLAAF-EXT-04-SO-042921) were collected from the top 2 feet of native soil via hand auger at an interval of 0 to 2 feet bgs.

- PFOS was detected in all four soil samples at concentrations ranging from 0.0043 mg/kg (FTIR-BLAAF-EXT-02-SO-042921) to 0.012 mg/kg (FTIR-BLAAF-EXT-01-SO-042921). The detected concentrations do not exceed the OSD residential risk screening level (0.13 mg/kg) or the industrial/commercial risk screening level (1.6 mg/kg).
- PFOA was detected in all four soil samples at concentrations ranging from 0.0092 mg/kg (FTIR-BLAAF-EXT-04-SO-042921) to 0.016 mg/kg (FTIR-BLAAF-EXT-03-SO-042921). The detected concentrations do not exceed the OSD residential risk screening level (0.13 mg/kg) or the industrial/commercial risk screening level (1.6 mg/kg).
- PFBS was detected in one of the four soil samples at a concentration of 0.00055 J mg/kg (FTIR-BLAAF-EXT-04-SO-042921). The detected concentrations do not exceed the OSD residential risk screening level (1.9 mg/kg) or the industrial/commercial risk screening level (25 mg/kg).

7.19 BLAAF – Helipad

The subsections below summarize the groundwater and soil PFOS, PFOA, and PFBS analytical results associated with the BLAAF – Helipad AOPI. The sampling locations and analytical results are presented on **Figure 7-14**. The groundwater and soil analytical results are presented in **Tables 7-1** and **7-2**, respectively.

7.19.1 Groundwater

Two grab groundwater samples (FTIR-BLA5-3-042921 and FTIR-W3-042921) were collected from existing monitoring wells BLA 5-3 (approximately 0.54 mile downgradient) and W-3 (approximately 200 feet upgradient) following low-flow purging with a bladder pump. The static water depth was 194.7 and 194.15 feet btoc, respectively.

- PFOS was detected in one of the two groundwater samples at a concentration of 4.8 ng/L (FTIR-BLA5-3-042921). The detected concentration does not exceed the OSD tap water risk screening level (40 ng/L).
- PFOA was not detected in either of the two groundwater samples.
- PFBS was not detected in either of the two groundwater samples.

7.19.2 Soil

Four soil samples (FTIR-BLAAF-HELO-01-SO-042921, FTIR-BLAAF-HELO-02-SO-042921, FTIR-BLAAF-HELO-03-SO-042921, and FTIR-BLAAF-HELO-04-SO-042921) and one duplicate soil sample (FTIR-FD-03-SO-042921 / FTIR-BLAAF-HELO-01-SO-042921) were collected from native soil via hand auger at an interval of 0 to 2 feet bgs.

- PFOS was detected in all four soil samples and the duplicate sample at concentrations ranging from 0.0054 mg/kg (FTIR-BLAAF-HELO-01-SO-042921) to 0.012 mg/kg (FTIR-BLAAF-HELO-04-SO-042921). The detected concentrations do not exceed the OSD residential risk screening level (0.13 mg/kg) or the industrial/commercial risk screening level (1.6 mg/kg).
- PFOA was detected in three of the four soil samples and the duplicate sample at concentrations ranging from 0.0023 mg/kg (FTIR-FD-03-SO-042921 / FTIR-BLAAF-HELO-01-SO-042921) to 0.0045 mg/kg (BLAAF-HELO-03-SO-042921). The detected concentrations do not exceed the OSD residential risk screening level (0.13 mg/kg) or the industrial/commercial risk screening level (1.6 mg/kg).
- PFBS was not detected in any of the four soil samples or the duplicate sample.

7.20 FTIR-20 Former Fire Training Area

The subsection below summarizes the soil PFOS, PFOA, and PFBS analytical results associated with FTIR-20 Former Fire Training Area AOPI. The sampling locations and analytical results are presented on **Figure 7-15**. The soil analytical results are presented in **Table 7-2**.

7.20.1 Soil

A total of 16 soil samples were collected at FTIR-20 FTA. Five samples were collected from native soil at an interval of 0 to 2 feet bgs (FTIR-FTIR20-01-2-SO-050421, FTIR-FTIR20-02-2-SO-050421, FTIR-FTIR20-03-2-SO-050421, FTIR-FTIR20-04-2-SO-050421, and FTIR-FTIR20-05-2-SO-050421) via hand auger. Seven samples were collected at an interval of 3 to 5 feet bgs (FTIR-FTIR20-01-5-SO-050421, FTIR-FTIR20-02-5-SO-050421, FTIR-FTIR20-03-5-SO-050421, FTIR-FTIR20-04-5-SO-050421, FTIR-FTIR20-05-5-SO-050421, FTIR-FTIR20-06-5-SO-050421, and FTIR-FTIR20-07-5-SO-050421) via hand auger. Two samples were collected at an interval of 8 to 10 feet bgs (FTIR-FTIR20-06-10-SO-050421 and FTIR-FTIR20-07-10-SO-050421) and two samples were collected at an interval of 13 to 15 feet bgs (FTIR-FTIR20-06-15-SO-050421 and FTIR-FTIR20-07-15-SO-050421) via a DPT rig drill rod at two borings. These deeper samples were collected in an effort to account for the disturbance and redistribution of contaminated soil resulting from a known historical excavation and subsequent backfill using excavated material in the area.

- PFOS was detected in three of the five soil samples collected at 0 to 2 feet bgs at concentrations ranging from 0.0015 mg/kg (FTIR-FTIR20-01-2-SO-050421) to 0.44 J mg/kg (FTIR-FTIR20-04-2-SO-050421). The detected concentration in one of these soil samples (FTIR-FTIR20-04-2-SO-050421) exceeds the OSD residential risk screening level (0.13 mg/kg) but not the OSD industrial/commercial risk screening level (1.6 mg/kg).

PFOS was detected in 10 of the 12 soil samples collected at 3 to 5, 8 to 10, or 13 to 15 feet bgs at concentrations ranging from 0.0013 mg/kg (FTIR-FTIR20-03-5-SO-050421) to 0.40 mg/kg (FTIR-FTIR20-07-5-SO-050421). The detected concentrations do not exceed the OSD industrial/commercial risk screening level (1.6 mg/kg).

- PFOA was detected in three of the five soil samples collected at 0 to 2 feet bgs at concentrations ranging from 0.00094 J mg/kg (FTIR-FTIR20-04-2-SO-050421) to 0.0030 mg/kg (FTIR-FTIR20-03-2-SO-050421). The detected concentrations do not exceed the OSD residential risk screening level (0.13 mg/kg) or the industrial/commercial risk screening level (1.6 mg/kg).

  PFOA was detected in nine of the 12 soil samples collected at 3 to 5, 8 to 10, or 13 to 15 feet bgs at concentrations ranging from 0.00050 J mg/kg (FTIR-FTIR20-06-15-SO-050421) to 0.018 mg/kg (FTIR-FTIR20-05-5-SO-050421). The detected concentrations do not exceed the OSD industrial/commercial risk screening level (1.6 mg/kg).

- PFBS was not detected in any of the five soil samples collected at 0 to 2 feet bgs.

  PFBS was detected in five of the 12 soil samples collected at 3 to 5, 8 to 10, or 13 to 15 feet bgs at concentrations ranging from 0.0010 mg/kg (FTIR-FTIR20-05-5-SO-050421) to 0.0087 mg/kg (FTIR-FTIR20-07-5-SO-050421). The detected concentrations do not exceed the OSD industrial/commercial risk screening level (25 mg/kg).

7.21 J Stand Fire Truck Pump Flush Area

The subsection below summarizes the soil and sediment PFOS, PFOA, and PFBS analytical results associated with the J Stand Fire Truck Pump Flush Area AOPI. The sampling locations and analytical results are presented on **Figure 7-15**. The soil and sediment analytical results are presented in **Tables 7-2** and **7-3**, respectively.

7.21.1 Soil

Three soil samples (FTIR-JSTAND-01-SO-050221, FTIR-JSTAND-02-SO-050221, and FTIR-JSTAND-03-SO-050221) and one duplicate soil sample (FTIR-JSTAND-01-SO-050221 / FTIR-FD-04-SO-050221) were collected from native soil via hand auger at an interval of 0 to 2 feet bgs.

- PFOS was detected in two of the soil samples and the duplicate sample at concentrations ranging from 0.0099 mg/kg (FTIR-FD-04-SO-050221 / FTIR-JSTAND-01-SO-050221) to 0.020 mg/kg (FTIR-JSTAND-02-SO-050221). The detected concentrations do not exceed the OSD residential risk screening level (0.13 mg/kg) or the industrial/commercial risk screening level (1.6 mg/kg).
- PFOA was detected in all three soil samples and the duplicate sample at concentrations ranging from 0.00082 J mg/kg (FTIR-JSTAND-01-SO-050221) to 0.0071 mg/kg (FTIR-JSTAND-03-SO-050221). The detected concentrations do not exceed the OSD residential risk screening level (0.13 mg/kg) or the industrial/commercial risk screening level (1.6 mg/kg).
- PFBS was not detected in any of the three soil samples or the duplicate sample.

7.21.2 Sediment

One sediment sample (FTIR-JSTAND-01-SE-050221) was collected via hand auger at 0 to 3.9 inches (0 to 10 centimeters) from the surface water runoff drainage area downslope of the suspected residual AFFF release areas.

- PFOS was detected in the sediment sample at a concentration of 0.00079 J- mg/kg. The detected concentration does not exceed the OSD residential risk screening level (0.13 mg/kg) or the industrial/commercial risk screening level (1.6 mg/kg).
- PFOA was not detected in the sediment sample.
- PFBS was not detected in the sediment sample.

7.22 FOB Miami

The subsection below summarizes the soil PFOS, PFOA, and PFBS analytical results associated with the FOB Miami AOPI.[7] The sampling locations and analytical results are presented on **Figure 7-16**. The soil analytical results are presented in **Table 7-2**.

7.22.1 Soil

Four soil samples (FTIR-MIAMI-01-SO-050321, FTIR-MIAMI-02-SO-050321, FTIR-MIAMI-03-SO-050321, and FTIR-MIAMI-04-SO-050321) were collected from native soil via hand auger at an interval of 0 to 2 feet bgs.

- PFOS was not detected in any of the four soil samples.
- PFOA was not detected in any of the four soil samples.
- PFBS was not detected in any of the four soil samples.

7.23 NASA Goldstone Former Microwave Test Facility

The subsection below summarizes the soil PFOS, PFOA, and PFBS analytical results associated with the fire training area at the NASA Goldstone Former Microwave Test Facility AOPI. The sampling locations and analytical results are presented on **Figure 7-17a**. The soil analytical results are presented in **Table 7-2**.

7.23.1 Soil

Three soil samples (FTIR-GOLDSTONE-01-SO-050321, FTIR-GOLDSTONE-02-SO-050321, and FTIR-GOLDSTONE-03-SO-050321) and one duplicate sample (FTIR-FD-05-SO-050321 / FTIR-GOLDSTONE-03-SO-050321) were collected from native soil via hand auger at an interval of 0 to 2 feet bgs.

- PFOS was not detected in any of the three soil samples or the duplicate sample.

[7] A UXO technician accompanied the SI field team during sampling activities.

- PFOA was detected in one of the three soil samples and the duplicate sample at a concentration of 0.0065 mg/kg. The detected concentrations do not exceed the OSD residential risk screening level (0.13 mg/kg) or the industrial/commercial risk screening level (1.6 mg/kg).
- PFBS was not detected in any of the three soil samples or the duplicate sample.

A historical report (JPL 1988) acquired in March 2022 indicated that the fire training area at the Former Microwave Test Facility included an LPG AST and a flammable liquid pit. The presence of a flammable liquid pit indicates that AFFF was likely used to quench fires. While not to scale, the location of the LPG AST on a figure from this report depicting the Microwave Test Facility structures appears to be accurate based on historical satellite imagery. However, this figure also includes what appear to be symbols representing features or materials/props used in firefighter training activities. These symbols identify a flammable liquid pit; an LPG line, shut-off valve, and a burner and control valve; oil drums; vehicles; open shelving; wood scrap; and fire sprinklers. **Figure 7-17b** presents this 1988 figure with an overlay of the AOPI footprint and soil sampling locations (and soil analytical results). It is possible that the flammable liquid pit was located outside the boundary of the AOPI. Ground disturbance north of the Former Microwave Test Facility may indicate an area in which these features were located, but a definitive location could not be confirmed from review of historical satellite imagery.

7.24 Dedicated Equipment Background Samples

A total of five DEBs were collected, including two from the same AOPI (FTIR-01 Sanitary Landfill).[8,9] Four of the five parent sample and DEB pairs had detections for PFOS, PFOA, and/or PFBS constituents in both the parent and DEB sample (**Appendix O**).

- PFBS was detected in the parent-DEB sample pair (FTIR-STP17A-042821 and FTIR-BLDG817-DEB-01-042821) collected for the Area North of I Avenue Near Building P817 AOPI at concentrations below the OSD risk screening level. However, the slight decrease in the concentration of PFBS (and other PFAS analytes) in the parent sample indicates that the impact of dedicated, down-hole sampling equipment on groundwater concentrations is inconclusive in well STP-17A.
- PFOA was detected in the parent-DEB sample pair (FTIR-MW2-042621 and FTIR-FTIR01-DEB-01-042621) collected from the FTIR-01 Sanitary Landfill AOPI at concentrations below the OSD risk screening level. However, the slight decrease in the concentration of PFOA in the parent sample indicates that the impact of dedicated, down-hole sampling equipment on groundwater concentrations is inconclusive in well MW-2.

[8] A DEB sample was collected from the down-hole dedicated equipment in two monitoring wells (MW-2 [MW2] and MW-10 [MW10]) associated with the FTIR-01 Sanitary Landfill AOPI. Both DEB samples were given the same ID number, but they are distinguishable from each other by the date each was collected (FTIR-MW2-042621 and FTIR01-DEB-01-042621; FTIR-MW10-042721 and FTIR-01-DEB-01-042721).
[9] DEB sample FTIR-BLA-DEB-01-042921, associated with well W-3 (W3) which does not contain down-hole dedicated equipment, was not collected prior to purging the well. Rather, the sample was collected from groundwater purged from the well. As a result, FTIR-BLA-DEB-01-042921 is not considered a DEB sample and is not discussed in this section.

- PFOA was detected in the DEB sample at a concentration below the OSD risk screening level but was not detected in the parent sample of the parent-DEB sample pair (FTIR-STP16A-042821 and FTIR-RUFMA-DEB-01-042821) collected for the RUFMA Former Fire Training Area AOPI. Several (but not all) other PFAS analytes detected in the DEB sample were not detected in the parent sample. This indicates that PFOA is present in stagnant groundwater and detected concentrations of these analytes in well STP-16A may be biased high by contributions from equipment that contains PFOS, PFOA, and/or PFBS components.
- PFOS, PFOA, and PFBS were not detected in the parent-DEB sample pair (FTIR-RI8-042721 and FTIR-DRYPITS-DEB-01-042721) collected for the Land Farm Drying Pits AOPI. Therefore, the presence of dedicated down-hole sampling equipment in well RI-8 does not appear to impact groundwater concentrations.
- PFOS, PFOA, and PFBS were detected in the parent-DEB sample pair (FTIR-MW10-042721 and FTIR-FTIR-01-DEB-01-042721) collected for the FTIR-01 Sanitary Landfill AOPI. The concentrations of PFOS in both the parent and the DEB sample exceeded the OSD risk screening level. The concentrations of PFOA and PFBS in the parent-DEB samples were below OSD risk screening levels but their concentrations did not decrease appreciably in the parent sample. Therefore, the presence of dedicated down-hole sampling equipment in well MW-10 does not have a meaningful impact on groundwater concentrations.

Four of the five parent-DEB sample pairs collected at FTIR suggest that sampling using the dedicated down-hole sampling equipment does not bias sample PFOS, PFOA, and/or PFBS results. The final parent-DEB sample pair (FTIR-STP16A-042821 and FTIR-RUFMA-DEB-01-042821) suggests that using the existing, dedicated, down-hole sampling equipment in well STP-16A may bias high sample PFOS, PFOA, and/or PFBS results.

7.25 Investigation Derived Waste

A composite sample of the purge and decontamination wastewater was collected from each of the two 55-gallon drums (a total of two composite samples) staged outside of Building 606 pending characterization and removal from the installation. The results from IDW sample FTIR-IDW-01-050521 indicated the following concentrations: 210 ng/L PFOS; 13 ng/L PFOA; and PFBS was not detected above the LOD. The results from IDW sample FTIR-IDW-02-050521 indicated the following concentrations: 130 ng/L PFOS; 15 ng/L PFOA; and PFBS was not detected above the LOD (**Appendix O**). The PFOS concentrations exceed the OSD risk screening level, but the PFOA concentrations do not exceed the OSD risk screening level. The IDW water was removed from FTIR on 08 November 2021, and disposed at U.S. Ecology Nevada, Inc., a Subtitle C landfill that accepts PFAS-containing waste located in Beatty, Nevada, on 11 November 2021. The IDW disposal plan was coordinated with FTIR DPW, as well as BDA personnel as necessary. The full analytical results (i.e., for all constituents analyzed) for IDW samples collected during the SI are included in **Appendix O**. The waste manifest is included in **Appendix P** (note that the waste manifest includes one 55-gallon drum of IDW liquid generated during the SI at the FTIR-Leased Property at Barstow-Daggett Airport, which is covered by a separate PA/SI report).

7.26 TOC, pH, and Grain Size

In addition to sampling soil for PFOS, PFOA, and PFBS, every sample was analyzed for moisture content, and one soil sample per AOPI was analyzed for TOC, pH, and grain size data as they may be useful in future fate and transport studies. However, at the Active Recreational Ball Fields AOPI, two soil samples and one duplicate sample were analyzed for TOC, pH, and grain size; and, at the BLAAF Helipad and the J Stand Fire Truck Pump Flush Area AOPIs, one soil sample and one duplicate sample were analyzed for TOC, pH, and grain size.

The TOC in the soil samples ranged from 328 to 6,830 mg/kg. The TOC at this installation was generally within range of what is typically observed in desert soil (topsoil: 5,000 to 30,000 mg/kg, desert: less than 5,000 mg/kg, organic: greater than120,000 mg/kg). The TOC measured in the duplicate sample of one of the two soil samples collected at the Active Recreational Ball Fields AOPI (FTIR-FD-01-SO-050121/FTIR-BALL-04-SO-050121) had a TOC concentration of 5,440 mg/kg. This is likely because this soil sample/duplicate sample location is located in the irrigated portion of the ball field (i.e., it is indicative of topsoil). The TOC measured in the soil sample collected from the BLAAF – Fire Extinguisher Training Area (FTIR-BLAAF-EXT-01-SO-42921) had a TOC concentration of 6,830 mg/kg. This AOPI location is a dirt surface, is not irrigated, and does not exhibit the qualities of topsoil.

The combined percentage of fines (i.e., silt and clay) in soils at BLAAF at FTIR ranged from 62.8% to 91.4% with an average of 81.2%. In general, PFAS constituents tend to be more mobile in soils with less than 20% fines (silt and clay) and lower TOC. The average percent moisture of the soil at BLAAF (12.9%) was typical for clay (0 to 20%). The pH of the soil was slightly alkaline (7 to 9 standard units). While PFAS constituents are relatively less mobile in soils with high percentages of fines, depleted TOC may allow for enhanced mobility of the constituents in soil.

The combined percentage of fines (i.e., silt and clay) in FTIR soils not located at BLAAF ranged from 3.5% to 18.6% with an average of 10.7%. In general, PFAS constituents tend to be more mobile in soils with less than 20% fines (silt and clay) and lower TOC. The average percent moisture of the soil (5%) was typical for sandy soil (0 to 10%). The pH of the soil was slightly alkaline (7 to 9 standard units). Based on these geochemical and physical soil characteristics (i.e., low percentage of fines and TOC) observed underlying the majority of AOPIs at the installation during the SI, PFAS constituents are expected to be relatively more mobile than in soils with greater percentages of fines and TOC (as encountered at BLAAF).

7.27 Blank Samples

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

7.28 Conceptual Site Models

The preliminary CSMs presented in the QAPP Addendum (Arcadis 2021a) were re-evaluated and updated, if necessary, based on the SI sampling results. The CSMs presented on **Figures 7-18** through **7-26** and in this section therefore represent the current understanding of the potential for human exposure. For some AOPIs, the CSM is the same and, thus, shown on the same figure.

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

Based on the historical or current use, storage, and disposal, including incidental uses, of PFAS-containing materials at the FTIR AOPIs, affected media are likely to consist of soil and groundwater. The primary release and transport mechanism at FTIR is dissolution/desorption from soil and paved surfaces and infiltration to groundwater. Generic categories of potential human receptors and their associated exposure scenarios that are typically evaluated in a CERCLA human health risk assessment were considered and include on-installation site workers (e.g., industrial/commercial workers, utility workers, or future construction workers who could be exposed to chemicals in soil at an AOPI or to chemicals in tap water in an industrial/commercial building), on-installation residents (e.g., adults and children who could be exposed to chemicals in tap water in a residence), and on-installation recreational users (e.g., hikers or hunters who could be exposed to chemicals in waterways at an installation). Off-installation receptor types could include drinking water receptors (i.e., commercial/industrial workers or residents) and recreational users.

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

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

- The AOPIs are not used for residential or recreational purposes (except for the Active Recreational Ball Fields AOPI discussed below) and are wholly located on-post. Therefore, the soil exposure pathways for on-installation residents and recreational users and for off-installation receptors are incomplete.
- Recreational users are not likely to contact groundwater during outdoor recreational activities; therefore, the groundwater exposure pathway for on-installation recreational users is incomplete.
- Groundwater originating at the AOPIs flows toward the center of the groundwater basins, mainly within FTIR’s boundaries. Therefore, the groundwater exposure pathway (via drinking water ingestion and dermal contact) for off-installation receptors is considered to be incomplete.

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

Figure 7-18 shows the CSM for the Active Recreational Ball Fields AOPI, where historical, occasional firefighter training activities with water and potentially AFFF occurred.

- PFOS was detected in soil samples collected at the AOPI. Site workers (i.e., installation personnel) and recreational users could contact constituents in soil via incidental ingestion, dermal contact, and inhalation of dust. Therefore, the soil exposure pathways for on-installation site workers and recreational users are complete.
- Groundwater was not sampled at the Active Recreational Ball Fields AOPI. Due to the generally centripetal flow of groundwater toward the center of the Irwin Basin and the presence of drinking water production well I-7 approximately 1 mile to the east-northeast of this AOPI, PFAS potentially infiltrating to groundwater could impact the drinking water well. Therefore, the groundwater exposure pathways (via drinking water ingestion and dermal contact) for installation site workers and residents are potentially complete.

Figure 7-19 shows the CSM for the following 11 AOPIs located within the Irwin Groundwater Basin: AFFF Storage Shed (Building P358), Bulk POL Tanker Fire Response, Bulk POL Containment Basins, DES Training Complex, Fire Hose Pressure-Testing Area, Fire Station 1 (Building P400) and Former AFFF Storage (Building P411), Fire Station 2 (Building P6101), Former Fire Station, FTIR Helipad, RUFMA Drainage Basins, and RUFMA Former Firefighter Training Area. AFFF contact with soil and/or paved surfaces occurred at these AOPIs during firefighting training exercises, AFFF storage, fire hose pressure-testing, nozzle testing, fire truck washing, and incident responses.

- PFOS, PFOA, and/or PFBS were detected in soil at these AOPIs, and site workers (i.e., installation personnel) could contact constituents in soil via incidental ingestion, dermal contact, and inhalation of dust. Therefore, the soil exposure pathway for on-installation site workers is complete.
- PFOS and PFOA were detected in groundwater downgradient of the DES Training Complex AOPI. PFOS, PFOA, and PFBS were not detected in the single groundwater sample from the RUFMA Former Fire Training Area AOPI; however, PFOS and PFOA were detected in soil at this AOPI and could impact groundwater in the future. Groundwater was not sampled at the other nine AOPIs addressed by **Figure 7-19**. Due to the generally centripetal flow of groundwater toward the center of the basin and the presence of active production wells, I-7 and I-9, near the center of the Irwin Groundwater Basin, PFAS potentially infiltrating to groundwater from all of the AOPIs in this basin have the potential to impact these wells. Therefore, the groundwater exposure pathways (via drinking water ingestion and dermal contact) for installation site workers and residents are potentially complete.

Figure 7-20 shows the CSM for two AOPIs located within the Irwin Groundwater Basin: Area North of I Avenue Near Building P817 and FTIR-01 Landfill. The Area North of I Avenue Near Building P817 was used as an occasional FTA since at least 1989 until 2012. During training, water and possibly AFFF were used. FTIR-01 Landfill has received potentially AFFF-impacted sediment material removed from the RUFMA Wash-Rack AOPI and bio-remediated at the Land Farm Drying Pits AOPI.

- Soil samples were not collected at these AOPIs. If PFOS, PFOA, and/or PFBS are present in soil, site workers could contact constituents via incidental ingestion, dermal contact, and inhalation of dust. Therefore, the soil exposure pathway for on-installation site workers is potentially complete.

- PFOS, PFOA, and/or PFBS were detected in groundwater at these AOPIs. Due to the generally centripetal flow of groundwater toward the center of the basin and the presence of active production wells, I-7 and I-9, near the center of the Irwin Groundwater Basin, PFAS potentially infiltrating to groundwater from all of the AOPIs in this basin have the potential to impact these wells. Therefore, the groundwater exposure pathways (via drinking water ingestion and dermal contact) for installation site workers and residents are potentially complete.

Figure 7-21 shows the CSM for Land Farm Drying Pits AOPI. Since 2006, the drying pits at the land farm periodically receive sediment removed from the RUFMA Wash-Rack AOPI.

- Soil samples were not collected at the Land Farm Drying Pits AOPI. If PFOS, PFOA, and/or PFBS are present in soil, site workers could contact constituents via incidental ingestion, dermal contact, and inhalation of dust. Therefore, the soil exposure pathway for on-installation site workers is potentially complete.
- PFOS, PFOA, and PFBS were not detected in a groundwater sample collected at this AOPI. Based on the SI sample results, the groundwater exposure pathways (via drinking water ingestion and dermal contact) for installation site workers and residents are considered to be incomplete.

Figure 7-22 shows the CSM for the Parking Lot South of Building P861 and FOB Miami AOPIs. The Parking Lot South of Building P861 was used as an occasional FTA since at least 1989 until 2012. This AOPI is located on property leased by the ARNG. During training, water and possibly AFFF were used. FOB Miami was identified as an AOPI due to the storage and servicing of potential AFFF/ FFFP-containing fire extinguishers.

- PFOS, PFOA, and PFBS were not detected in soil samples collected at these two AOPIs. Therefore, the soil exposure pathway for on-installation site workers is incomplete.
- Groundwater samples were not collected at these two AOPIs. However, drinking water is supplied to FOB Miami by Irwin Water Works located in the cantonment. Additionally, due to the non-detect results for soil and the unconfirmed use of PFAS-containing materials at both AOPIs, it is inferred that PFOS, PFOA, and PFBS are not present at these AOPIs, and the groundwater exposure pathways are considered to be incomplete.

Figure 7-23 shows the CSM for the RUFMA Wash Rack AOPI. AFFF historically was used during firefighting training activities on the paved RUFMA (2002 through 2016). The paved surfaces were rinsed with water and drained to a series of wash racks on the northeastern RUFMA boundary. These wash racks are a closed-loop recirculating system installed when the RUFMA was paved in 2002, and likely received diluted AFFF.

The laboratory inadvertently analyzed the supernatant (liquid) portion of the sediment sample and the duplicate sediment sample. As a result, the sample results (including non-detects) were affected by serious deficiencies in the ability to analyze the sample and to meet published method and project quality control criteria. The presence or absence of the analyte cannot be substantiated by the data provided. Rejection of the data was decided by the project team and the USACE chemist.

- The analytical results for the sediment sample and the associated duplicate sample are rejected. As a result, there is no determination on whether PFOS, PFOA, and/or PFBS are present within the wash rack sediments. If PFOS, PFOA, and/or PFBS are present, maintenance workers could contact constituents in drainage basin sediments via incidental ingestion and dermal contact.

Therefore, the wash rack sediment exposure pathway for on-installation site workers is considered to be potentially complete.

- Rinse water is shown as a potential exposure medium on **Figure 7-23**; however, rinse water within the drainage basin is not directly accessible and is returned via the recirculation systems water tank. Therefore, all exposure pathways for rinse water are incomplete.
- Rinse water may have infiltrated subsurface soil and migrated to groundwater through cracks in the pavement or concrete drainage basin. PFOS, PFOA, and/or PFBS may be present in subsurface soil. Future construction or maintenance workers may be exposed to constituents in subsurface soil via incidental ingestion, dermal contact, and inhalation of dust. Therefore, the subsurface soil exposure pathway for on-installation site workers is potentially complete. Subsurface soil exposure pathways for all other receptors are incomplete.
- Due to the generally centripetal flow of groundwater toward the center of the basin and the presence of active production wells I-7 and I-9 near the center of the Irwin Groundwater Basin (particularly I-9), PFOS, PFOA, and/or PFBS potentially infiltrating to groundwater from all of the AOPIs in this basin have the potential to impact these wells. Therefore, the groundwater exposure pathways (via drinking water ingestion and dermal contact) for installation site workers and residents are potentially complete.

Figure 7-24 shows the CSM for the following four AOPIs located within the Bicycle Groundwater Basin: BLAAF Fire Extinguisher Training Area, BLAAF – Helipad, FTIR-20 Former Fire Training Area, and J Stand Fire Truck Pump Flush Area. AFFF was historically released to soil during firefighting and fire extinguisher training exercises, or as a result of wheeled, AFFF/FFFP (currently FFFP) aviation fire extinguishers stored (staged) on the concrete helipad.

- PFOS, PFOA, and/or PFBS were detected in soil at these four AOPIs. Additionally, PFOS was detected in a sediment sample collected from a surface runoff drainage area downslope of the suspected use areas at the J Stand Fire Truck Pump Flush Area. Site workers (i.e., installation personnel) could contact constituents in soil/sediment via incidental ingestion, dermal contact, and inhalation of dust. Therefore, the soil/sediment exposure pathway for on-installation site workers is complete.
- PFOS was detected in groundwater downgradient of the BLAAF – Helipad AOPI. Groundwater samples were not collected at the other three AOPIs addressed by **Figure 7-22**. The AOPIs are located outside the vicinity, and are considered downgradient, of drinking water wells in the Bicycle Groundwater Basin used to supply potable water at FTIR, in part due to the unique hydrogeology in the vicinity and to the west of BLAAF. The presence of two unnamed faults that bisect the southern portion of the Bicycle Lake playa (from approximately northwest to southeast), and/or differences in lithology unrelated to faulting, serve as at least a partial barrier(s) to lateral groundwater flow (Densmore et al. 2018). However, the groundwater exposure pathways (via drinking water ingestion and dermal contact) for site workers and residents are potentially complete to account for potential future use of the downgradient on-post groundwater.

Figure 7-25 shows the CSM for the BLAAF – North Staging Area and BLAAF – South Staging Area AOPIs. These AOPIs have the potential for PFOS, PFOA, and/or PFBS presence due to the storage (staging) of wheeled AFFF/FFFP (currently FFFP) aviation fire extinguishers. There are no documented AFFF/FFFP uses, and SI sampling was not performed at these AOPIs.

- Soil samples were not collected at these AOPIs. If PFOS, PFOA, and/or PFBS are present in soil, site workers could contact constituents via incidental ingestion, dermal contact, and inhalation of dust. Therefore, the soil exposure pathway for on-installation site workers is potentially complete.
- PFOS was detected in groundwater 0.54 mile downgradient of the BLAAF – Helipad AOPI, which is proximal to these AOPIs. The AOPIs are located outside the vicinity, and are considered downgradient, of drinking water wells used to supply potable water at FTIR. However, the groundwater exposure pathways (via drinking water ingestion and dermal contact) for site workers and residents are potentially complete to account for potential future use of the downgradient on-post groundwater.

Figure 7-26 shows the CSM for the NASA Goldstone Former Microwave Test Facility AOPI. This former facility and the associated fire training area are approximately 0.75 miles northwest of Echo Station (the closest Goldstone station to the cantonment). Fire training activities included putting out fires and conducting rescues. It is possible that AFFF or FFFP was used in fire training exercises at this AOPI.

- PFOA was detected in soil at this AOPI, and site workers could contact constituents via incidental ingestion, dermal contact, and inhalation of dust. Therefore, the soil exposure pathway for on-installation site workers is complete.
- Groundwater was not sampled at this AOPI. There are no drinking water wells in this basin, and it is unlikely that future potable wells will be installed in the area. Drinking water is supplied to the NASA Goldstone facilities by Irwin Water Works located in the cantonment. Therefore, the groundwater exposure pathways (via drinking water ingestion and dermal contact) for on-installation site workers and residents are incomplete.

Following the SI sampling, 23 out of the 25 AOPIs (including the two AOPIs not sampled during the SI) were considered to have complete or potentially complete exposure pathways. Although the CSMs indicate complete or potentially complete exposure pathways may exist, the recommendation for remedial investigation is based on the comparison of analytical results for PFOS, PFOA, and PFBS to the OSD risk screening levels (**Table 6-2**).

8 CONCLUSIONS AND RECOMMENDATIONS

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

OSD provided residential risk screening levels based on the USEPA oral reference dose for PFOS, PFOA, and PFBS in soil and groundwater (tap water) and industrial/commercial risk screening levels for PFOS, PFOA, and PFBS in soil (**Appendix A**). A combination of document review, internet searches, interviews with installation personnel, and an installation site visit were used to identify specific areas of suspected PFOS, PFOA, and PFBS use, storage, and/or disposal at FTIR. Following the evaluation, 25 AOPIs were identified.

FTIR's drinking water currently comes from groundwater extracted from seven productions wells (there are two further drinking water production wells in the Langford Groundwater Basin for which the current operation status is unknown) (**Table 2-1** provides information on all of FTIR's production wells). These production wells are located in three separate groundwater basins:

- Irwin Groundwater Basin: Production wells I-7 and I-9
- Bicycle Groundwater Basin: Production wells B-4 and B-5
- Langford Groundwater Basin: Production wells L-1, L-2, and L-3

In September 2020, PFBS was detected at a concentration of 2.0 ng/L in production well I-7; however, PFBS was not detected in the sample collected from the finished (treated) drinking water (USAPHC 2020). Production well I-7 was offline for the subsequent two production well sampling events conducted by FTIR in January 2021 and April 2021; FTIR's finished drinking water had no detections of PFOS, PFOA, or PFBS during these events (see **Table 2-2** for all historical PFOS, PFOA, and PFBS historical data). FTIR's production well analytical data for September 2020 indicate that PFOS, PFOA, and PFBS can reach production well I-7. The source(s) of the PFBS detection in production well I-7 is unknown, but there are several AOPIs in relatively close proximity to or directly upgradient of production well I-7 with detections of PFOS, PFOA, and/or PFBS in soil samples collected and analyzed as part of the SI. Many of these AOPIs had detections that did not exceed the OSD risk screening levels.

The EDR report identified one off-post potable well (**Figure 2-5**) approximately 1 mile south of the installation boundary and more than 5 miles from the nearest AOPI. The EDR report providing well search results is provided as **Appendix E.**

Twenty-three of the 25 AOPIs were sampled during the SI at FTIR to identify presence or absence of PFOS, PFOA, and PFBS at these 23 AOPIs. The SI scope of work was completed in accordance with the Final PQAPP (Arcadis 2019) and the FTIR QAPP Addendum (Arcadis 2021a).

Twenty of the 23 AOPIs included in the SI had detections of PFOS, PFOA, and/or PFBS in groundwater, soil, and/or sediment (the analytical results for the sediment sample collected from the RUFMA Wash-Rack AOPI were rejected) and six AOPIs exceeded OSD risk screening levels.

Groundwater

Groundwater samples were collected at six of the 23 AOPIs. Four of the six AOPIs had at least one detection of PFOS, PFOA, and/or PFBS in groundwater.

- The PFOS tap water risk screening level (40 ng/L) was exceeded in three groundwater samples collected from the FTIR-01 Sanitary Landfill AOPI. The maximum detected concentration of PFOS was 78 ng/L (FTIR-MW5-042721).
- The PFOA tap water risk screening level (40 ng/L) was exceeded in one groundwater sample collected from the FTIR-01 Sanitary Landfill. The maximum detected concentration of PFOA was 43 ng/L (FTIR-MW5-042721).
- The PFBS tap water risk screening level (600 ng/L) was not exceeded in any of the groundwater samples. The maximum detected concentration of PFBS was 9.7 ng/L (FTIR-01 Sanitary Landfill AOPI [FTIR-MW10-042721]).

Soil

Soil samples were collected at 19 of the 23 AOPIs. Seventeen of the 19 AOPIs had at least one detection of PFOS, PFOA, and/or PFBS in soil.

- The PFOS soil residential risk screening level (0.13 mg/kg) was exceeded in at least one soil sample collected from five AOPIs: the AFFF Storage Shed (Building P358) AOPI (one soil exceedance), Bulk POL Tanker Fire Response AOPI (one soil exceedance), DES Training Area AOPI (one soil exceedance), Fire Station 1 (Building P400) and Former AFFF Storage (Building P411) AOPI (two soil exceedances), and FTIR-20 Former Firefighter Training Area AOPI (one soil exceedance).

  The PFOS soil industrial/commercial risk screening level (1.6 mg/kg) was exceeded in one soil sample collected from the AFFF Storage Shed (Building P358) AOPI.
- The PFOA soil residential risk screening level (0.13 mg/kg) was exceeded in one soil sample collected from the Fire Station 1 (Building P400) and Former AFFF Storage (Building P411) AOPI.
- The PFBS soil residential risk screening level (25 mg/kg) was not exceeded in any of the soil samples.

Sediment

Sediment samples were collected at two of the 23 AOPIs. The analytical quantitative results for the sediment sample and duplicate sample collected at the RUFMA Wash-Rack AOPI were rejected. The sediment sample collected from the J Stand Fire Truck Pump Flush Area had a detection of PFOS only at a concentration of 0.00079 J- mg/kg.

Following the SI sampling, 23 out of the 25 AOPIs (including the two AOPIs that were not sampled as part of the SI) were considered to have complete or potentially complete exposure pathways. The soil exposure pathway for on-installation site workers is complete at 17 AOPIs, and for on-installation recreational users is complete at one AOPI, where PFOS, PFOA, and/or PFBS were detected in soil. The soil exposure pathway for on-installation site workers is potentially complete at six AOPIs where soil samples were not collected yet evidence suggests PFOS, PFOA, and/or PFBS could be present in soil. The groundwater exposure pathways for on-installation site workers and residents are potentially

complete at 15 AOPIs in the Irwin Basin and six AOPIs in the Bicycle Basin. Finally, the sediment exposure pathway is complete at one AOPI and potentially complete at one AOPI.

The recommendation for supplemental sampling, future study in a remedial investigation, or no action at this time is based on the comparison of the SI analytical results for PFOS, PFOA, and PFBS to the OSD risk screening levels (**Table 6-2**) and/or consideration of complete or potentially pathways indicated by the CSMs. The criteria used for making these recommendations are as follows.

- If all collected samples, regardless of medium/media, have no detected concentrations of PFOS, PFOA, and PFBS above the LOD, then "no action at this time" will be recommended.
- If soil and groundwater analytical data were collected from the source or downgradient location of use and/or storage and the detected concentrations of PFOS, PFOA, and/or PFBS in both the soil and groundwater samples are below OSD risk screening levels, then "no action at this time" will be recommended.
- If soil analytical data indicate PFOS, PFOA, and/or PFBS presence below OSD risk screening levels, but a potentially complete pathway to groundwater exists, then "supplemental groundwater sampling" will be recommended.[10]
- If PFOS, PFOA, and/or PFBS is detected in a sample (any medium) at a concentration that exceeds the associated OSD risk screening level for that medium, then "further study in a remedial investigation" will be recommended.

Table 8-1 below summarizes the AOPIs identified at FTIR; PFOS, PFOA, and PFBS sampling; and recommendations for each AOPI. Further investigation is warranted at FTIR. In accordance with CERCLA, site-specific risk will be assessed during a future phase to evaluate whether remedial actions are required.

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

AOPI Name	PFOS, PFOA, and/or PFBS detected greater than OSD Risk Screening Levels? (Yes/No/ND/NS)			Recommendation
	GW	SO	SE	
Active Recreational Ball Fields	NS	No	NS	Supplemental groundwater sampling[1]
AFFF Storage Shed (Building P358)	NS	Yes	NS	Further study in a remedial investigation
Area North of I Avenue Near Building P817	No	NS	NS	No action at this time

[10] The RUFMA Wash-Rack AOPI is included in this group due to the rejected sediment analytical data and subsequent data gap.

AOPI Name	PFOS, PFOA, and/or PFBS detected greater than OSD Risk Screening Levels? (Yes/No/ND/NS)			Recommendation
	GW	SO	SE	
Bulk POL Tanker Fire Response	NS	Yes	NS	Further study in a remedial investigation
Bulk POL Containment Basins	NS	No	NS	Supplemental groundwater sampling[1]
DES Training Complex	No	Yes	NS	Further study in a remedial investigation
Fire Hose Pressure-Testing Area	NS	No	NS	Supplemental groundwater sampling[1]
Fire Station 1 (Building P400) and Former AFFF Storage (Building P411)	NS	Yes	NS	Further study in a remedial investigation
Fire Station 2 (Building P6101)	NS	No	NS	Supplemental groundwater sampling[1]
Former Fire Station	NS	No	NS	Supplemental groundwater sampling[1]
FTIR-01 Sanitary Landfill	Yes	NS	NS	Further study in a remedial investigation
Land Farm Drying Pits	No	NS	NS	No action at this time
FTIR Helipad	NS	No	NS	Supplemental groundwater sampling[1]
Parking Lot South of Building P861	NS	ND	NS	No action at this time
RUFMA Drainage Basins	NS	No	NS	Supplemental groundwater sampling[1]
RUFMA Former Fire Training Area	No	No	NS	Supplemental groundwater sampling[1]
RUFMA Wash-Rack	NS	NS	Rejected[2]	Supplemental groundwater sampling[3]
BLAAF - Fire Extinguisher Training Area	No[4]	No	NS	No action at this time
BLAAF - Helipad	No	No	NS	No action at this time
BLAAF - North Staging Area*	NS	NS	NS	No action at this time
BLAAF - South Staging Area*	NS	NS	NS	No action at this time
FTIR-20 Former Fire Training Area	NS	Yes	NS	Further study in a remedial investigation
J Stand Fire Truck Pump Flush Area	NS	No	No	Supplemental groundwater sampling[1]

AOPI Name	PFOS, PFOA, and/or PFBS detected greater than OSD Risk Screening Levels? (Yes/No/ND/NS)			Recommendation
	GW	SO	SE	
FOB Miami	NS	ND	NS	No action at this time
NASA Goldstone Former Microwave Test Facility	NS	No	NS	Supplemental groundwater sampling[1]

Notes:
* AOPI not sampled in this SI.
1. If soil/sediment analytical data indicate PFOS, PFOA, and/or PFBS presence below OSD risk screening levels, but a potentially complete pathway to groundwater exists, then supplemental groundwater sampling will be recommended.
2. The laboratory inadvertently analyzed the supernatant (liquid) portion of the sediment sample and the duplicate sediment sample. As a result, the sample results (including non-detects) were affected by serious deficiencies in the ability to analyze the sample and to meet published method and project quality control criteria. The presence or absence of the analyte cannot be substantiated by the data provided. Rejection of the data was decided by the project team and the USACE chemist.
3. As a result of the rejected sediment data, there are no PFOS, PFOA, and PFBS data available (i.e., a data gap). The RUFMA Wash-Rack AOPI is included in the group of AOPIs recommended for supplemental groundwater sampling due to the sediment data gap and its proximity to an active production well used for drinking water.
4. The BLAAF – Helipad AOPI groundwater samples are surrogate groundwater samples for the BLAAF - Fire Extinguisher Training Area AOPI, because no other existing well was available for sampling.
Light gray shading – detection greater than the OSD risk screening level
GW – groundwater
ND – non-detect
NS – not sampled
SE – sediment
SO – soil

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

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

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

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

PFOS, PFOA, and/or PFBS were detected in all five shallow soil samples collected at the Former Fire Station AOPI (operational from the 1940s until 1985); therefore, it is possible that AFFF was used and/or stored at the fire station when FTIR was a California ARNG installation (1970 to 1980). The location(s) of any firefighter training or fire responses with AFFF by the California ARNG are unknown.[11]

Finally, the collection of PFOS, PFOA, and PFBS analytical data was limited to existing monitoring wells. Most of the AOPIs did not have an existing monitoring well located in close proximity to or downgradient of the AOPI. Available data, including PFOS, PFOA, and PFBS, are listed in **Appendix O**, which were analyzed per the selected analytical method.

Results from this PA/SI indicate further study in a remedial investigation is warranted at FTIR in accordance with the guidance provided by the OSD, as well as supplemental groundwater sampling at select AOPIs.

[11] The installation was transferred from the California ARNG to the Army, and NTC was activated, in 1980; Fort Irwin was activated in 1981 to support the NTC.

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ACRONYMS

°F	degrees Fahrenheit
%	percent
Aerostar	Aerostar SES, LLC
AFFF	aqueous film-forming foam
AOPI	area of potential interest
Arcadis	Arcadis U.S., Inc.
Army	United States Army
ARNG	Army National Guard
AST	above-ground storage tank
BDA	Barstow-Daggett Airport
bgs	below ground surface
btoc	below top of casing
BLAAF	Bicycle Lake Army Airfield
BLM	United States Bureau of Land Management
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CSM	conceptual site model
DEB	dedicated equipment background
DES	Directorate of Emergency Services
DoD	Department of Defense
DPT	direct-push technology
DPW	Directorate of Public Works
DQO	data quality objective
DUSR	Data Usability Summary Report
EB	equipment blank
EDR	Environmental Data Resources, Inc.
ELAP	Environmental Laboratory Accreditation Program
FCR	Field Change Report
FFFP	film-forming fluoroprotein
FOB	Forward Operating Base

FTA	fire training area
FTIR	Fort Irwin
GIS	geographic information system
Goldstone	Goldstone Deep Space Communications Complex
GW	groundwater
HQAES	Headquarters Army Environmental System
IDW	investigation-derived waste
IMCOM	Installation Management Command
installation	United States Army or Reserve installation
IRP	Installation Restoration Program
JPL	Jet Propulsion Laboratory
LOD	limit of detection
LOQ	limit of quantitation
LPG	liquid propane gas
MATES	Maneuver Area Training Equipment Sites
mg/kg	milligrams per kilogram (parts per million)
NASA	National Aeronautics and Space Administration
ng/L	nanograms per liter (parts per trillion)
NTC	National Training Center
NS	not sampled
OSD	Office of the Secretary of Defense
PA	preliminary assessment
Parsons	Parsons Engineering Science, Inc.
PFAS	per- and polyfluoroalkyl substances
PFBS	perfluorobutanesulfonic acid
PFOA	perfluorooctanoic acid
PFOS	perfluorooctane sulfonate
POC	point of contact
POL	petroleum, oil, and lubricants
ppm	parts per million
ppt	parts per trillion

PQAPP	Programmatic Uniform Federal Policy-Quality Assurance Project Plan
QA	quality assurance
QAPP	Quality Assurance Project Plan
QC	quality control
QSM	Quality Systems Manual
RSL	Regional Screening Level
RUFMA	Rotational Unit Field Maintenance Area
SE	sediment
SI	site inspection
SO	soil
SOP	standard operating procedure
SSHP	Site Safety and Health Plan
TGI	technical guidance instruction
TOC	total organic carbon
U.S.	United States
USACE	United States Army Corps of Engineers
USAEC	United States Army Environmental Command
USAPHC	United States Army Public Health Center
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
WWTP	wastewater treatment plant

TABLES

Table 2-1 - On-Post Production Wells
USAEC PFAS Preliminary Assessment/Site Inspection
The National Training Center and Fort Irwin, California

ARCADIS

Production Well ID	Well Type	Well Status	Total Depth in ft bgs[1]	Most Recent Depth to Water in ft bgs (Date Measured)[1]
B-1	NA	Inactive/ abandoned	600	266.12 (03/02/2005)
B-2	NA	Destroyed	NA	NA
B-3	NA	Destroyed	NA	NA
B-4	Drinking water supply	Active	≥594	295.77 (12/13/2010)
B-5	Drinking water supply	Active	800	232.80 (04/16/2019)
B-5A	NA	NA	803	229.88 (03/09/2021)
B-6	Drinking water supply	Inactive	535	249.30 (02/14/2008)
B-9	NA	Destroyed	NA	NA
B-10	Unknown; not used for drinking water	Active	NA	NA
I-1	NA	Destroyed	NA	NA
I-2	NA	Destroyed	NA	NA
I-2A	Irrigation	Active	NA	272.39 (12/15/2010)
I-3	Unknown; not used for drinking water	Inactive/ abandoned/ destroyed	NA	197.19 (12/15/2010)
I-4	NA	Destroyed	NA	NA
I-5	NA	Destroyed	NA	178.07 (12/15/2010)
I-6	NA	Destroyed	NA	NA
I-7	Drinking water supply	Active	490	148.52 (11/02/2021)
I-8	NA	Abandoned/ destroyed	NA	NA
I-9	Drinking water supply	Active	450	166.22 (11/02/2021)
I-10	Unknown; not used for drinking water	Inactive/ abandoned	330	112.02 (11/02/2021)
L-1	Drinking water supply	Active	562	74.71 (03/28/2012)
L-2	Drinking water supply	Active	660	143.20 (12/19/2019)
L-3	Drinking water supply	Active	370	196.21 (03/10/2021)
L-4	Drinking water supply	Unknown	NA	NA
L-5	Drinking water supply	Unknown	NA	NA

Notes:
1. Gray-shaded text indicates an active production well used for drinking water supply.
ID = identification
B = Bicycle Groundwater Basin
I = Irwin Groundwater Basin
L = Langford Groundwater Basin
ft bgs = feet below ground surface
NA = not available/not applicable

Sources:
California Department of Water Resources. No date. SGMA Data Viewer. Available at: https://sgma.water.ca.gov/webgis/?appid=SGMADataViewer#gwlevels.
California Water Boards. No date. GAMA Groundwater Information System. Available at: https://gamagroundwater.waterboards.ca.gov/gama/gamamap/public/default.asp?CMD=runreport&myaddress=34.069566%2C+-118.404883&zl=15.
United States Geological Survey. No date. National Water Information System. Available at: https://maps.waterdata.usgs.gov/mapper/index.html.

Table 2-2. Historical PFOS, PFOA, and PFBS Analytical Results
USAEC PFAS Preliminary Assessment/Site Inspection
The National Training Center and Fort Irwin, California

	Location	IWW (treated)	Bicycle Lake BS Effluent (treated)	Langford Lake BS Effluent (treated)	Well I-7 (treated)	IWW (treated)	Bicycle Lake BS Effluent (treated)	Langford Lake BS Effluent (treated)	Well I-7 (treated)
	Sample ID	361070580191801 (EP #101 - RO Treatment Plant Effluent)	361070580391803	361070580491804	361070580591805	361070580191801 (EP #101 - RO Treatment Plant Effluent)	361070580391803 (Bicycle Lake BS Effluent)	361070580491804	361070580591805
	Sample Date	12/28/2015	12/28/2015	12/28/2015	12/28/2015	6/27/2016	6/27/2016	6/27/2016	6/27/2016
Chemical name	OSD risk screening level* in ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L
Perfluorooctane sulfonate (PFOS)	40	40 U	40 U	40 U	40 U	40 U	40 U	40 U	40 U
Perfluorooctanoic acid (PFOA)	40	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U
Perfluorobutanesulfonic acid (PFBS)	600	90 U	90 U	90 U	90 U	90 U	90 U	90 U	90 U

	Location	Well B-4	Well I-7	Well I-9	Well L-1	Well L-2	Well L-5	IWW Treated Drinking Water
	Sample ID	176420001/FIR_GW _B4	173770001/FIR_GW _I7	173770004/FIR_GW _I9	173770002/FIR_GW _L1	173770003/FIR_GW _L2	173770005/FIR_GW _L5	173770006/IWW_EFF (IWW)
	Sample Date	2/21/2017	1/18/2017	1/18/2017	1/18/2017	1/18/2017	1/18/2017	1/18/2017
Chemical name	OSD risk screening level* in ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L
Perfluorooctane sulfonate (PFOS)	40	NA	NA	NA	NA	NA	NA	NA
Perfluorooctanoic acid (PFOA)	40	0.30 U	0.30 U	0.30 U	0.30 U	0.30 U	0.30 U	0.30 U
Perfluorobutanesulfonic acid (PFBS)	600	NA	NA	NA	NA	NA	NA	NA

Table 2-2. Historical PFOS, PFOA, and PFBS Analytical Results
USAEC PFAS Preliminary Assessment/Site Inspection
The National Training Center and Fort Irwin, California

	Location	Well B-4	Well B-5	Well I-7	Well I-9	Well L-1	Well L-2	Well L-5	IWW Raw Drinking Water	IWW Treated Drinking Water
	Sample ID	B4	B5	I7	I9	L1	L2	L5	IWS-RAW	IWS-POE
	Sample Date	9/17/2020	9/17/2020	9/16/2020	9/16/2020	9/16/2020	9/16/2020	9/16/2020	9/16/2020	9/16/2020
Chemical name	OSD risk screening level* in ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L
Perfluorooctane sulfonate (PFOS)	40	< 1.8	< 1.8	< 1.8	< 1.9	< 1.8	< 1.8	< 1.9	< 1.9	< 1.9
Perfluorooctanoic acid (PFOA)	40	< 1.8	< 1.8	< 1.8	< 1.9	< 1.8	< 1.8	< 1.9	< 1.9 *3	< 1.9 *3
Perfluorobutanesulfonic acid (PFBS)	600	< 1.8	< 1.8	**2.0**	< 1.9	< 1.8	< 1.8	< 1.9	< 1.9	< 1.9

	Location	Well B-4	Well B-5	Well I-9	Well L-1	Well L-2	Well L-5	IWW Raw Drinking Water	IWW Treated Drinking Water
	Sample ID	Well B-4	Well B-5	Well I-9	Well L-1	Well L-2	Well L-5	IWW RAW	IWW POE
	Sample Date	1/19/2021	1/19/2021	1/19/2021	1/19/2021	1/19/2021	1/20/2021	1/19/2021	1/19/2021
Chemical name	OSD risk screening level* in ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L
Perfluorooctane sulfonate (PFOS)	40	< 1.7	< 1.7	< 1.7	< 1.7	< 1.7	< 1.7	< 1.8	< 1.7
Perfluorooctanoic acid (PFOA)	40	< 1.7	< 1.7	< 1.7	< 1.7	< 1.7	< 1.7	< 1.8	< 1.7
Perfluorobutanesulfonic acid (PFBS)	600	< 1.7	< 1.7	< 1.7	< 1.7	< 1.7	< 1.7	< 1.8	< 1.7

Table 2-2. Historical PFOS, PFOA, and PFBS Analytical Results
USAEC PFAS Preliminary Assessment/Site Inspection
The National Training Center and Fort Irwin, California

	Location	Well B-4	Well B-5	Well I-9	Well L-2	Well L-1	Well L-5	IWW Raw Drinking Water	IWW Treated Drinking Water
	Sample ID	B-4	B-5	I9	L-2	L-1	L-5	IWW RAW	IWW POE
	Sample Date	4/20/2021	4/20/2021	4/20/2021	4/20/2021	4/20/2021	4/20/2021	4/20/2021	4/20/2021
Chemical name	OSD risk screening level* in ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L
Perfluorooctane sulfonate (PFOS)	40	< 1.7	< 1.7	< 1.7	< 1.7	< 1.7	< 1.7	< 1.7	< 1.7
Perfluorooctanoic acid (PFOA)	40	< 1.7	< 1.7	< 1.7	< 1.7	< 1.7	< 1.7	< 1.7	< 1.7
Perfluorobutanesulfonic acid (PFBS)	600	< 1.7	< 1.7	< 1.7	< 1.7	< 1.7	< 1.7	< 1.7	< 1.7

Notes and Acronyms:

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

The samples collected in December 2015 and June 2016 were analyzed by USEPA Method 537. The analytical method for the samples collected in January 2017 is not available. The samples collected in September 2020 and the January and April 2021 were analyzed by USEPA Method 537.1.

Bolded values indicate the result was detected greater than the limit of detection

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

*3 = ISTD response or retention time outside acceptable limits.

*- = LCS and/or LCSD is outside acceptance limits, low biased.

*1 = LCS/LCSD RPD exceeds control limits.

DW = drinking water

IWW = Irwin Water Works

NA = not available

<, U = not detected above the laboratory limit of detection

ng/L = nanograms per liter

PFAS = per- and polyfluoroalkyl substances

OSD = Office of the Secretary of Defense

USEPA = United States Environmental Protection Agency

Data Sources:

Army. 2018. Installation Management Command - PFOA PFOS Water System Testing [Analytical Data] Report. August 20. Reports PFOS and PFOA analytical results from sampling conducted in June 2016 and January/February 2017. No analytical method was provided.

U.S. Army Public Health Center (USAPHC). 2020. Laboratory Sciences Final Analytical Report (Report Serial No. H20-02136 – Final Report). 15

USAPHC. 2021a. Laboratory Sciences Final Analytical Report (Report Serial No. H21-00149 – Final Report). 16 February.

USAPHC. 2021b. Laboratory Sciences Final Analytical Report (Report Serial No. H21-00836 – Final Report). 20 August.

Table 6-1 - Monitoring Well Construction Details
USAEC PFAS Preliminary Assessment/Site Inspection
The National Training Center and Fort Irwin, California

ARCADIS

Area of Potential Interest	Sampling Location ID[1]	Total Well Depth (Constructed)	Measuring Point Elevation	Measuring Point	April 2021 Depth to Groundwater from MP	April 2021 Groundwater Elevation	Screened Interval	Casing Diameter	Dedicated Bladder Pump
		(ft bgs)	(ft amsl)		(ft)	(ft amsl)	(ft bgs)	(inches)	(Y/N)
Area North of I Ave. Near Building 817	STP-17A	193	NM	NA	132.30	NC	138 - 148	3	N
DES Training Complex	IX-1	274	2,418.69	NA	102.72	NC	179 - 259	4	N
Land Farm Drying Pits	RI-8	110.63	2,401.40	TOC	81.66	NC	88 - 108	4	N
FTIR-01 Sanitary Landfill	MW-2	183.32	2,416.82	TOC	96.71	2,320.11	120 - 170	4	Y
	MW-4	183.60	2,403.90	TOC	81.62	2,322.28	125 - 175	4	Y
	MW-5	125.70	2,394.29	TOC	67.81	2,326.48	100 - 125[2]	4	Y
	MW-9	113.97	2,393.60	TOC	65.38	2,328.22	67 - 107	4	Y
	MW-10	117.36	2,424.70	TOC	89.56	2,335.14	68 - 108	4	Y
	RI-5	118.90	2,410.85	TOC	90.37	2,320.48	96 - 116	4	Y
	RI-12	137.00	2,428.41	TOC	108.17	2,320.24	115 - 135	4	Y
RUFMA	STP-16A	195	NM	NA	101.00	NC	124 - 134	3	N
BLAAF - Helipad[3] and BLAAF - Fire Extinguisher Training Area	BLA5-3	210	2,345	NA	194.70	NC	190 - 210	2	N
	W-3	300	2,350	NA	194.15	NC	200 - 300	0.5	N

Notes:
1. Groundwater samples were collected from existing monitoring wells.
2. Screen interval is estimated.
3. Wells BLA5-3 and W-3 were sampled as part of the site inspection approach for the BLAAF - Helipad AOPI.

Acronyms/Abreviations:
amsl = above mean sea level
bgs = below ground surface
BLAAF = Bicycle Lake Army Airfield
DES = Directorate of Emergency Services
ft = feet
FTIR = Fort Irwin
ID = identification
MP = measuring point
NA = not available
NC = not calculated
NM = not measured (not surveyed)
N = No
RUFMA = Rotational Unit Field Maintenance Area
TOC = top of casing
Y = Yes

Sources:
Construction details for the wells associated with the FTIR-01 Landfill and the Land Farm Drying Pits AOPIs are from 2019 and were provided by FTIR (internal document or table extracted from a report).

Boring logs for the "STP" wells were provided by FTIR (MWH 2012).

Fort Irwin Area Master Well List (USGS 2011).

Groundwater sampling logs from April 2021 SI sampling (Appendix K).

Table 7-1 - Groundwater PFOS, PFOA, and PFBS Analytical Results
USAEC PFAS Preliminary Assessment/Site Inspection
The National Training Center and Fort Irwin, California

AOPI	Location	Sample/ Parent ID	Sample Date	Analyte	PFOS (ng/L)		PFOA (ng/L)		PFBS (ng/L)	
				OSD Tap Water Risk Screening Level	40		40		600	
				Sample Type	Result	Qual	Result	Qual	Result	Qual
Area North of I Avenue Near Building 817	FTIR-STP17A	FTIR-STP17A-042821	04/28/2021	N	3.5	U	3.5	U	**6.0**	
DES Training Complex	FTIR-IX1	FTIR-IX1-01-042821	04/28/2021	N	**6.2**		**6.0**		3.6	U
Land Farm Drying Pits	FTIR-RI8	FTIR-RI8-042721	04/27/2021	N	3.4	U	3.4	U	3.4	U
FTIR-01 Sanitary Landfill	FTIR-MW10	FTIR-MW10-042721	04/27/2021	N	**77**		**23**		**9.7**	
	FTIR-MW2	FTIR-MW2-042621	04/26/2021	N	3.6	U	**2.0**	J	3.6	U
	FTIR-MW4	FTIR-MW4-042721	04/27/2021	N	**10**		**11**		3.6	U
	FTIR-MW5	FTIR-MW5-042721	04/27/2021	N	**78**		**43**		**4.6**	
	FTIR-MW9	FTIR-MW9-042721	04/27/2021	N	**43**		**32**		**3.6**	
	FTIR-RI12	FTIR-FD-01-GW-042621 / FTIR-RI12-042621	04/26/2021	FD	3.5	U	3.5	U	3.5	U
		FTIR-RI12-042621	04/26/2021	N	3.6	U	3.6	U	3.6	U
	FTIR-RI5	FTIR-RI5-042621	04/26/2021	N	3.5	U	**4.5**		3.5	U
RUFMA Former Fire Training Area	FTIR-STP16A	FTIR-STP16A-042821	04/28/2021	N	3.5	U	3.5	U	3.5	U

Table 7-1 - Groundwater PFOS, PFOA, and PFBS Analytical Results
USAEC PFAS Preliminary Assessment/Site Inspection
The National Training Center and Fort Irwin, California

Notes:
1. **Bolded** values indicate the result was detected greater than the limit of detection.
2. Gray-shaded values indicate the result was detected greater than the Office of the Secretary of Defense (OSD) risk screening levels for tap water (OSD. 2021. Memorandum: Investigating Per- and Polyfluoroalkyl Substances within the Department of Defense Cleanup Program. September).

Acronyms/Abbreviations:
-- = not applicable
AOPI = Area of Potential Interest
BLAAF = Bicycle Lake Army Airfield
DES = Directorate of Emergency Services
FD = field duplicate sample
FTIR = Fort Irwin
ID = identification
N = primary sample
ng/L = nanograms per liter (parts per trillion)
PFBS = perfluorobutane sulfonic acid
PFOA = perfluorooctanoic acid
PFOS = perfluorooctane sulfonic acid
Qual = qualifier
RUFMA = Rotational Unit Field Maintenance Area

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

Table 7-2 - Soil PFOS, PFOA, and PFBS Analytical Results
USAEC PFAS Preliminary Assessment/Site Inspection
The National Training Center and Fort Irwin, California

AOPI	Location	Sample/Parent ID	Sample Date	Analyte	PFOS (mg/kg)		PFOA (mg/kg)		PFBS (mg/kg)	
				OSD Industrial/Commercial Risk Screening Level	1.6		1.6		25	
				OSD Residential Risk Screening Level	0.13		0.13		1.9	
				Sample Type	Result	Qual	Result	Qual	Result	Qual
Active Recreational Ball Fields	FTIR-BALL-01	FTIR-BALL-01-SO-050121	05/01/2021	N	0.00090	U	0.00090	U	0.00090	U
	FTIR-BALL-02	FTIR-BALL-02-SO-050121	05/01/2021	N	**0.00056**	J	0.0010	U	0.0010	U
	FTIR-BALL-03	FTIR-BALL-03-SO-050121	05/01/2021	N	0.0014	U	0.0014	U	0.0014	U
	FTIR-BALL-04	FTIR-BALL-04-SO-050121	05/01/2021	N	**0.0039**	J-	0.00098	U	0.00098	U
		FTIR-FD-01-SO-050121 / FTIR-BALL-04-SO-050121	05/01/2021	FD	**0.0040**		0.00098	U	0.00098	U
	FTIR-BALL-05	FTIR-BALL-05-SO-050121	05/01/2021	N	**0.0017**		0.0011	U	0.0011	U
	FTIR-BALL-06	FTIR-BALL-06-SO-050121	05/01/2021	N	**0.025**		0.00093	U	0.00093	U
AFFF Storage Shed (Building P358)	FTIR-AFFF-01	FTIR-AFFF-01-SO-050221	05/02/2021	N	**1.4**	J	**0.036**		**0.00084**	J
Bulk POL Containment Basins	FTIR-POL-FTA-01	FTIR-POL-FTA-01-SO-042921	04/29/2021	N	**0.025**		0.0010	U	0.0010	U
	FTIR-POL-FTA-02	FTIR-POL-FTA-02-SO-042921	04/29/2021	N	**0.0051**		0.0010	U	0.0010	U
	FTIR-POL-FTA-03	FTIR-POL-FTA-03-SO-042921	04/29/2021	N	0.00095	U	0.00095	U	0.00095	U
	FTIR-POL-FTA-04	FTIR-POL-FTA-04-SO-042921	04/29/2021	N	0.00089	U	0.00089	U	**0.00063**	J
	FTIR-POL-FTA-05	FTIR-POL-FTA-05-SO-042921	04/29/2021	N	0.0010	U	0.0010	U	0.0010	U
Bulk POL Tanker Fire Response	FTIR-POLFIRE-01	FTIR-POLFIRE-01-SO-042921	04/29/2021	N	***1.7***	J	**0.0021**		0.00097	U
	FTIR-POLFIRE-02	FTIR-POLFIRE-02-SO-042921	04/29/2021	N	**0.016**		**0.0018**		0.00097	U
	FTIR-POLFIRE-03	FTIR-POLFIRE-03-SO-042921	04/29/2021	N	**0.063**		**0.00082**	J	0.00087	U
	FTIR-POLFIRE-04	FTIR-POLFIRE-04-SO-042921	04/29/2021	N	**0.0036**		0.00086	U	0.00086	U
DES Training Complex	FTIR-DES-01	FTIR-DES-01-SO-050521	05/05/2021	N	**0.0017**		**0.0053**		0.00087	U
	FTIR-DES-02	FTIR-DES-02-SO-050521	05/05/2021	N	**0.0032**		**0.021**		0.00093	U
	FTIR-DES-03	FTIR-DES-03-SO-050521	05/05/2021	N	**0.071**		**0.015**		0.00094	U
	FTIR-DES-04	FTIR-DES-04-SO-050521	05/05/2021	N	**0.23**	J	**0.0043**		0.00095	U
	FTIR-DES-05	FTIR-DES-05-SO-050521	05/05/2021	N	**0.0029**		**0.0041**		0.00096	U
	FTIR-DES-06	FTIR-DES-06-SO-050521	05/05/2021	N	0.00097	U	0.00097	U	0.00097	U
	FTIR-DES-07	FTIR-DES-07-SO-050521	05/05/2021	N	0.0010	U	0.0010	U	0.0010	U
Fire Hose Pressure-Testing Area	FTIR-HOSE-01	FTIR-HOSE-01-SO-043021	04/30/2021	N	**0.057**		**0.0036**		0.00087	U
Fire Station 1 (Building P400) and Former AFFF Storage (Building P411)	FTIR-FS1-01	FTIR-FS1-01-SO-043021	04/30/2021	N	**0.11**		**0.0081**		**0.00094**	
	FTIR-FS1-02	FTIR-FS1-02-SO-043021	04/30/2021	N	**1.2**	J	**0.018**		**0.00075**	J
	FTIR-FS1-03	FTIR-FS1-03-SO-043021	04/30/2021	N	**1.1**	J	**0.15**		**0.021**	
	FTIR-FS1-04	FTIR-FS1-04-SO-043021	04/30/2021	N	**0.081**		**0.0089**		0.00099	U
	FTIR-FS1-05	FTIR-FS1-05-SO-043021	04/30/2021	N	**0.066**		**0.0027**		**0.0019**	

Table 7-2 - Soil PFOS, PFOA, and PFBS Analytical Results
USAEC PFAS Preliminary Assessment/Site Inspection
The National Training Center and Fort Irwin, California

AOPI	Location	Sample/Parent ID	Sample Date	Analyte	PFOS (mg/kg)		PFOA (mg/kg)		PFBS (mg/kg)	
				OSD Industrial/Commercial Risk Screening Level	1.6		1.6		25	
				OSD Residential Risk Screening Level	0.13		0.13		1.9	
				Sample Type	Result	Qual	Result	Qual	Result	Qual
Fire Station 2 (Building P6101)	FTIR-FS2-01	FTIR-FS2-01-SO-050521	05/05/2021	N	**0.00058**	J	0.0011	U	0.0011	U
	FTIR-FS2-02	FTIR-FS2-02-SO-050521	05/05/2021	N	0.00097	U	**0.00075**	J	0.00097	U
	FTIR-FS2-03	FTIR-FS2-03-SO-050521	05/05/2021	N	**0.0044**		**0.0046**		0.0010	U
	FTIR-FS2-04	FTIR-FS2-04-SO-050521	05/05/2021	N	**0.032**		**0.016**		0.0010	U
	FTIR-FS2-05	FTIR-FS2-05-SO-050521	05/05/2021	N	**0.0075**		**0.0098**		0.00087	U
	FTIR-FS2-06	FTIR-FS2-06-SO-050521	05/05/2021	N	**0.019**		**0.00076**	J	0.00090	U
Former Fire Station	FTIR-FFS-01	FTIR-FFS-01-SO-050221	05/02/2021	N	**0.052**		**0.0014**		**0.00054**	J
	FTIR-FFS-02	FTIR-FFS-02-SO-050221	05/02/2021	N	**0.070**		**0.00055**	J	0.0011	U
	FTIR-FFS-03	FTIR-FFS-03-SO-050221	05/02/2021	N	**0.035**		**0.0037**		0.0010	U
	FTIR-FFS-04	FTIR-FFS-04-SO-050221	05/02/2021	N	**0.020**		**0.0022**		0.00096	U
	FTIR-FFS-05	FTIR-FFS-05-SO-050221	05/02/2021	N	**0.016**		**0.0030**	J+	0.00093	U
		FTIR-FD-02-SO-050221 / FTIR-FFS-05-SO-050221	05/02/2021	FD	**0.018**		**0.0040**		0.00085	U
FTIR Helipad	FTIR-HELO-01	FTIR-HELO-01-SO-050121	05/01/2021	N	**0.0026**		0.00093	U	0.00093	U
	FTIR-HELO-02	FTIR-HELO-02-SO-050121	05/01/2021	N	**0.0092**		**0.00053**	J	0.0010	U
	FTIR-HELO-03	FTIR-HELO-03-SO-050121	05/01/2021	N	**0.0082**		0.00093	U	0.00093	U
	FTIR-HELO-04	FTIR-HELO-04-SO-050121	05/01/2021	N	**0.039**		**0.00088**	J	0.00091	U
Parking Lot South of Building P861	FTIR-P861-01	FTIR-P861-01-SO-043021	04/30/2021	N	0.00085	U	0.00085	U	0.00085	U
	FTIR-P861-02	FTIR-P861-02-SO-043021	04/30/2021	N	0.00086	U	0.00086	U	0.00086	U
	FTIR-P861-03	FTIR-P861-03-SO-043021	04/30/2021	N	0.00098	U	0.00098	U	0.00098	U
	FTIR-P861-04	FTIR-P861-04-SO-043021	04/30/2021	N	0.00091	U	0.00091	U	0.00091	U
RUFMA Drainage Basins	FTIR-RUFMADB-01	FTIR-RUFMADB-01-15-SO-050421	05/04/2021	N	**0.0019**		**0.0014**		0.00096	U
	FTIR-RUFMADB-02	FTIR-RUFMADB-02-15-SO-050421	05/04/2021	N	0.00093	U	0.00093	U	0.00093	U
	FTIR-RUFMADB-03	FTIR-RUFMADB-03-15-SO-050421	05/04/2021	N	0.00094	U	0.00094	U	0.00094	U
RUFMA Former Fire Training Area	FTIR-RUFMA-01	FTIR-RUFMA-01-SO-050121	05/01/2021	N	0.0010	U	0.0010	U	0.0010	U
	FTIR-RUFMA-02	FTIR-RUFMA-02-SO-050121	05/01/2021	N	**0.0031**		0.0010	U	0.0010	U
	FTIR-RUFMA-03	FTIR-RUFMA-03-SO-050121	05/01/2021	N	0.00097	U	0.00097	U	0.00097	U
	FTIR-RUFMA-04	FTIR-RUFMA-04-SO-050121	05/01/2021	N	**0.00092**	J	**0.00067**	J	0.00098	U
BLAAF - Fire Extinguisher Training Area	FTIR-BLAAF-EXT-01	FTIR-BLAAF-EXT-01-SO-042921	04/29/2021	N	**0.012**		**0.013**		0.00096	U
	FTIR-BLAAF-EXT-02	FTIR-BLAAF-EXT-02-SO-042921	04/29/2021	N	**0.0043**		**0.014**		0.00092	U
	FTIR-BLAAF-EXT-03	FTIR-BLAAF-EXT-03-SO-042921	04/29/2021	N	**0.0067**		**0.016**		0.00094	U
	FTIR-BLAAF-EXT-04	FTIR-BLAAF-EXT-04-SO-042921	04/29/2021	N	**0.0075**		**0.0092**		**0.00055**	J

Table 7-2 - Soil PFOS, PFOA, and PFBS Analytical Results
USAEC PFAS Preliminary Assessment/Site Inspection
The National Training Center and Fort Irwin, California

AOPI	Location	Sample/Parent ID	Sample Date	Analyte	PFOS (mg/kg)		PFOA (mg/kg)		PFBS (mg/kg)	
				OSD Industrial/Commercial Risk Screening Level	1.6		1.6		25	
				OSD Residential Risk Screening Level	0.13		0.13		1.9	
				Sample Type	Result	Qual	Result	Qual	Result	Qual
BLAAF - Helipad	FTIR-BLAAF-HELO-01	FTIR-BLAAF-HELO-01-SO-042921	04/29/2021	N	**0.0054**		**0.0028**		0.0011	U
		FTIR-FD-03-SO-042921 / FTIR-BLAAF-HELO-01-SO-042921	04/29/2021	FD	**0.0055**		**0.0023**		0.0011	U
	FTIR-BLAAF-HELO-02	FTIR-BLAAF-HELO-02-SO-042921	04/29/2021	N	**0.0079**		**0.0027**		0.0010	U
	FTIR-BLAAF-HELO-03	FTIR-BLAAF-HELO-03-SO-042921	04/29/2021	N	**0.0076**		**0.0045**		0.0010	U
	FTIR-BLAAF-HELO-04	FTIR-BLAAF-HELO-04-SO-042921	04/29/2021	N	**0.012**		0.0010	U	0.0010	U
FTIR-20 Former Fire Training Area	FTIR-FTIR20-01	FTIR-FTIR20-01-2-SO-050421	05/04/2021	N	**0.0015**		0.0010	U	0.0010	U
		FTIR-FTIR20-01-5-SO-050421	05/04/2021	N	0.00097	U	0.00097	U	0.00097	U
	FTIR-FTIR20-02	FTIR-FTIR20-02-2-SO-050421	05/04/2021	N	0.00091	U	0.00091	U	0.00091	U
		FTIR-FTIR20-02-5-SO-050421	05/04/2021	N	**0.0030**		**0.0021**		0.00093	U
	FTIR-FTIR20-03	FTIR-FTIR20-03-2-SO-050421	05/04/2021	N	**0.0045**		**0.0030**		0.00099	U
		FTIR-FTIR20-03-5-SO-050421	05/04/2021	N	**0.0013**		0.0010	U	0.0010	U
	FTIR-FTIR20-04	FTIR-FTIR20-04-2-SO-050421	05/04/2021	N	**0.44**	J	**0.00094**	J	0.00098	U
		FTIR-FTIR20-04-5-SO-050421	05/04/2021	N	**0.17**		**0.017**		0.00096	U
	FTIR-FTIR20-05	FTIR-FTIR20-05-2-SO-050421	05/04/2021	N	0.00088	U	0.00088	U	0.00088	U
		FTIR-FTIR20-05-5-SO-050421	05/04/2021	N	**0.049**		**0.018**		**0.0010**	
	FTIR-FTIR20-06	FTIR-FTIR20-06-5-SO-050421	05/04/2021	N	**0.28**	J	**0.0087**		**0.0011**	
		FTIR-FTIR20-06-10-SO-050421	05/04/2021	N	**0.012**		**0.0019**		0.00095	U
		FTIR-FTIR20-06-15-SO-050421	05/04/2021	N	0.00093	U	**0.00050**	J	0.00093	U
	FTIR-FTIR20-07	FTIR-FTIR20-07-5-SO-050421	05/04/2021	N	**0.40**		**0.017**		**0.0087**	
		FTIR-FTIR20-07-10-SO-050421	05/04/2021	N	**0.19**	J	**0.0079**		**0.0038**	
		FTIR-FTIR20-07-15-SO-050421	05/04/2021	N	**0.098**		**0.0043**		**0.0047**	
J Stand Fire Truck Pump Flush Area	FTIR-JSTAND-01	FTIR-JSTAND-01-SO-050221	05/02/2021	N	**0.011**		**0.00082**	J	0.00095	U
		FTIR-FD-04-SO-050221 / FTIR-JSTAND-01-SO-050221	05/02/2021	FD	**0.0099**		**0.00083**	J	0.0010	U
	FTIR-JSTAND-02	FTIR-JSTAND-02-SO-050221	05/02/2021	N	**0.020**		**0.0017**		0.00097	U
	FTIR-JSTAND-03	FTIR-JSTAND-03-SO-050221	05/02/2021	N	0.0010	U	**0.0071**		0.0010	U
FOB Miami	FTIR-MIAMI-01	FTIR-MIAMI-01-SO-050321	05/03/2021	N	0.00099	U	0.00099	U	0.00099	U
	FTIR-MIAMI-02	FTIR-MIAMI-02-SO-050321	05/03/2021	N	0.0013	U	0.0013	U	0.0013	U
	FTIR-MIAMI-03	FTIR-MIAMI-03-SO-050321	05/03/2021	N	0.00097	U	0.00097	U	0.00097	U
	FTIR-MIAMI-04	FTIR-MIAMI-04-SO-050321	05/03/2021	N	0.00094	U	0.00094	U	0.00094	U
NASA Goldstone Former Microwave Test Facility	FTIR-GOLDSTONE-01	FTIR-GOLDSTONE-01-SO-050321	05/03/2021	N	0.00092	U	0.00092	U	0.00092	U
	FTIR-GOLDSTONE-02	FTIR-GOLDSTONE-02-SO-050321	05/03/2021	N	0.00090	U	0.00090	U	0.00090	U
	FTIR-GOLDSTONE-03	FTIR-GOLDSTONE-03-SO-050321	05/03/2021	N	0.00099	U	**0.0065**		0.00099	U
		FTIR-FD-05-SO-050321 / FTIR-GOLDSTONE-03-SO-050321	05/03/2021	FD	0.00092	U	**0.0065**		0.00092	U

Notes:
1. **Bolded** values indicate the result was detected greater than the limit of detection.
2. Data are compared to the Office of the Secretary of Defense (OSD) risk screening levels for both the residential as well as the industrial/commercial scenarios (OSD. 2021. Memorandum: Investigating Per- and Polyfluoroalkyl Substances within the Department of Defense Cleanup Program. September).
3. All soil and/or sediment data will be screened against both the Residential Scenario and Industrial/Commercial risk screening levels (if collected from or less than 2 feet below ground surface [bgs]), regardless of the current and projected land use of the AOPI. Soil samples collected from greater than 2 feet but less than 15 feet bgs will be compared to the industrial/commercial risk screening levels only.
4. Gray shaded values indicate the result was detected greater than the residential scenario risk screening levels (OSD 2021).
5. Gray shaded and italicized values indicate the result was detected greater than the industrial/commercial scenario (i.e., and therefore greater than the residential scenario) risk screening levels (OSD 2021).

Acronyms/Abbreviations:
-- = not applicable/not analyzed
AFFF = aqueos film-forming foam
AOPI = Area of Potential Interest
BLAAF = Bicycle Lake Army Airfield
DES = Directorate of Emergency Services
FD = field duplicate sample
FOB = Forward Observation Base
ID = identification
mg/kg = milligrams per kilogram (parts per million)
N = primary sample
NASA = National Aeronautics and Space Administration
PFBS = perfluorobutane sulfonic acid
PFOA = perfluorooctanoic acid
PFOS = perfluorooctane sulfonic acid
POL = petroleum, oil, and lubricants
Qual = qualifier
RUFMA = Rotational Unit Field Maintenance Area
FTIR = Fort Irwin

Qualifiers:
J = The analyte was positively identified; however, the associated numerical value is an estimated concentration only.
J+ = The result is an estimated quantity; the result may be biased high.
J- = The result is an estimated quantity; the result may be biased low.
U = The analyte was analyzed for but the result was not detected above the limit of quantitation.
UJ = The analyte was analyzed for but was not detected. The limit of quantitation (LOQ) is approximate and may be inaccurate or imprecise.

Table 7-3 - Sediment PFOS, PFOA, and PFBS Analytical Results
USAEC PFAS Preliminary Assessment/Site Inspection
The National Training Center and Fort Irwin, California

AOPI	Location	Sample/Parent ID	Sample Date	Analyte	PFOS (ng/L)		PFOA (ng/L)		PFBS (ng/L)	
				OSD Industrial/Commercial Risk Screening Levels	1.6		1.6		25	
				OSD Residential Risk Screening Levels	0.13		0.13		1.9	
				Sample Type	Result	Qual	Result	Qual	Result	Qual
RUFMA Wash-Rack	FTIR-RUFMA-WR-01	FTIR-RUFMAWR-01-SE-050421	05/04/2021	N		R		R		R
		FTIR-RUFMA-FD-01-SE-050421 / FTIR-RUFMAWR-01-SE-050421	05/04/2021	FD		R		R		R
J Stand Fire Truck Pump Flush Area	FTIR-JSTAND-01	FTIR-JSTAND-01-SE-050221	05/02/2021	N	**0.00079**	J-	0.0010	U	0.0010	U

Table 7-3 - Sediment PFOS, PFOA, and PFBS Analytical Results
USAEC PFAS Preliminary Assessment/Site Inspection
The National Training Center and Fort Irwin, California

Notes:

1. **Bolded** values indicate the result was detected greater than the limit of detection.
2. The sediment sample was inadvertently analyzed as a supernatant sample (analyzed the liquid lying above the sediment solids).
3. FTIR-RUFMAWR-01-SE was not compared to the OSD risk screening levels for tap water because the aqueous sample is not a direct expression of groundwater at the related AOPI and is not a drinking water source.
4. Data are compared to the Office of the Secretary of Defense (OSD) risk screening levels for both the residential as well as the industrial/commercial scenarios (OSD. 2021. Memorandum: Investigating Per- and Polyfluoroalkyl Substances within the Department of Defense Cleanup Program.

Acronyms/Abbreviations:

-- = not applicable/not analyzed
AOPI = Area of Potential Interest
FD = field duplicate sample
FTIR = Fort Irwin
ID = identification
mg/kg = milligrams per kilogram (parts per million)
N = primary sample
PFBS = perfluorobutane sulfonic acid
PFOA = perfluorooctanoic acid
PFOS = perfluorooctane sulfonic acid
Qual = qualifier
RUFMA = Rotational Unit Field Maintenance Area

Qualifiers:

J- = The result is an estimated quantity; the result may be biased low.
R = The sample results (including non-detects) were affected by serious deficiencies in the ability to analyze the sample and to meet published method quality control criteria. Rejection of the data was decided by the project team and USACE chemist.
U = The analyte was analyzed for but the result was not detected above the limit of quantitation.

FIGURES

USAEC PFAS Preliminary Assessment / Site Inspection Fort Irwin, CA

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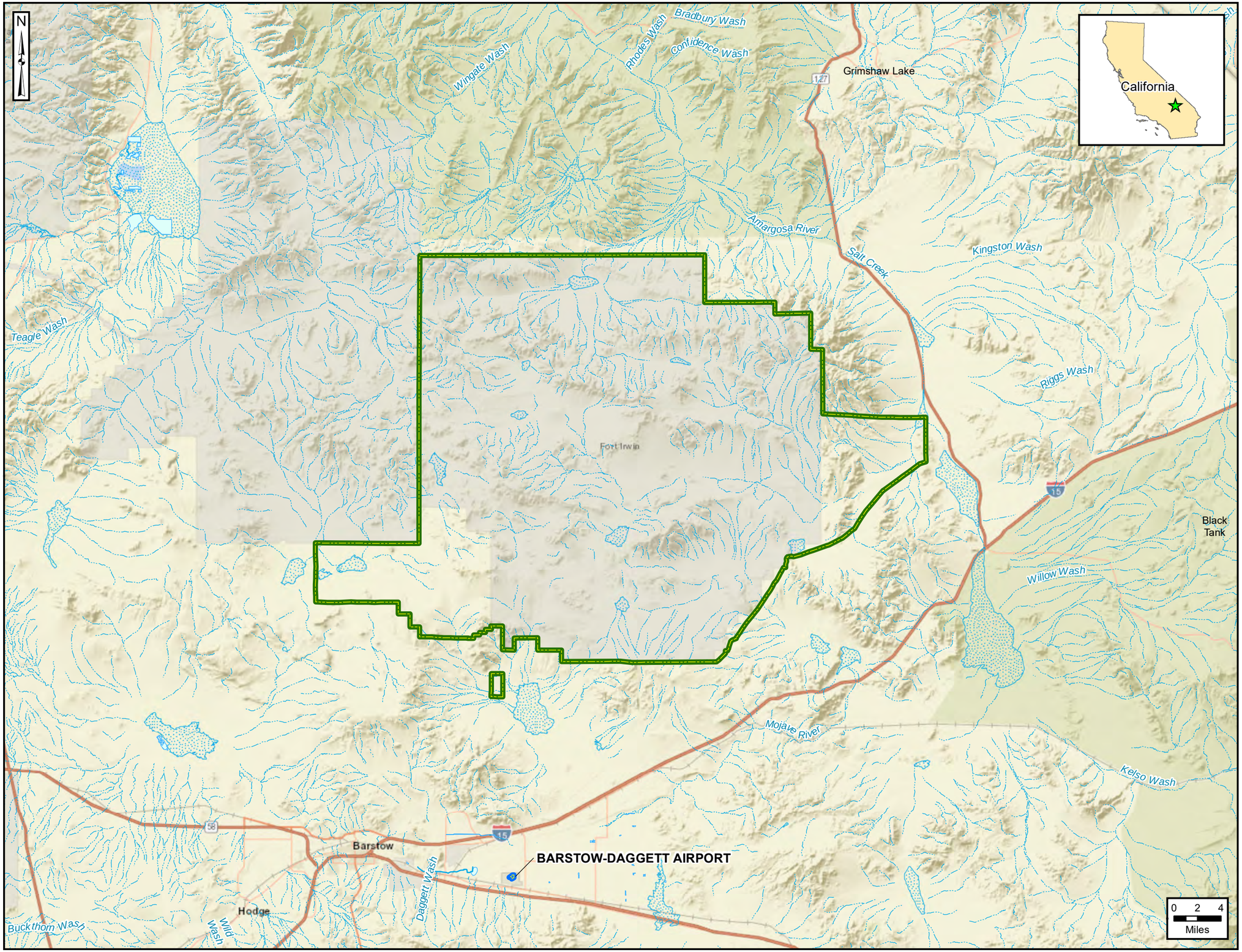
Figure 2-1
Site Location



Legend

- Installation Boundary
- Fort Irwin-Leased Property at Barstow-Daggett Airport
- River/Stream (Perennial)
- Stream (Ephemeral)
- Water Body
- Dry Lake Bed

Data Sources:
ESRI ArcGIS Online, StreetMap Data

Coordinate System:
WGS 1984, UTM Zone 11 North

USAEC PFAS Preliminary Assessment / Site Inspection Fort Irwin, CA

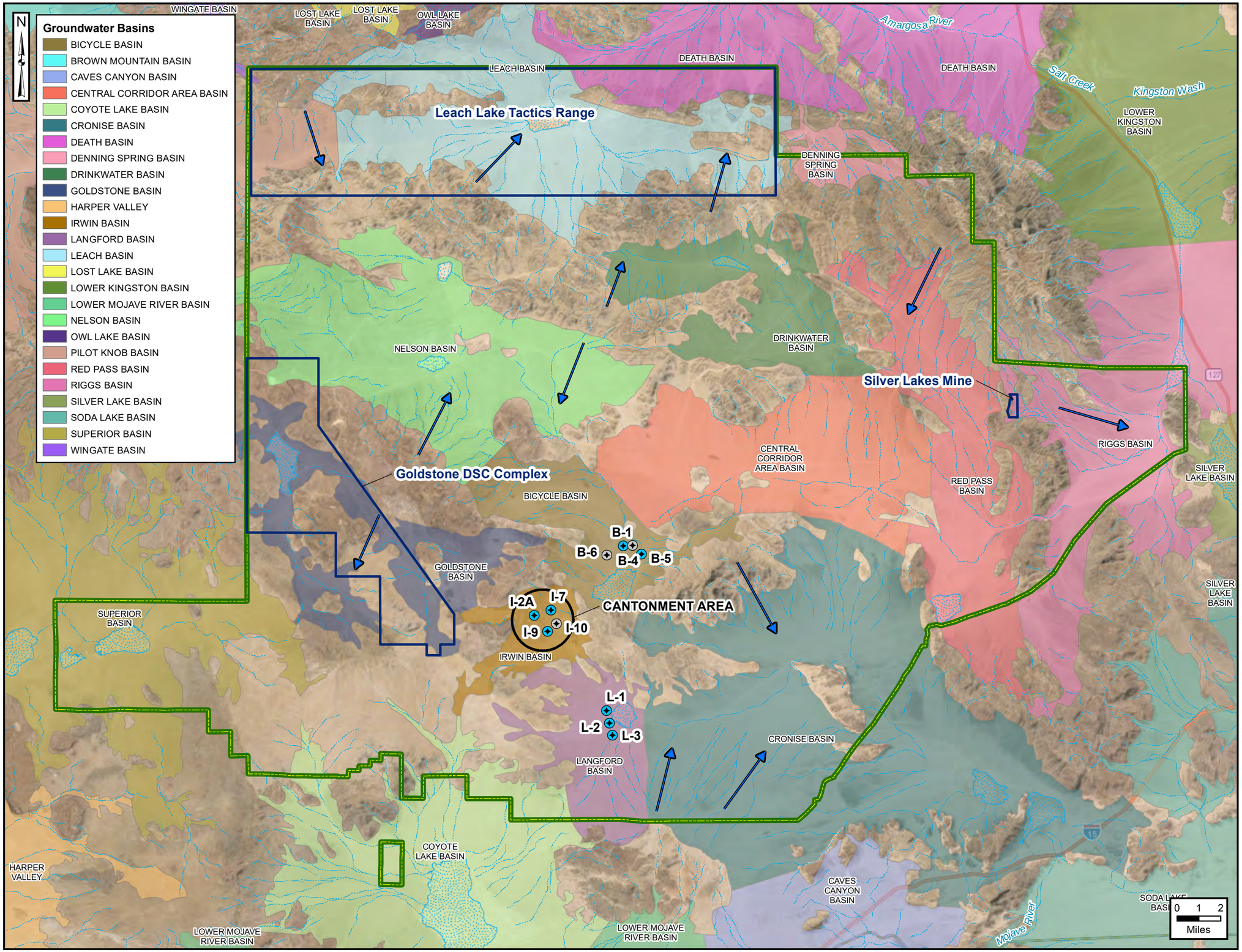


Figure 2-2
Site Layout

Legend

- Installation Boundary
- Tenant-Leased Property
- Stream (Ephemeral)
- Dry Lake Bed
- Surface Water Flow Direction
- Drinking Water Production Well
- Drinking Water Production Well (Inactive)

DSC = Deep Space Communications

Note:
Groundwater flow is generally toward the center of the basins. Shading illustrates the location and extent of the groundwater basins.

Data Sources:
Fort Irwin, GIS Data, 2018
CA DWR, Groundwater Basins
ESRI ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 11 North

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Fort Irwin, CA

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Figure 2-3a
Topographic Map

Leach Lake Tactics Range

Goldstone DSC Complex

Silver Lakes Mine

CANTONMENT AREA

Legend

- Installation Boundary
- Tenant-Leased Property
- Stream (Ephemeral)
- Dry Lake Bed

DSC = Deep Space Communications

Data Sources:
ESRI ArcGIS Online, USA Topo Maps

Coordinate System:
WGS 1984, UTM Zone 11 North

0 1 2
Miles

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Figure 2-3b Cantonment Area Topography

Legend

- Installation Boundary
- Elevation Contour (feet)
- Stream (Ephemeral)

Elevation (feet above mean sea level)

- High : 1190 feet
- Low : 698 feet

Data Sources:
ESRI ArcGIS Online, USA Topo Maps

Coordinate System:
WGS 1984, UTM Zone 11 North

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Figure 2-4
Groundwater Flow Map and Production Wells

N

GOLDSTONE BASIN

BICYCLE BASIN

IRWIN BASIN

LANGFORD BASIN

CRONISE BASIN

B-4
B-1
B-6
B-5
I-7
I-2A
I-10
I-9
L-1
L-2
L-3

0 0.5 1
Miles

Legend

- Installation Boundary
- Stream (Ephemeral)
- Dry Lake Bed
- Drinking Water Production Well
- Drinking Water Production Well (Inactive)
- Approximate Groundwater Flow Direction

Groundwater Basin

- Bicycle Basin
- Cronise Basin
- Goldstone Basin
- Irwin Basin
- Langford Basin

Note:
Groundwater flow is generally toward the center of the basins. Shading illustrates the location and extent of the groundwater basins.

Data Sources:
Fort Irwin, GIS Data, 2018
CA DWR, Groundwater Basins
ESRI ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 11 North

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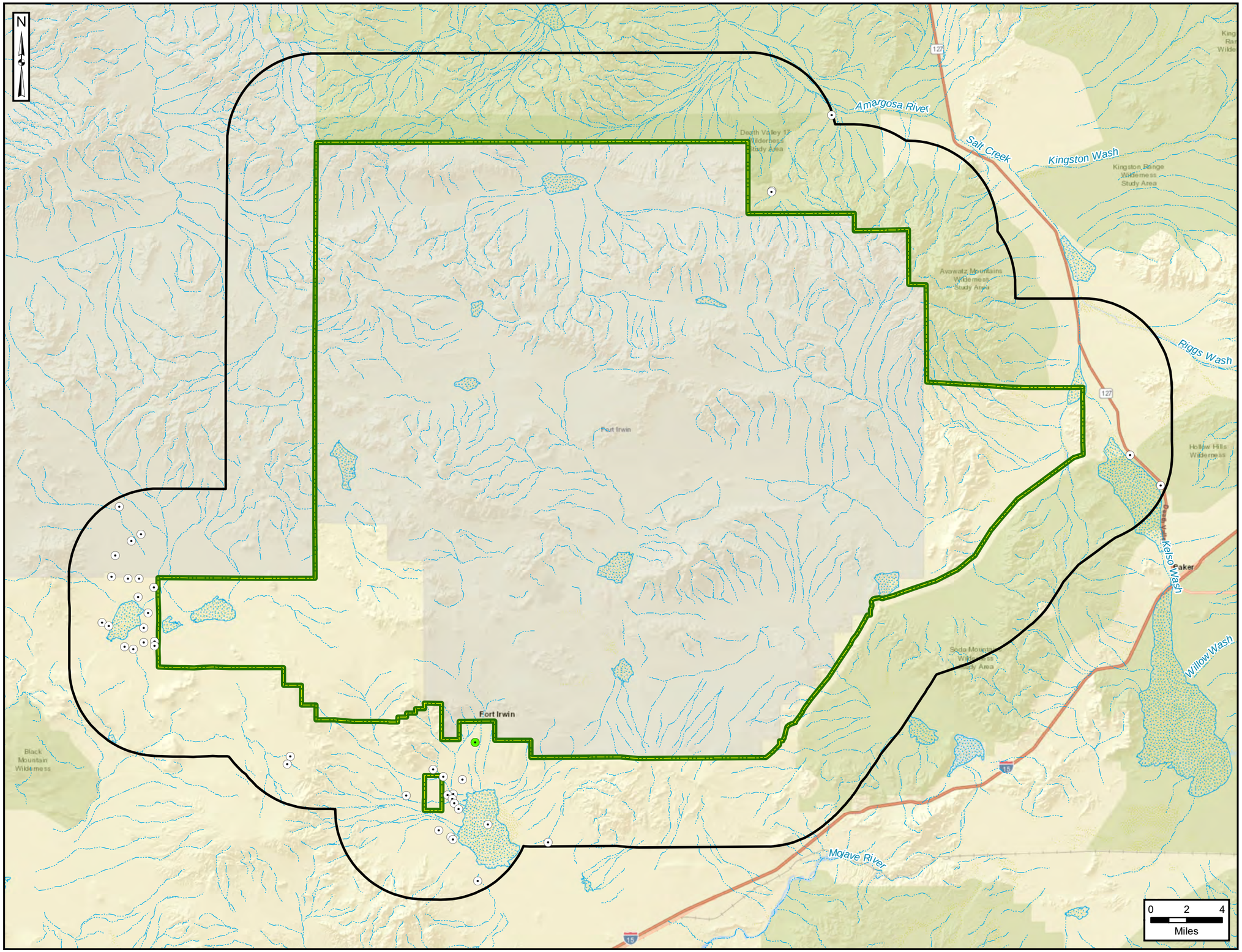
Figure 2-5
Off-Post Potable Supply Wells



Legend

- Installation Boundary
- 5-Mile Radius
- Stream (Ephemeral)
- Dry Lake Bed
- Domestic Well
- Other Well (Unknown Use)

Notes:
Water supply well locations and identifications were provided by Environmental Data Resources, Inc. (EDR). The functional status of the wells may not be known.

No public water supply system or other public supply wells were identified within 5 miles of Fort Irwin. Only one off-post well was identified as a domestic well, while the use of the other wells is unknown.

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

Coordinate System:
WGS 1984, UTM Zone 11 North

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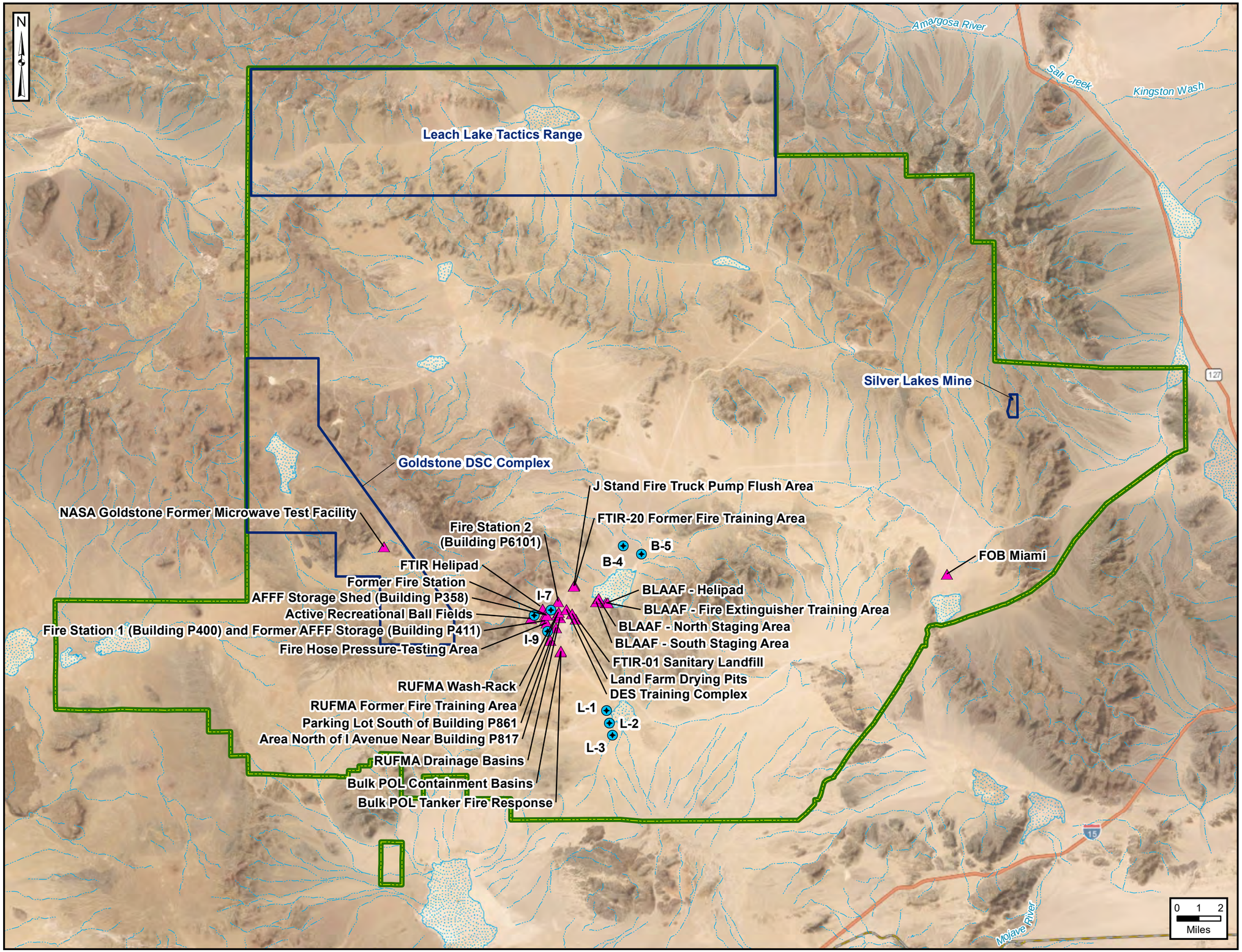
Figure 5-2
AOPI Locations



Legend

- Installation Boundary
- Tenant-Leased Property
- AOPI Location
- Stream (Ephemeral)
- Dry Lake Bed
- Drinking Water Production Well

AFFF = acqueous film-forming form
AOPI = area of potential interest
BLAAF = Bicycle Lake Army Airfield
DES = Directorate of Emergency Services
DSC = Deep Space Communications
FOB = Forward Operating Base
FTIR = National Training Center and Fort Irwin
NASA = National Aeronautics and Space Administration
POL = Petroleum, Oil, and Lubricants
RUFMA = Rotational Unit Field Maintenance Area

Data Sources:
ESRI ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 11 North

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Figure 5-3
Aerial Photo of Active Recreational Ball Fields AOPI

Legend

- Installation Boundary
- AOPI
- Approximate Groundwater Flow Direction
- Approximate Surface Runoff Flow Direction

AOPI = area of potential interest

Data Sources:
ESRI ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 11 North

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Figure 5-4
Aerial Photo of Former Fire Station and AFFF Storage Shed (Building P358) AOPIs

N

3rd St

Camp Irwin Rd

Former Fire Station

3rd St

D Ave

E Ave

p Irwin Rd

D Ave

AFFF Storage Shed (Building P358)

0 50 100
Feet

Legend

- Installation Boundary
- AOPI
- Approximate Groundwater Flow Direction
- Alternate Groundwater Flow Direction when I-7 is Actively Pumping
- Approximate Surface Runoff Flow Direction

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

Data Sources:
Google Earth, Aerial Imagery, 2014

Coordinate System:
WGS 1984, UTM Zone 11 North

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Figure 5-5
Aerial Photo of
Area North of I Avenue
Near Building P817 AOPI

Legend

- Installation Boundary
- AOPI
- Approximate Groundwater Flow Direction
- Approximate Surface Runoff Flow Direction
- Monitoring Well
- Drinking Water Production Well
- Non-Drinking Water Production Well (Inactive/Abandoned)

AOPI = area of potential interest

Data Sources:
ESRI ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 11 North

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Figure 5-6
Aerial Photo of
Bulk POL Tanker Fire Response and
Bulk POL Containment Basins AOPIs

Legend

- Installation Boundary
- AOPI
- Approximate Groundwater Flow Direction
- Approximate Surface Runoff Flow Direction

AOPI = area of potential interest
POL = Petroleum, Oil, and Lubricants

Data Sources:
ESRI ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 11 North

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Figure 5-7
Aerial Photo of
DES Training Complex AOPI

Legend

- Installation Boundary
- AOPI
- Lined Training Pit
- Approximate Groundwater Flow Direction
- Approximate Surface Runoff Flow Direction
- Monitoring Well

AOPI = area of potential interest
DES = Directorate of Emergency Services

Data Sources:
Google Earth, Aerial Imagery, 2013

Coordinate System:
WGS 1984, UTM Zone 11 North

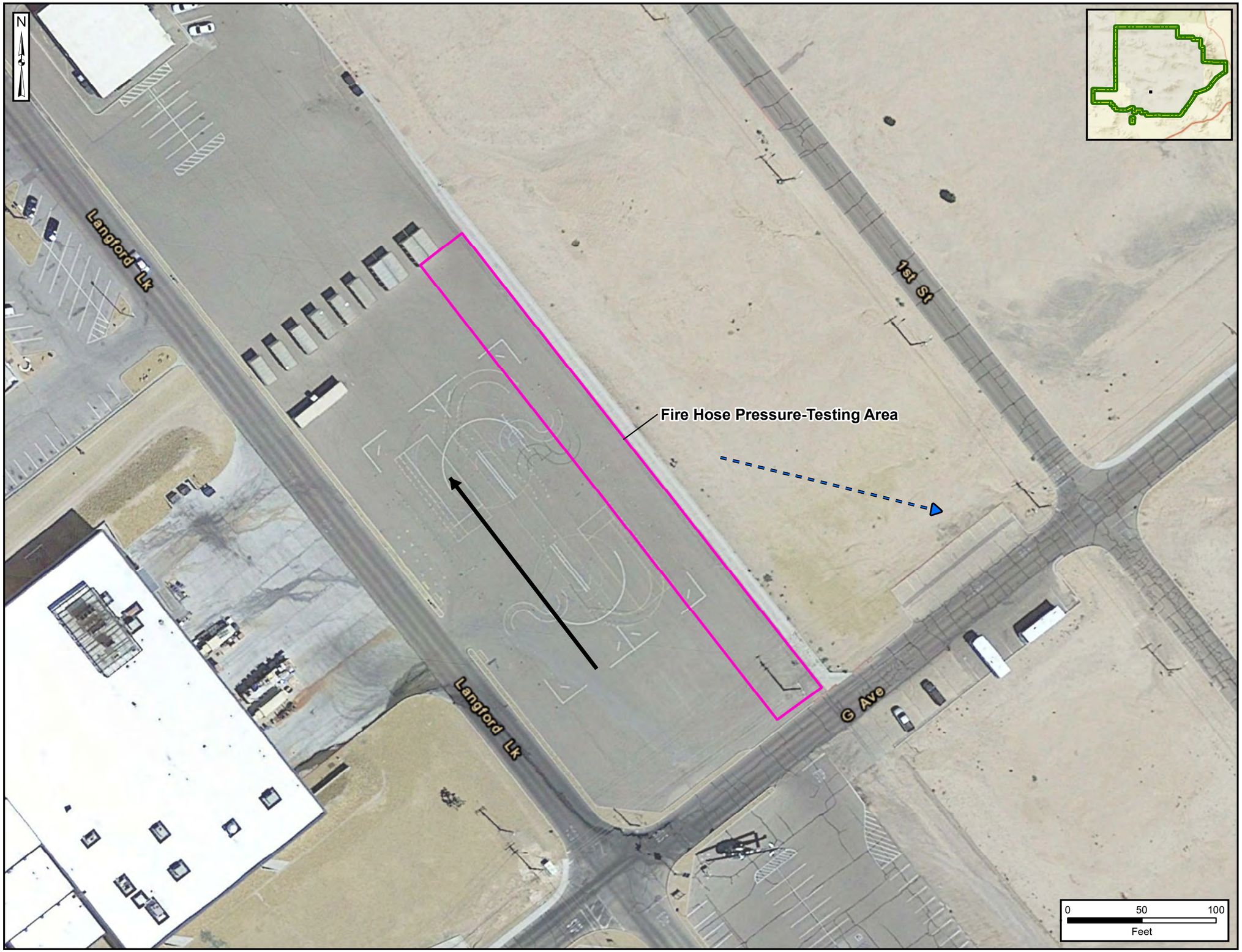

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Figure 5-8
Aerial Photo of
Fire Hose
Pressure-Testing Area AOPI

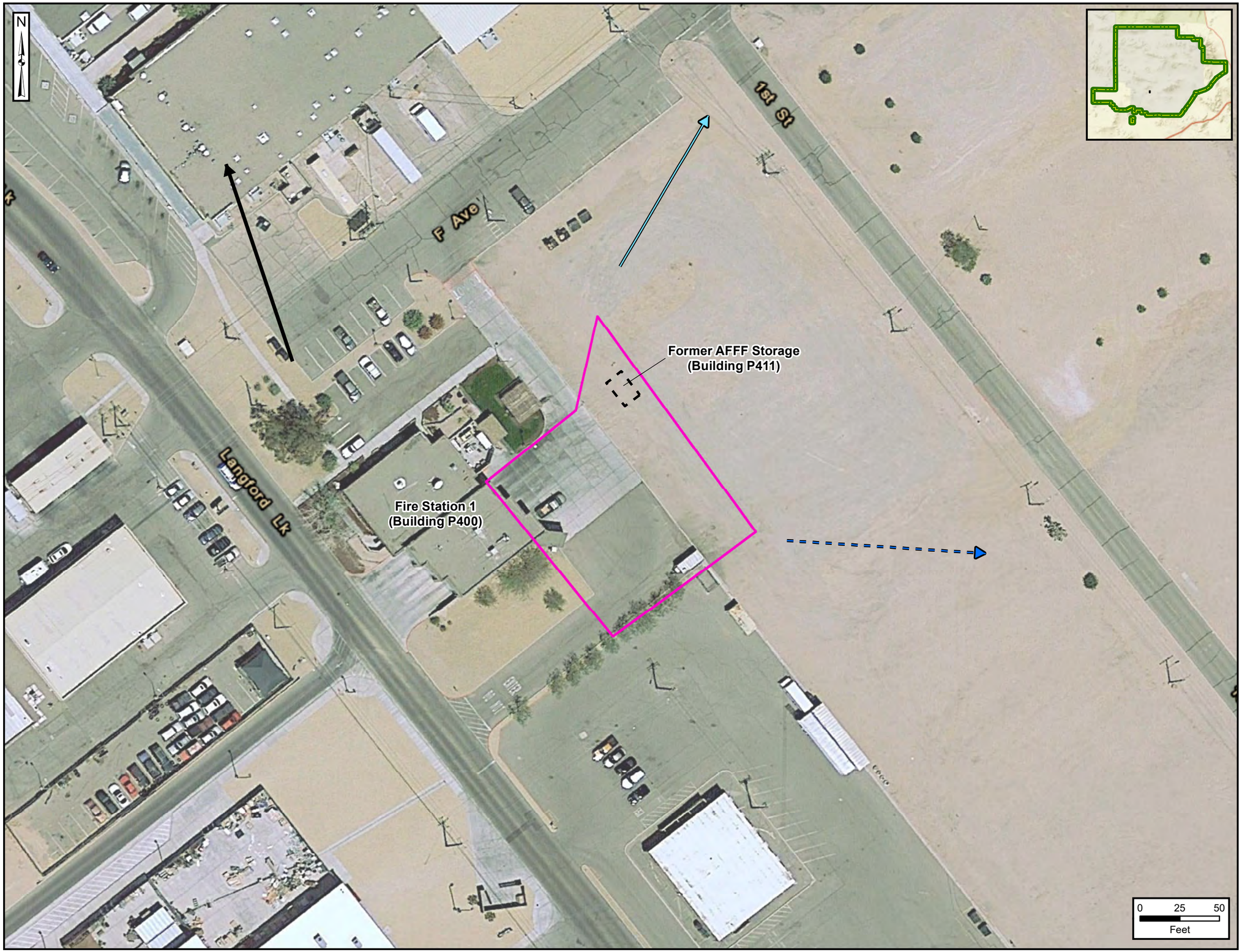
Legend

- Installation Boundary
- AOPI
- Approximate Groundwater Flow Direction
- Approximate Surface Runoff Flow Direction

AOPI = area of potential interest

Data Sources:
Google Earth, Aerial Imagery, 2014

Coordinate System:
WGS 1984, UTM Zone 11 North



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Fort Irwin, CA

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Figure 5-9
Aerial Photo of
Fire Station 1 (Building P400) and Former AFFF Storage (Building P411) AOPI

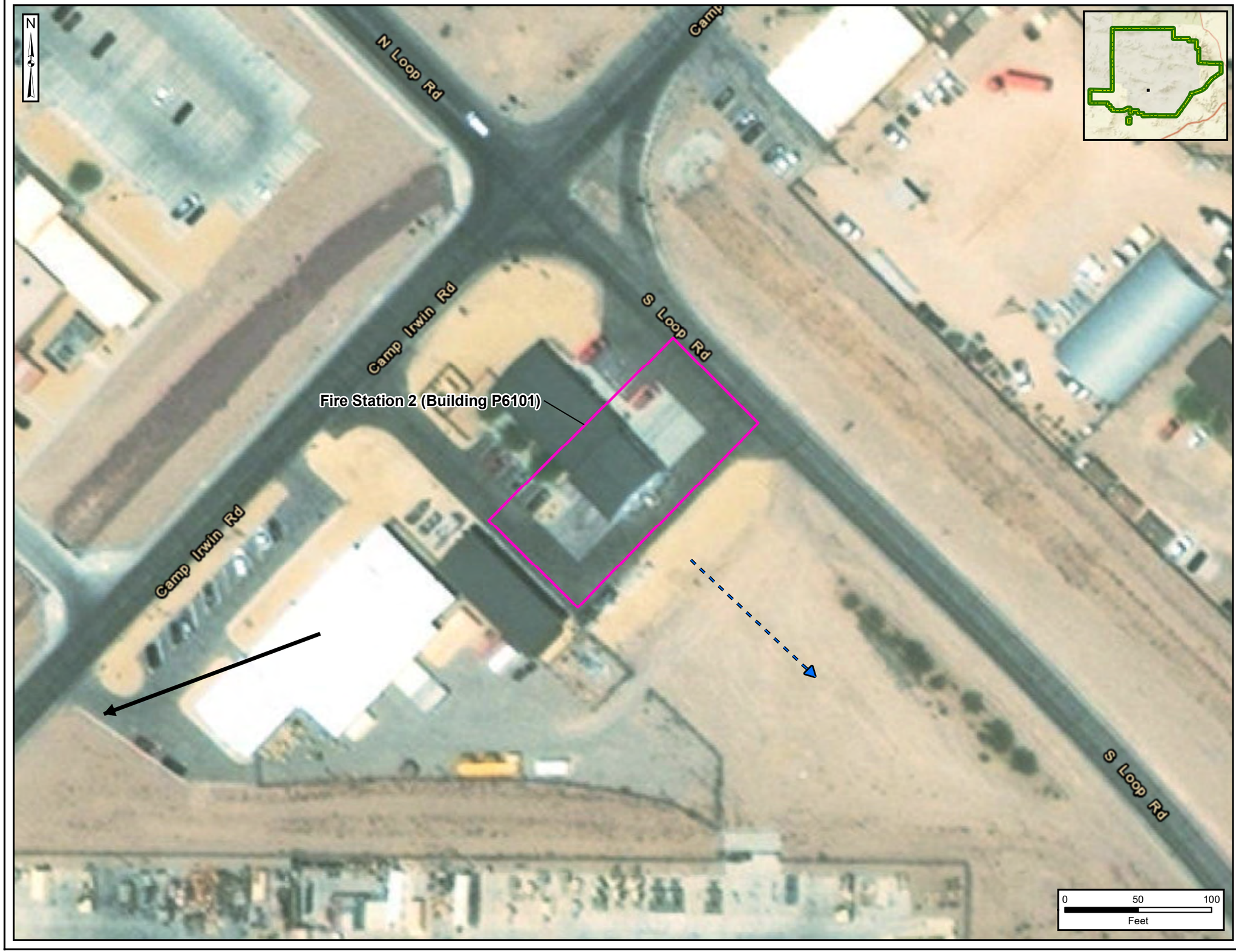
Legend

- Installation Boundary
- AOPI
- Historical Building Footprint (estimated)
- Approximate Groundwater Flow Direction
- Alternate Groundwater Flow Direction when I-7 is Actively Pumping
- Approximate Surface Runoff Flow Direction

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

Data Sources:
Google Earth, Aerial Imagery, 2013

Coordinate System:
WGS 1984, UTM Zone 11 North



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Fort Irwin, CA

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Figure 5-10
Aerial Photo of
Fire Station 2
(Building P6101) AOPI

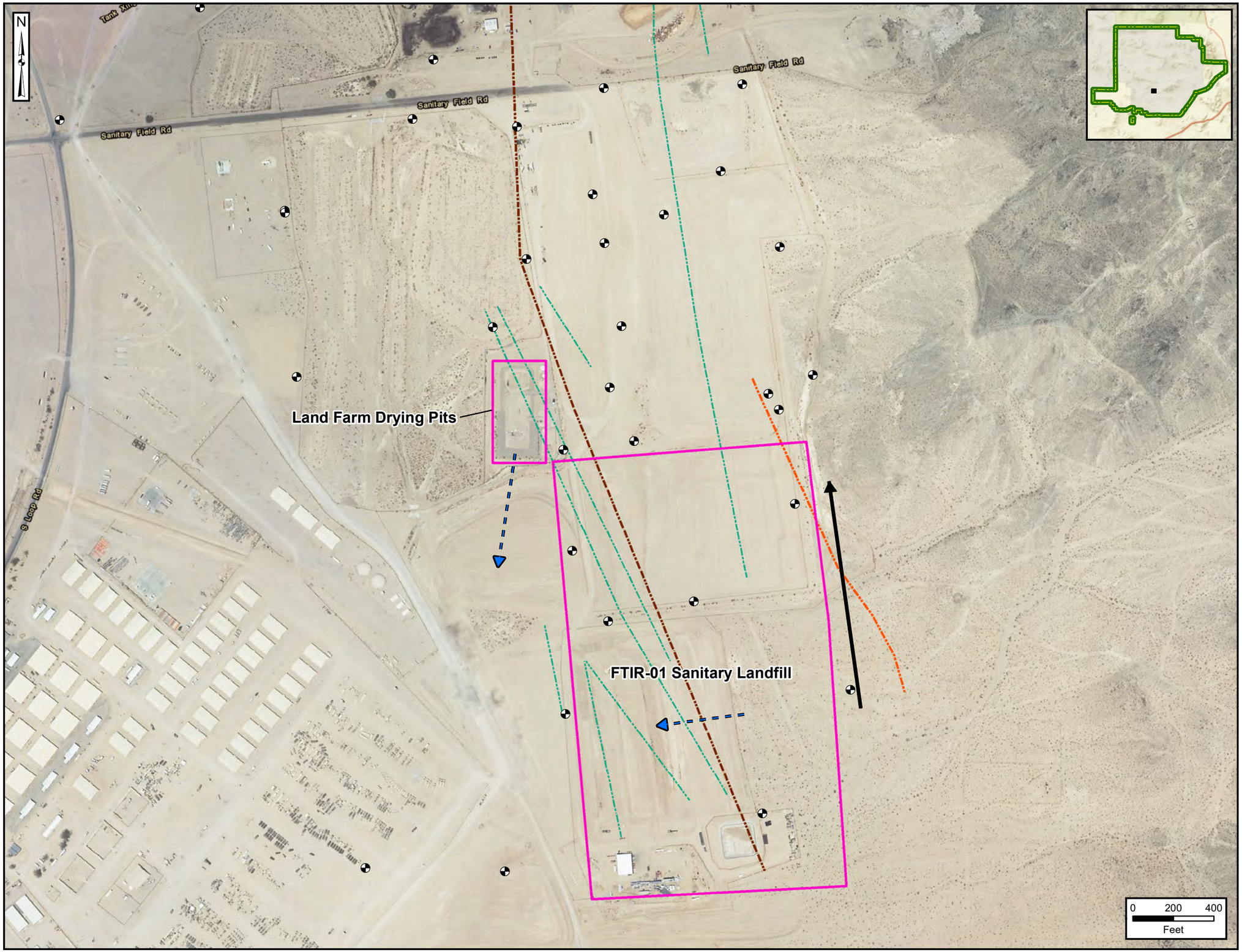
Legend

- Installation Boundary
- AOPI
- Approximate Groundwater Flow Direction
- Approximate Surface Runoff Flow Direction

AOPI = area of potential interest

Data Sources:
ESRI ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 11 North



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Fort Irwin, CA

ARCADIS

Figure 5-11
Aerial Photo of
FTIR-01 Sanitary Landfill and Land Farm Drying Pits AOPIs

Legend

- Installation Boundary
- AOPI
- Approximate Groundwater Flow Direction
- Approximate Surface Runoff Flow Direction
- Monitoring Well
- Bicycle Lake Fault
- Bicycle Fault Structure
- Inferred Landfill Fault Structure Composite

AOPI = area of potential interest
FTIR = Fort Irwin

Data Sources:
Aerostar SES, Groundwater Flow, 2017
Aerostar SES, Faults, 2017
USACE, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 11 North

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Preliminary Assessment / Site Inspection
Fort Irwin, CA

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Figure 5-12
Aerial Photo of
FTIR Helipad AOPI

Legend

- Installation Boundary
- AOPI
- Approximate Groundwater Flow Direction
- Alternate Groundwater Flow Direction when I-7 is Actively Pumping
- Approximate Surface Runoff Flow Direction

AOPI = area of potential interest

Data Sources:
ESRI ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 11 North

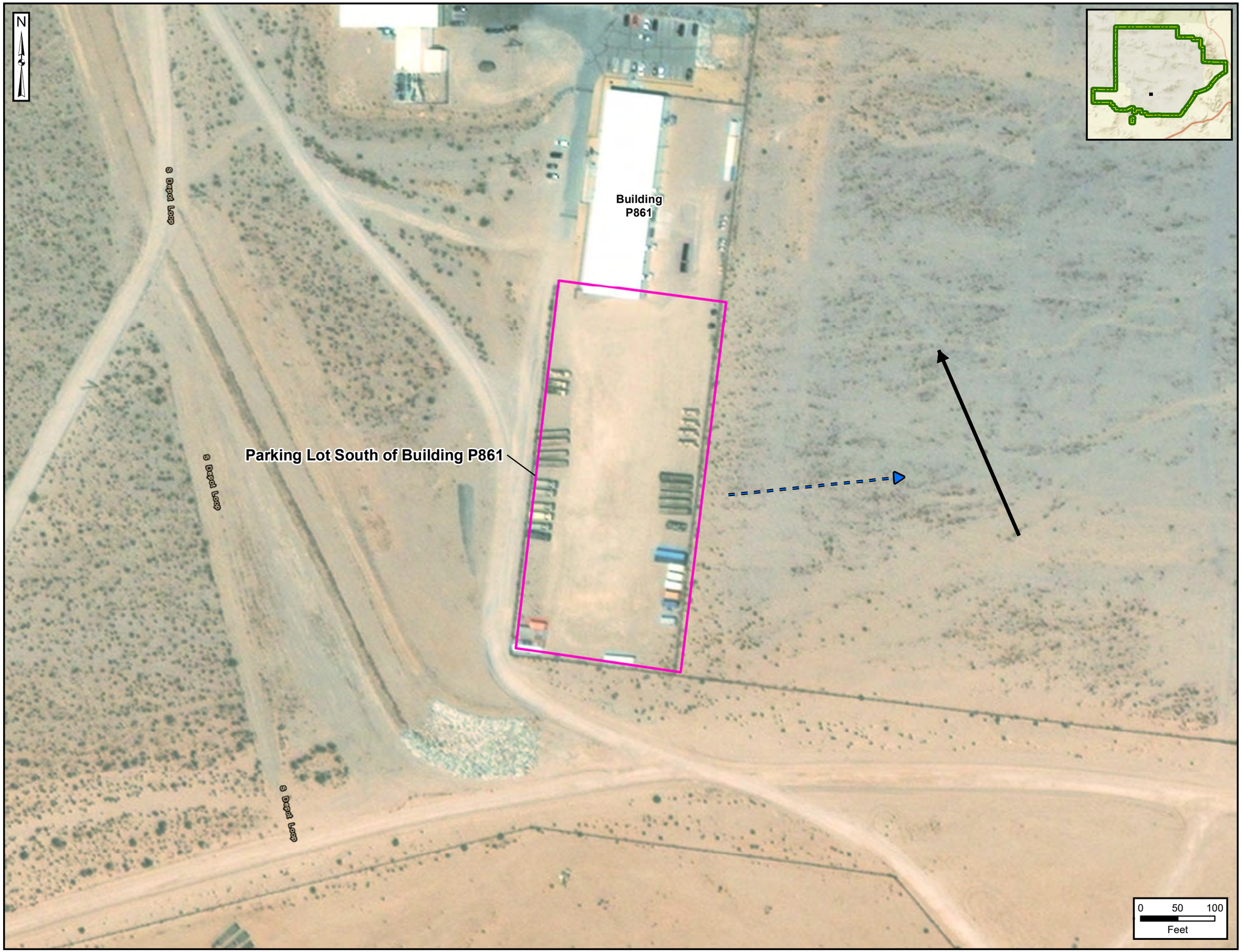

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Figure 5-13
Aerial Photo of
Parking Lot South of
Building P861 AOPI

Legend

- Installation Boundary
- AOPI
- Approximate Groundwater Flow Direction
- Approximate Surface Runoff Flow Direction

AOPI = area of potential interest

Data Sources:
ESRI ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 11 North

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Figure 5-14
Aerial Photo of
RUFMA AOPIs

Legend

- Installation Boundary
- AOPI
- Approximate AFFF Use Area
- Approximate Groundwater Flow Direction
- Alternate Groundwater Flow Direction when I-7 is Actively Pumping
- Approximate Surface Runoff Flow Direction
- Monitoring Well
- Drinking Water Production Well

AFFF = aqueous film-forming foam
AOPI = area of potential interest
RUFMA = Rotational Unit Field Maintenance Area

Data Sources:
ESRI ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 11 North

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Figure 5-15
Aerial Photo of
Bicycle Lake Army Airfield AOPIs

N

Unnamed Fault 1

Unnamed Fault 2

Bicycle Lake Army Airfield - North Staging Area

Westbrook Ave

Westbrook Ave

Westbrook Ave

Bicycle Lake Army Airfield - South Staging Area

Bicycle Lake Army Airfield - Fire Extinguisher Training Area

Bicycle Lake Army Airfield - Helipad

0 200 400
Feet

Legend

- Installation Boundary
- AOPI
- Fault
- Approximate Groundwater Flow Direction
- Approximate Surface Runoff Flow Direction
- Monitoring Well

AOPI = area of potential interest

Data Sources:
USGS, Scientific Investigations Report 2018-5067, Faults, 2018
ESRI ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 11 North

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Figure 5-16
Aerial Photo of
FTIR-20 Former Fire Training Area and J Stand Fire Truck Pump Flush Area AOPIs

Legend

- Installation Boundary
- AOPI
- Approximate Groundwater Flow Direction
- Approximate Surface Runoff Flow Direction
- Monitoring Well

AOPI = area of potential interest
FTIR = Fort Irwin

Data Sources:
ESRI ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 11 North

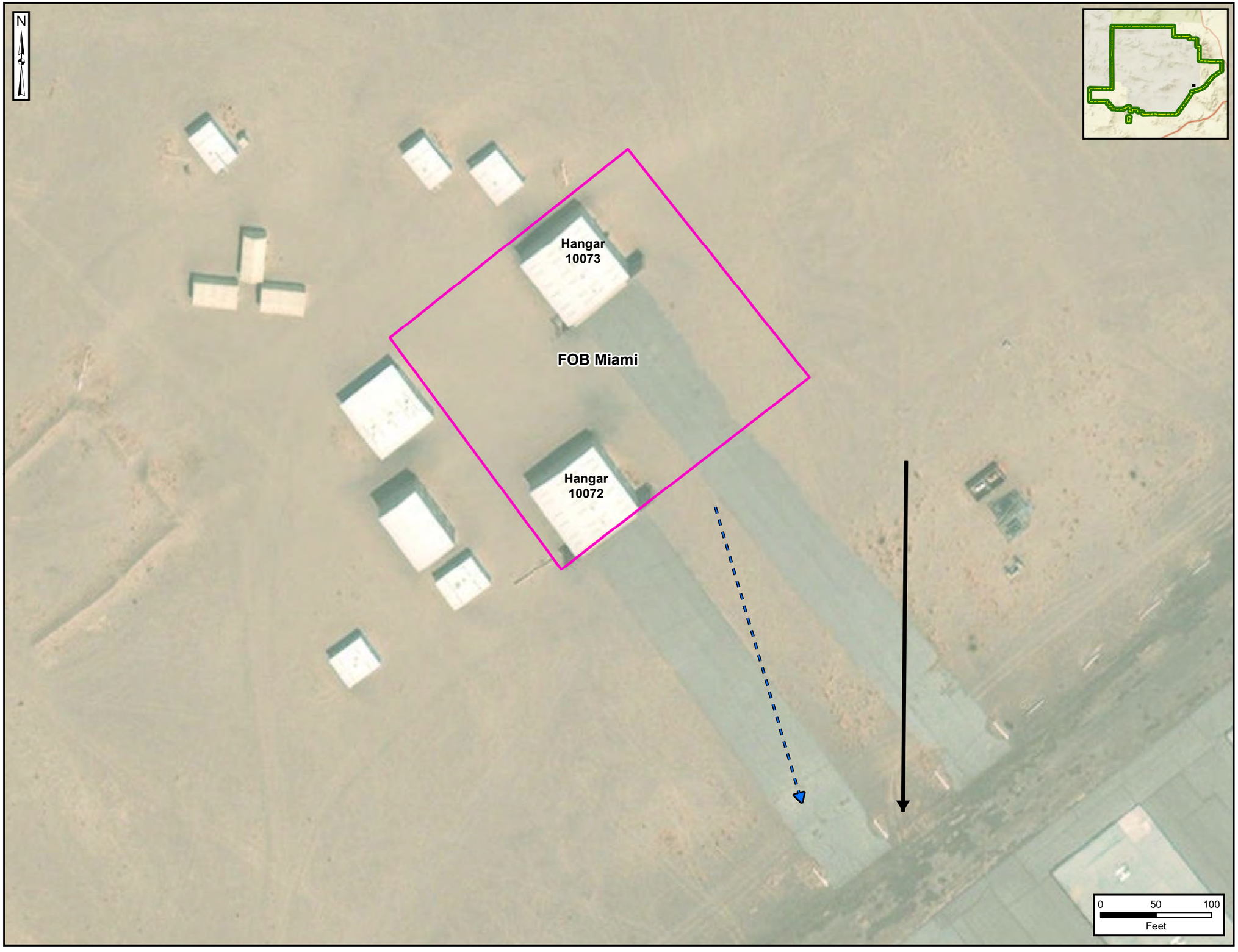

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Figure 5-17
Aerial Photo of
FOB Miami AOPI

Legend

- Installation Boundary
- AOPI
- Approximate Groundwater Flow Direction
- Approximate Surface Runoff Flow Direction

AOPI = area of potential interest
FOB = Forward Operating Base

Data Sources:
ESRI, ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 11 North

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Fort Irwin, CA

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Figure 5-18
Aerial Photo of
NASA Goldstone
Former Microwave Test Facility AOPI

Legend

- Installation Boundary
- AOPI
- Approximate Surface Runoff Flow Direction

AOPI = area of potential interest
AST = aboveground storage tank
LPG = liquefied petroleum gases
Goldstone = Goldstone Deep Space Communications Complex
NASA = National Aeronautics and Space Administration

Data Sources:
ESRI ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 11 North

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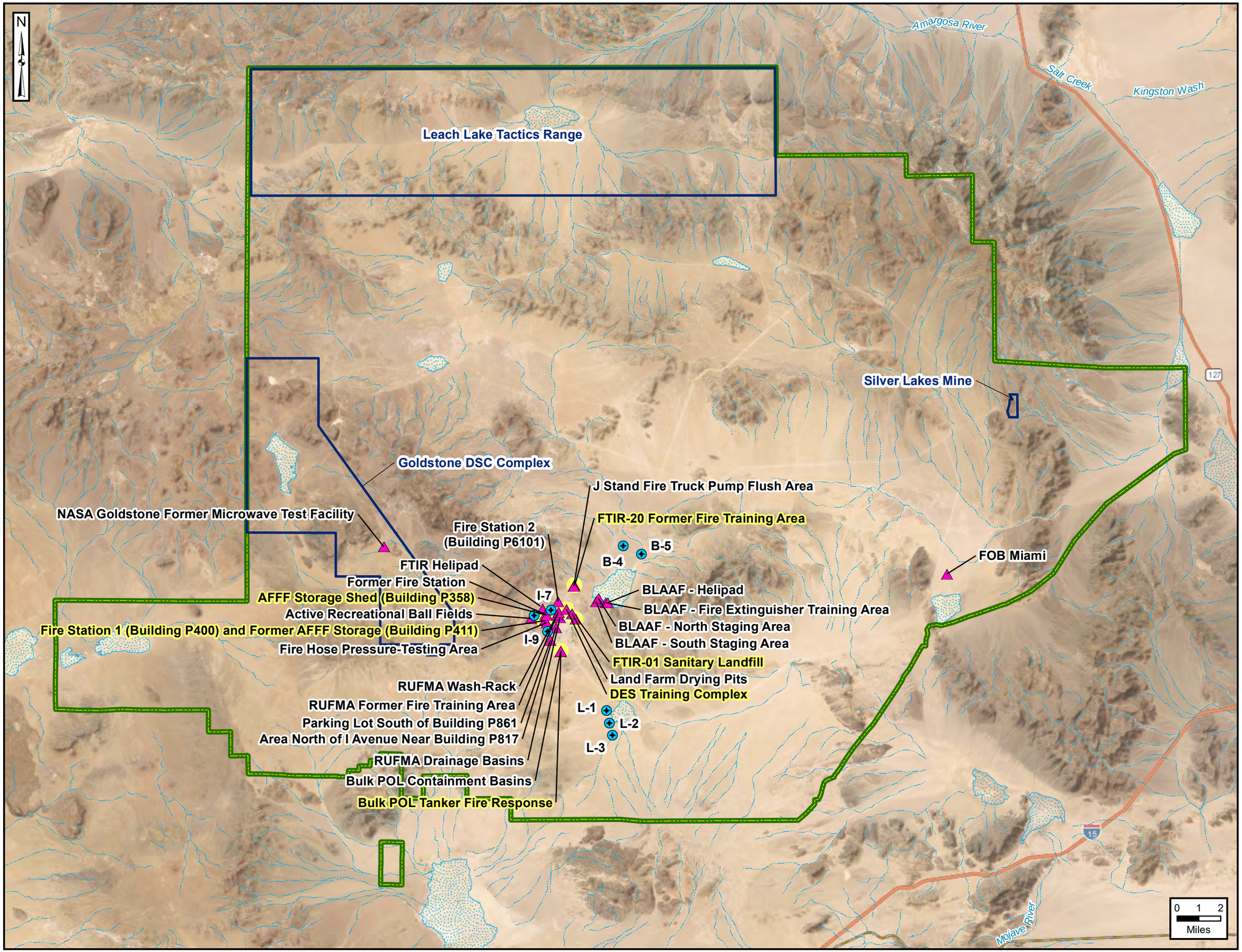
Figure 7-1
AOPI Locations and OSD Risk Screening Level Exceedances



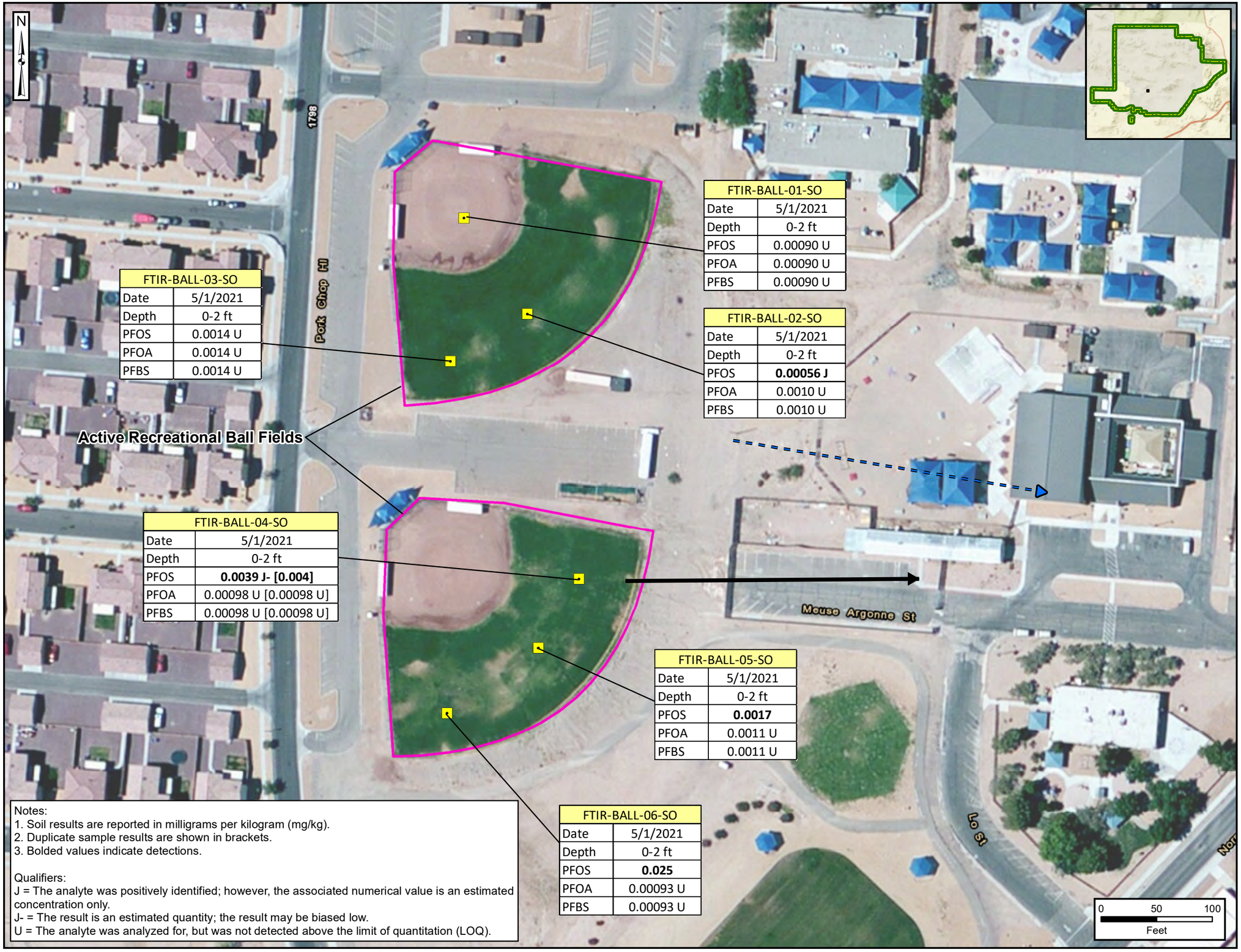
Legend

- Installation Boundary
- Tenant-Leased Property
- AOPI Location
- AOPI with OSD Risk Screening Level Exceedance
- Stream (Intermittent)
- Dry Lake Bed
- Drinking Water Production Well

AFFF = acqueous film-forming form
AOPI = area of potential interest
BLAAF = Bicycle Lake Army Airfield
DES = Directorate of Emergency Services
DSC = Deep Space Communications
FOB = Forward Operating Base
FTIR = National Training Center and Fort Irwin
NASA = National Aeronautics and Space Administration
OSD = Office of the Secretary of Defense
POL = Petroleum, Oil, and Lubricants
RUFMA = Rotational Unit Field Maintenance Area

Data Sources:
ESRI ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 11 North



Notes:
1. Soil results are reported in milligrams per kilogram (mg/kg).
2. Duplicate sample results are shown in brackets.
3. Bolded values indicate detections.

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

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Figure 7-2
Active Recreational Ball Fields AOPI
PFOS, PFOA, and PFBS Analytical Results

Legend

- Installation Boundary
- AOPI
- Approximate Groundwater Flow Direction
- Approximate Surface Runoff Flow Direction

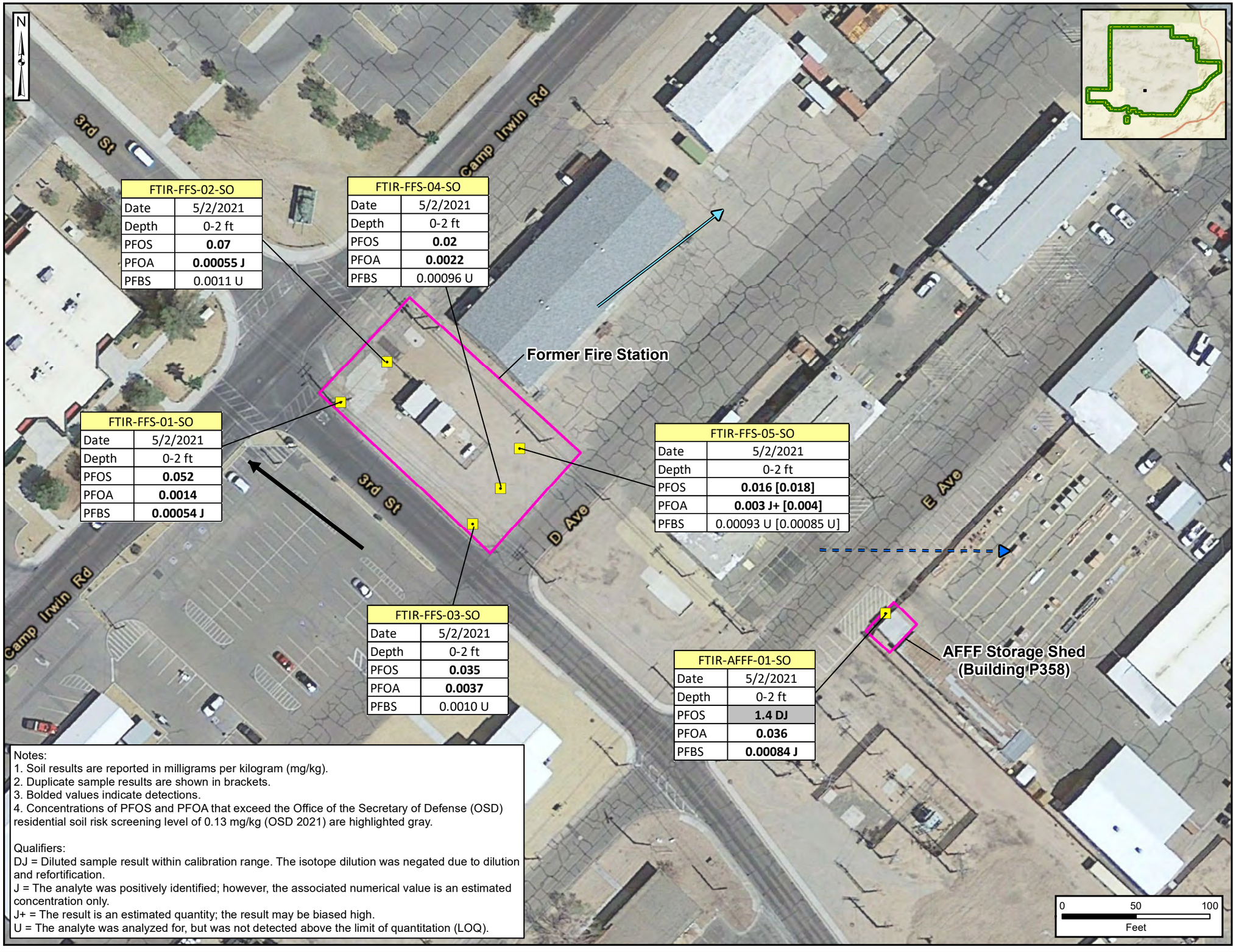
Sampling Locations

- Shallow Soil

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

Data Sources:
ESRI ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 11 North



FTIR-FFS-02-SO	
Date	5/2/2021
Depth	0-2 ft
PFOS	**0.07**
PFOA	**0.00055 J**
PFBS	0.0011 U

FTIR-FFS-04-SO	
Date	5/2/2021
Depth	0-2 ft
PFOS	**0.02**
PFOA	**0.0022**
PFBS	0.00096 U

FTIR-FFS-01-SO	
Date	5/2/2021
Depth	0-2 ft
PFOS	**0.052**
PFOA	**0.0014**
PFBS	**0.00054 J**

FTIR-FFS-05-SO	
Date	5/2/2021
Depth	0-2 ft
PFOS	**0.016 [0.018]**
PFOA	**0.003 J+ [0.004]**
PFBS	0.00093 U [0.00085 U]

FTIR-FFS-03-SO	
Date	5/2/2021
Depth	0-2 ft
PFOS	**0.035**
PFOA	**0.0037**
PFBS	0.0010 U

FTIR-AFFF-01-SO	
Date	5/2/2021
Depth	0-2 ft
PFOS	**1.4 DJ**
PFOA	**0.036**
PFBS	**0.00084 J**

Notes:
1. Soil results are reported in milligrams per kilogram (mg/kg).
2. Duplicate sample results are shown in brackets.
3. Bolded values indicate detections.
4. Concentrations of PFOS and PFOA that exceed the Office of the Secretary of Defense (OSD) residential soil risk screening level of 0.13 mg/kg (OSD 2021) are highlighted gray.

Qualifiers:
DJ = Diluted sample result within calibration range. The isotope dilution was negated due to dilution and refortification.
J = The analyte was positively identified; however, the associated numerical value is an estimated concentration only.
J+ = The result is an estimated quantity; the result may be biased high.
U = The analyte was analyzed for, but was not detected above the limit of quantitation (LOQ).

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Figure 7-3
Former Fire Station and AFFF Storage Shed (Building P358) AOPIs PFOS, PFOA, and PFBS Analytical Results

Legend

- Installation Boundary
- AOPI
- Approximate Groundwater Flow Direction
- Alternate Groundwater Flow Direction when I-7 is Actively Pumping
- Approximate Surface Runoff Flow Direction

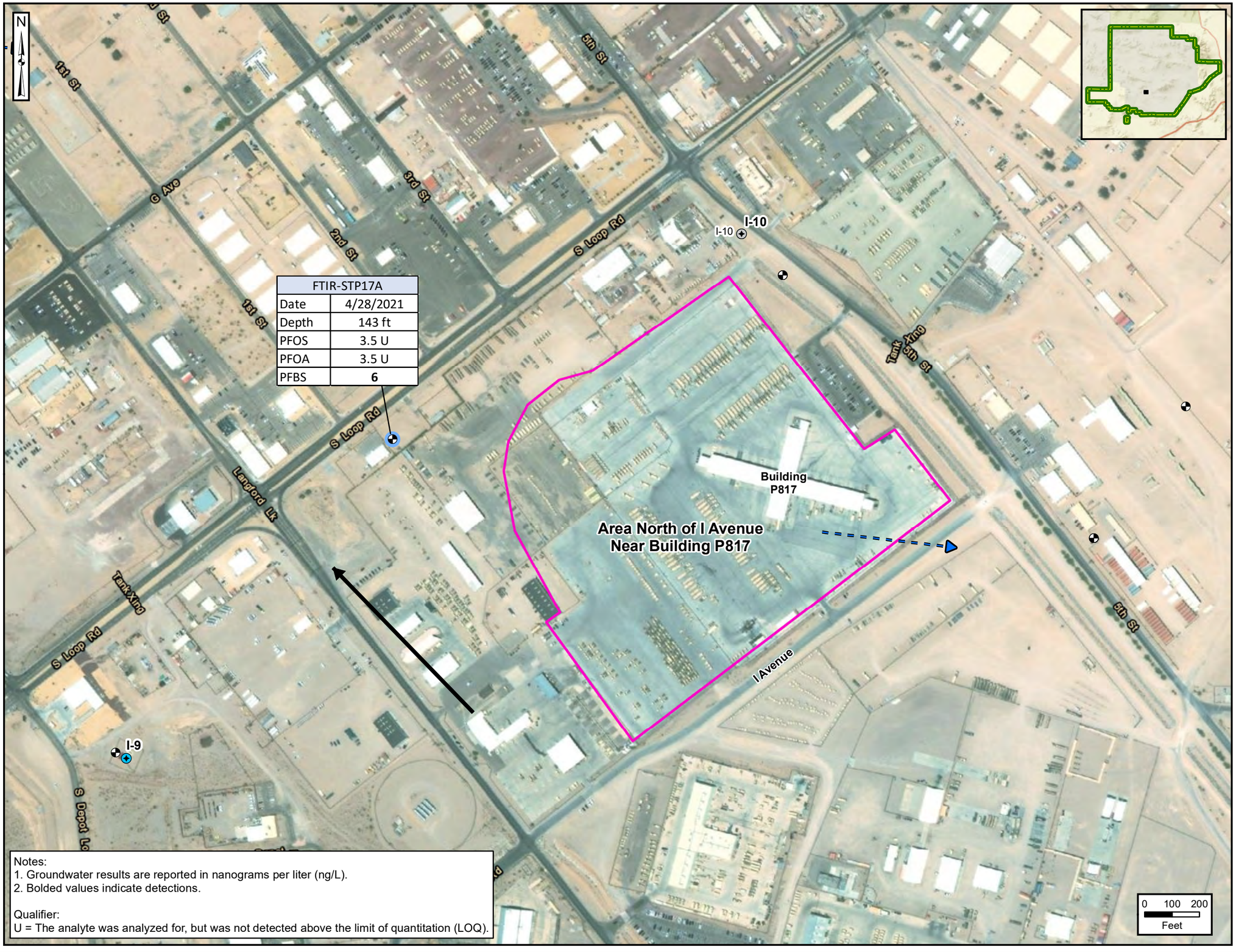
Sampling Locations

- Shallow Soil

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

Data Sources:
Google Earth, Aerial Imagery, 2014

Coordinate System:
WGS 1984, UTM Zone 11 North



FTIR-STP17A	
Date	4/28/2021
Depth	143 ft
PFOS	3.5 U
PFOA	3.5 U
PFBS	**6**

Notes:
1. Groundwater results are reported in nanograms per liter (ng/L).
2. Bolded values indicate detections.

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

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Figure 7-4
Area North of I Avenue
Near Building P817 AOPI
PFOS, PFOA, and PFBS
Analytical Results

Legend

- Installation Boundary
- AOPI
- Approximate Groundwater Flow Direction
- Approximate Surface Runoff Flow Direction
- Monitoring Well
- Drinking Water Production Well
- Non-Drinking Water Production Well (Inactive/Abandoned) *

Sampling Locations

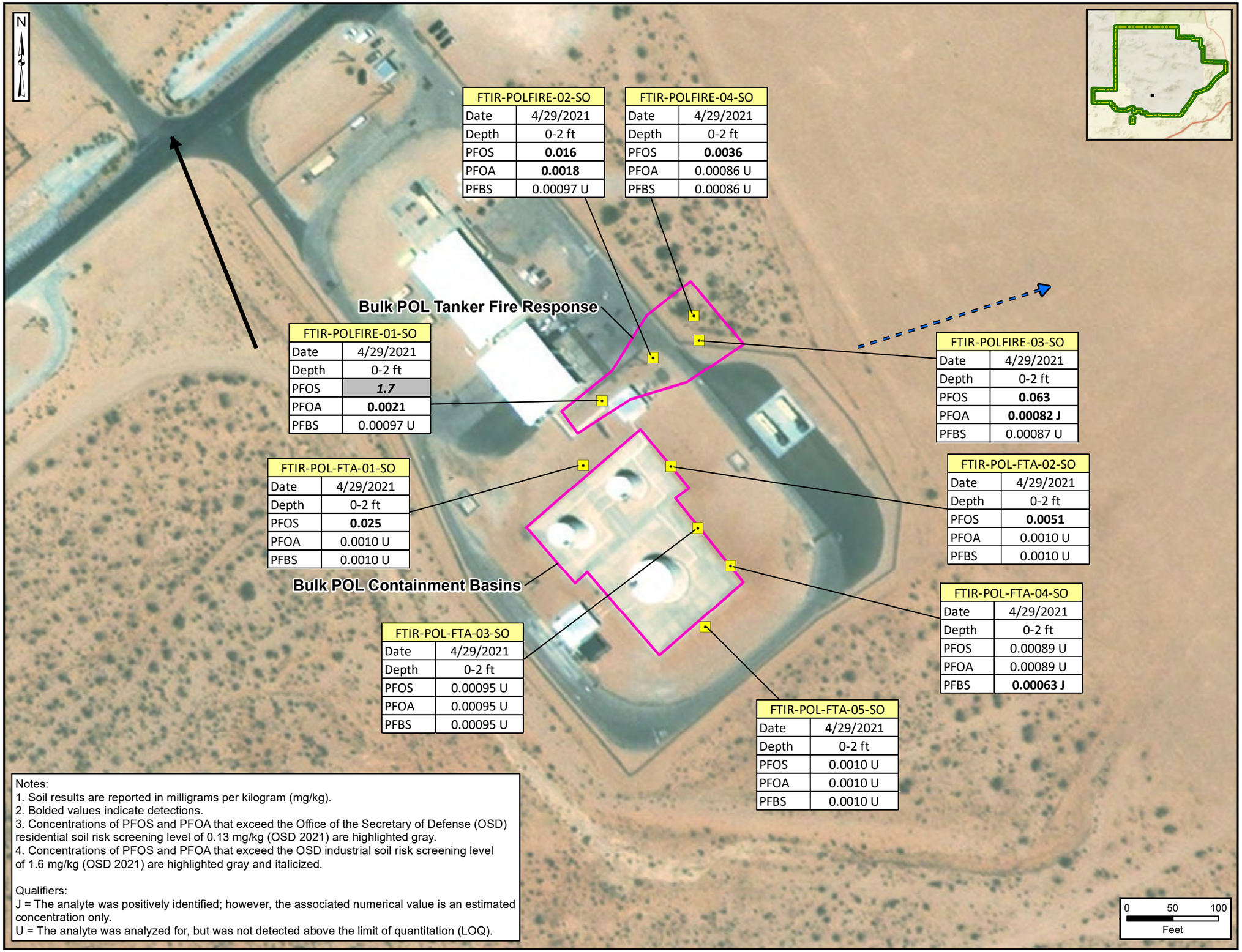
- Groundwater (Existing Well)

* Sampling was planned at Well I10 but could not be collected; well inactive or destroyed.

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

Data Sources:
ESRI ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 11 North



Notes:
1. Soil results are reported in milligrams per kilogram (mg/kg).
2. Bolded values indicate detections.
3. Concentrations of PFOS and PFOA that exceed the Office of the Secretary of Defense (OSD) residential soil risk screening level of 0.13 mg/kg (OSD 2021) are highlighted gray.
4. Concentrations of PFOS and PFOA that exceed the OSD industrial soil risk screening level of 1.6 mg/kg (OSD 2021) are highlighted gray and italicized.

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

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Figure 7-5
Bulk POL Tanker Fire Response and Bulk POL Containment Basins AOPIs PFOS, PFOA, and PFBS Analytical Results

Legend

- Installation Boundary
- AOPI
- Approximate Groundwater Flow Direction
- Approximate Surface Runoff Flow Direction

Sampling Locations

- Shallow Soil

AOPI = area of potential interest
ft = feet
PFBS = perfluorobutanesulfonic acid
PFOA = perfluorooctanoic acid
PFOS = perfluorooctane sulfonate
POL = Petroleum, Oil, and Lubricants
SO = soil

Data Sources:
ESRI ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 11 North

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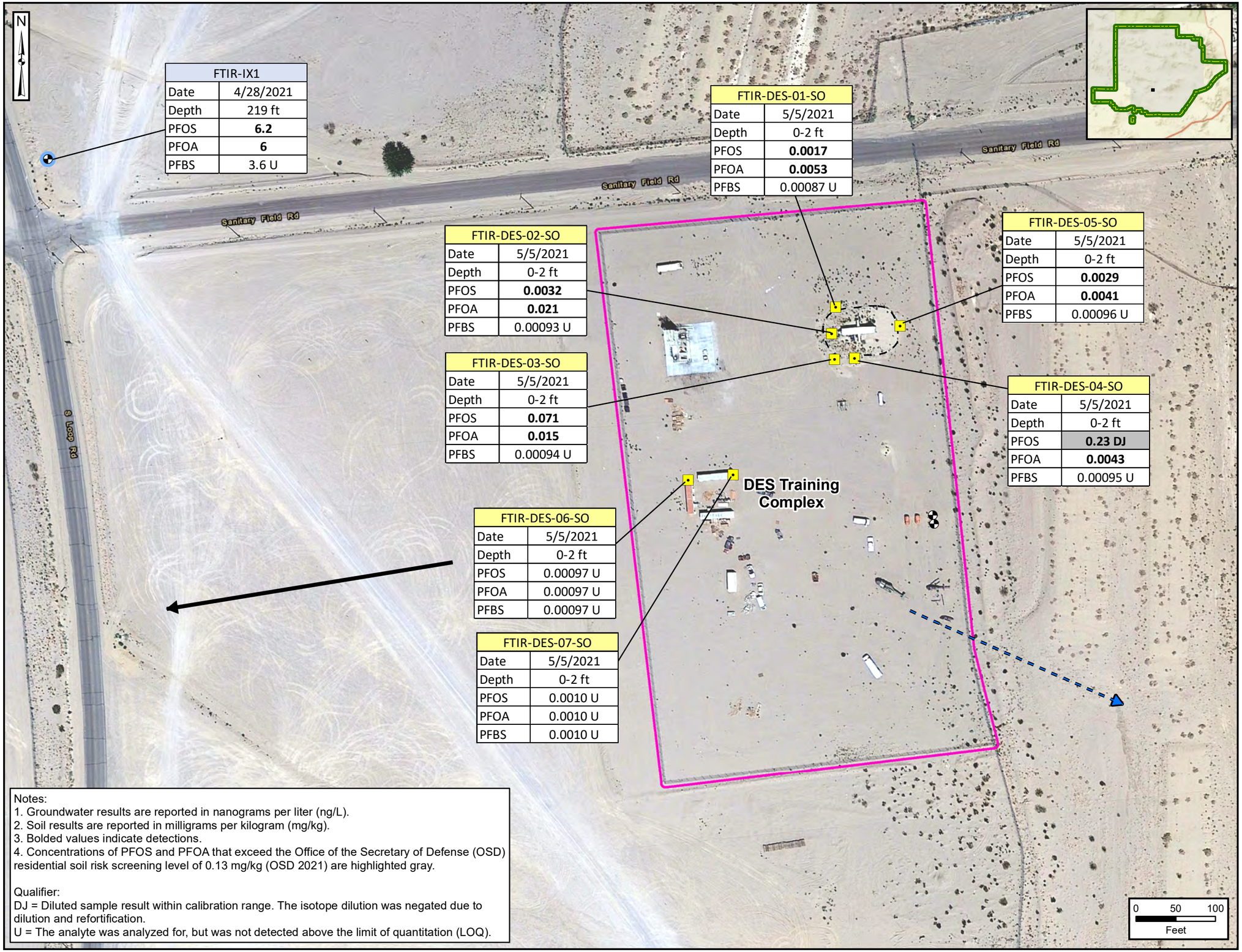
Figure 7-6
DES Training Complex AOPI PFOS, PFOA, and PFBS Analytical Results



FTIR-IX1	
Date	4/28/2021
Depth	219 ft
PFOS	**6.2**
PFOA	**6**
PFBS	3.6 U

FTIR-DES-01-SO	
Date	5/5/2021
Depth	0-2 ft
PFOS	**0.0017**
PFOA	**0.0053**
PFBS	0.00087 U

FTIR-DES-02-SO	
Date	5/5/2021
Depth	0-2 ft
PFOS	**0.0032**
PFOA	**0.021**
PFBS	0.00093 U

FTIR-DES-03-SO	
Date	5/5/2021
Depth	0-2 ft
PFOS	**0.071**
PFOA	**0.015**
PFBS	0.00094 U

FTIR-DES-04-SO	
Date	5/5/2021
Depth	0-2 ft
PFOS	**0.23 DJ**
PFOA	**0.0043**
PFBS	0.00095 U

FTIR-DES-05-SO	
Date	5/5/2021
Depth	0-2 ft
PFOS	**0.0029**
PFOA	**0.0041**
PFBS	0.00096 U

FTIR-DES-06-SO	
Date	5/5/2021
Depth	0-2 ft
PFOS	0.00097 U
PFOA	0.00097 U
PFBS	0.00097 U

FTIR-DES-07-SO	
Date	5/5/2021
Depth	0-2 ft
PFOS	0.0010 U
PFOA	0.0010 U
PFBS	0.0010 U

Legend

- Installation Boundary
- AOPI
- Lined Training Pit
- Approximate Groundwater Flow Direction
- Approximate Surface Runoff Flow Direction
- Monitoring Well

Sampling Locations

- Shallow Soil
- Groundwater (Existing Well)

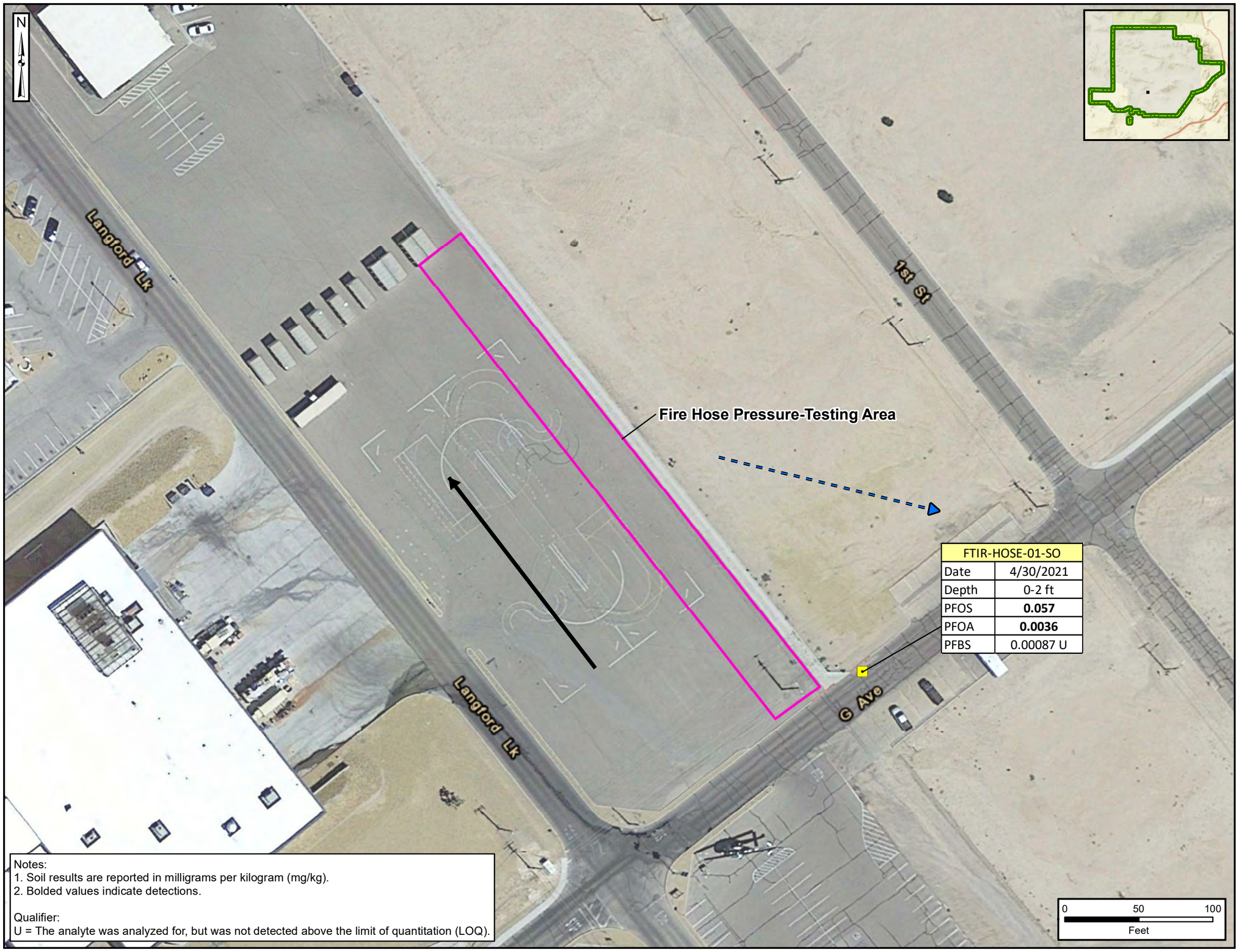
AOPI = area of potential interest
DES = Directorate of Emergency Services
ft = feet
PFBS = perfluorobutanesulfonic acid
PFOA = perfluorooctanoic acid
PFOS = perfluorooctane sulfonate
SO = soil

Notes:
1. Groundwater results are reported in nanograms per liter (ng/L).
2. Soil results are reported in milligrams per kilogram (mg/kg).
3. Bolded values indicate detections.
4. Concentrations of PFOS and PFOA that exceed the Office of the Secretary of Defense (OSD) residential soil risk screening level of 0.13 mg/kg (OSD 2021) are highlighted gray.

Qualifier:
DJ = Diluted sample result within calibration range. The isotope dilution was negated due to dilution and refortification.
U = The analyte was analyzed for, but was not detected above the limit of quantitation (LOQ).

Data Sources:
Google Earth, Aerial Imagery, 2013

Coordinate System:
WGS 1984, UTM Zone 11 North



Notes:
1. Soil results are reported in milligrams per kilogram (mg/kg).
2. Bolded values indicate detections.

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

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Figure 7-7
Fire Hose Pressure-Testing Area AOPI
PFOS, PFOA, and PFBS Analytical Results

Legend

- Installation Boundary
- AOPI
- Approximate Groundwater Flow Direction
- Approximate Surface Runoff Flow Direction

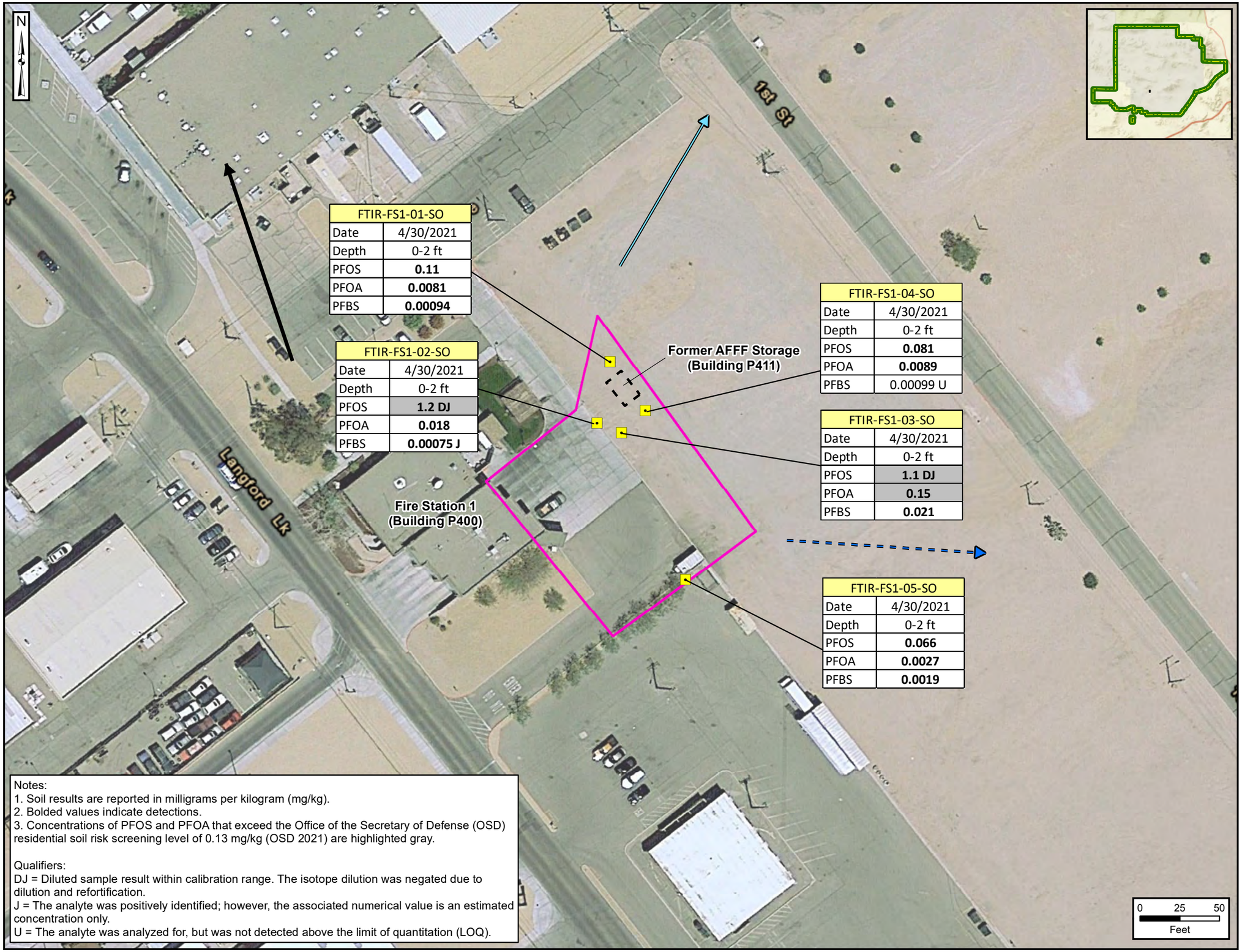
Sampling Locations

- Shallow Soil

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

Data Sources:
Google Earth, Aerial Imagery, 2014

Coordinate System:
WGS 1984, UTM Zone 11 North



Notes:
1. Soil results are reported in milligrams per kilogram (mg/kg).
2. Bolded values indicate detections.
3. Concentrations of PFOS and PFOA that exceed the Office of the Secretary of Defense (OSD) residential soil risk screening level of 0.13 mg/kg (OSD 2021) are highlighted gray.

Qualifiers:
DJ = Diluted sample result within calibration range. The isotope dilution was negated due to dilution and refortification.
J = The analyte was positively identified; however, the associated numerical value is an estimated concentration only.
U = The analyte was analyzed for, but was not detected above the limit of quantitation (LOQ).

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Figure 7-8
Fire Station 1 (Building P400) and Former AFFF Storage (Building P411) AOPI PFOS, PFOA, and PFBS Analytical Results

Legend

- Installation Boundary
- AOPI
- Historical Building Footprint (estimated)
- Approximate Groundwater Flow Direction
- Alternate Groundwater Flow Direction when I-7 is Actively Pumping
- Approximate Surface Runoff Flow Direction

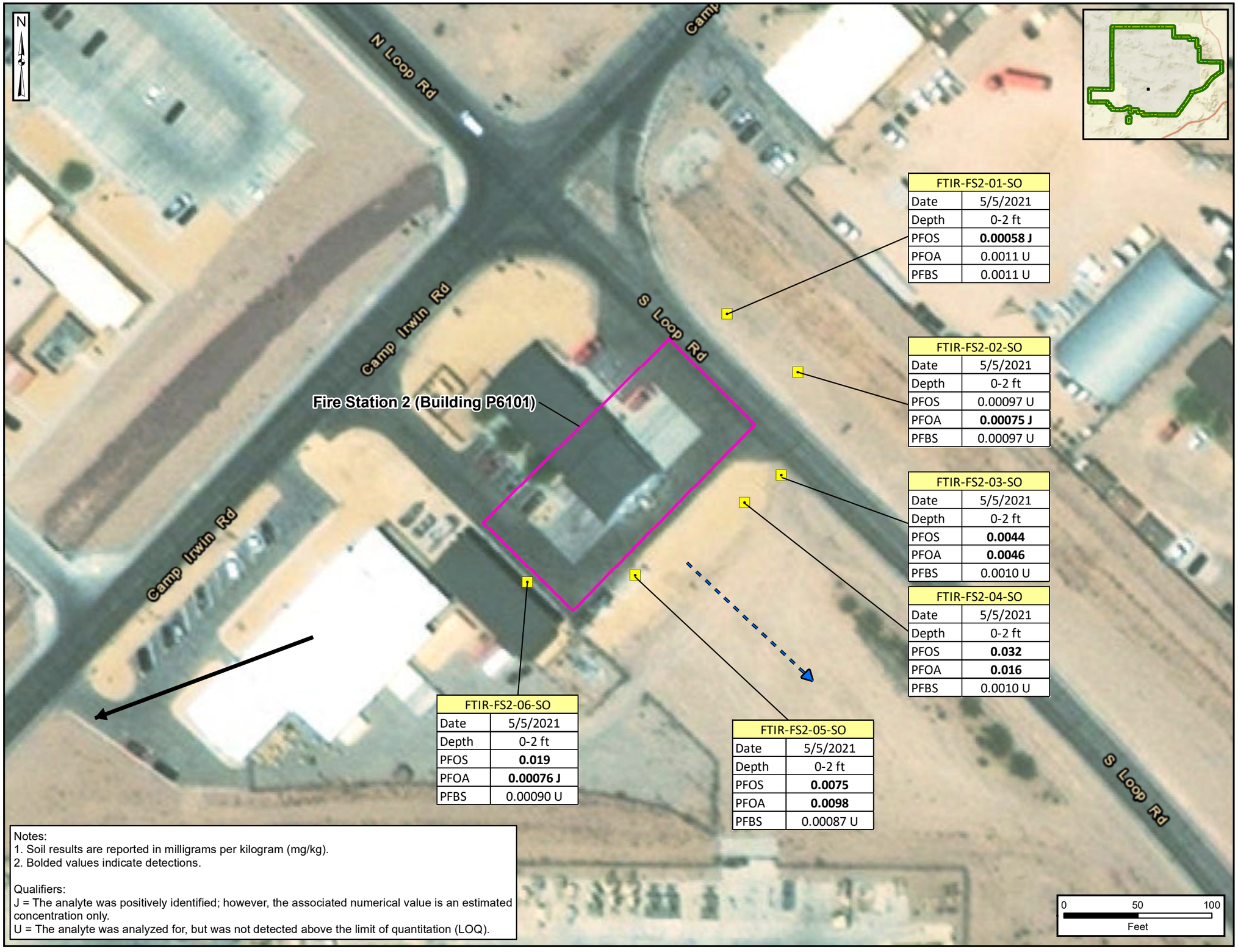
Sampling Locations

- Shallow Soil

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

Data Sources:
Google Earth, Aerial Imagery, 2013

Coordinate System:
WGS 1984, UTM Zone 11 North



Notes:
1. Soil results are reported in milligrams per kilogram (mg/kg).
2. Bolded values indicate detections.

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

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Figure 7-9
Fire Station 2 (Building P6101) AOPI PFOS, PFOA, and PFBS Analytical Results

Legend

- Installation Boundary
- AOPI
- Approximate Groundwater Flow Direction
- Approximate Surface Runoff Flow Direction

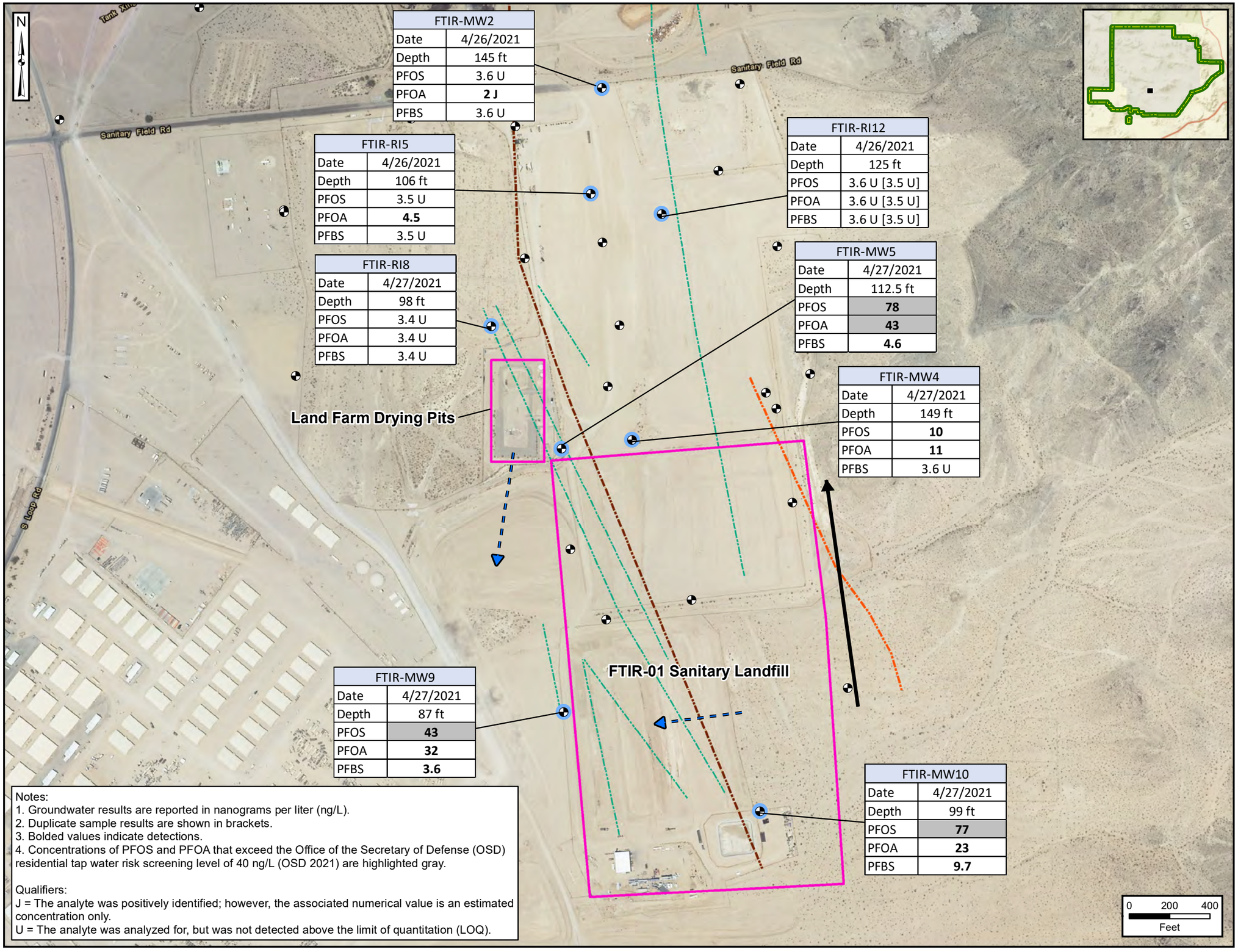
Sampling Locations

- Shallow Soil

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

Data Sources:
ESRI ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 11 North



FTIR-MW2	
Date	4/26/2021
Depth	145 ft
PFOS	3.6 U
PFOA	**2 J**
PFBS	3.6 U

FTIR-RI5	
Date	4/26/2021
Depth	106 ft
PFOS	3.5 U
PFOA	**4.5**
PFBS	3.5 U

FTIR-RI12	
Date	4/26/2021
Depth	125 ft
PFOS	3.6 U [3.5 U]
PFOA	3.6 U [3.5 U]
PFBS	3.6 U [3.5 U]

FTIR-RI8	
Date	4/27/2021
Depth	98 ft
PFOS	3.4 U
PFOA	3.4 U
PFBS	3.4 U

FTIR-MW5	
Date	4/27/2021
Depth	112.5 ft
PFOS	**78**
PFOA	**43**
PFBS	**4.6**

FTIR-MW4	
Date	4/27/2021
Depth	149 ft
PFOS	**10**
PFOA	**11**
PFBS	3.6 U

FTIR-MW9	
Date	4/27/2021
Depth	87 ft
PFOS	**43**
PFOA	**32**
PFBS	**3.6**

FTIR-MW10	
Date	4/27/2021
Depth	99 ft
PFOS	**77**
PFOA	**23**
PFBS	**9.7**

Notes:
1. Groundwater results are reported in nanograms per liter (ng/L).
2. Duplicate sample results are shown in brackets.
3. Bolded values indicate detections.
4. Concentrations of PFOS and PFOA that exceed the Office of the Secretary of Defense (OSD) residential tap water risk screening level of 40 ng/L (OSD 2021) are highlighted gray.

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

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Figure 7-10
FTIR-01 Sanitary Landfill and Land Farm Drying Pits AOPIs PFOS, PFOA, and PFBS Analytical Results

Legend

- Installation Boundary
- AOPI
- Approximate Groundwater Flow Direction
- Approximate Surface Runoff Flow Direction
- Monitoring Well
- Bicycle Lake Fault
- Bicycle Fault Structure
- Inferred Landfill Fault Structure Composite

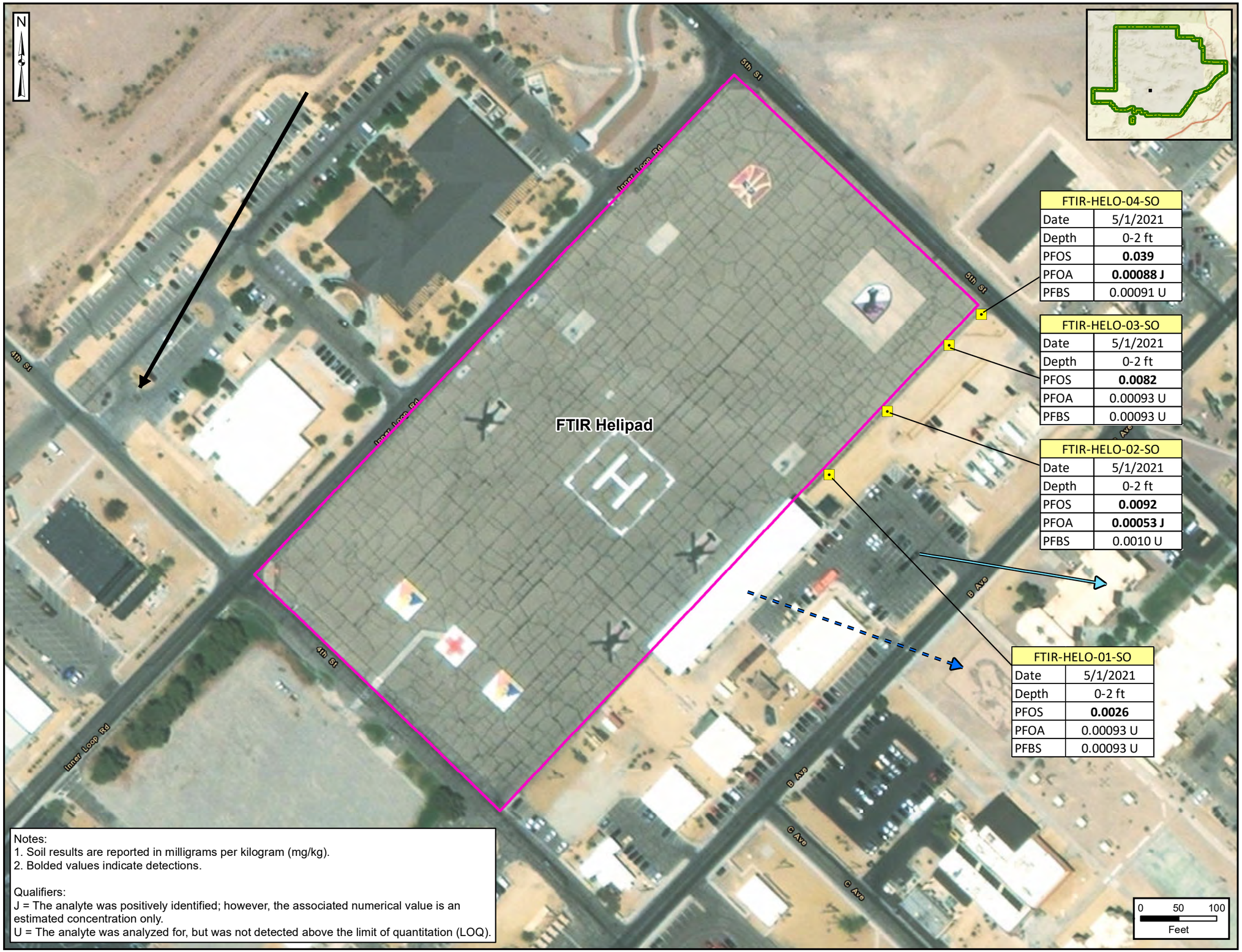
Sampling Locations

- Groundwater (Existing Well)

AOPI = area of potential interest
ft = feet
FTIR = Fort Irwin
PFBS = perfluorobutanesulfonic acid
PFOA = perfluorooctanoic acid
PFOS = perfluorooctane sulfonate

Data Sources:
Aerostar SES, Groundwater Flow, 2017
Aerostar SES, Faults, 2017
USACE, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 11 North



Notes:
1. Soil results are reported in milligrams per kilogram (mg/kg).
2. Bolded values indicate detections.

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

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Figure 7-11
FTIR Helipad AOPI
PFOS, PFOA, and PFBS Analytical Results

Legend

- Installation Boundary
- AOPI
- Approximate Groundwater Flow Direction
- Alternate Groundwater Flow Direction when I-7 is Actively Pumping
- Approximate Surface Runoff Flow Direction

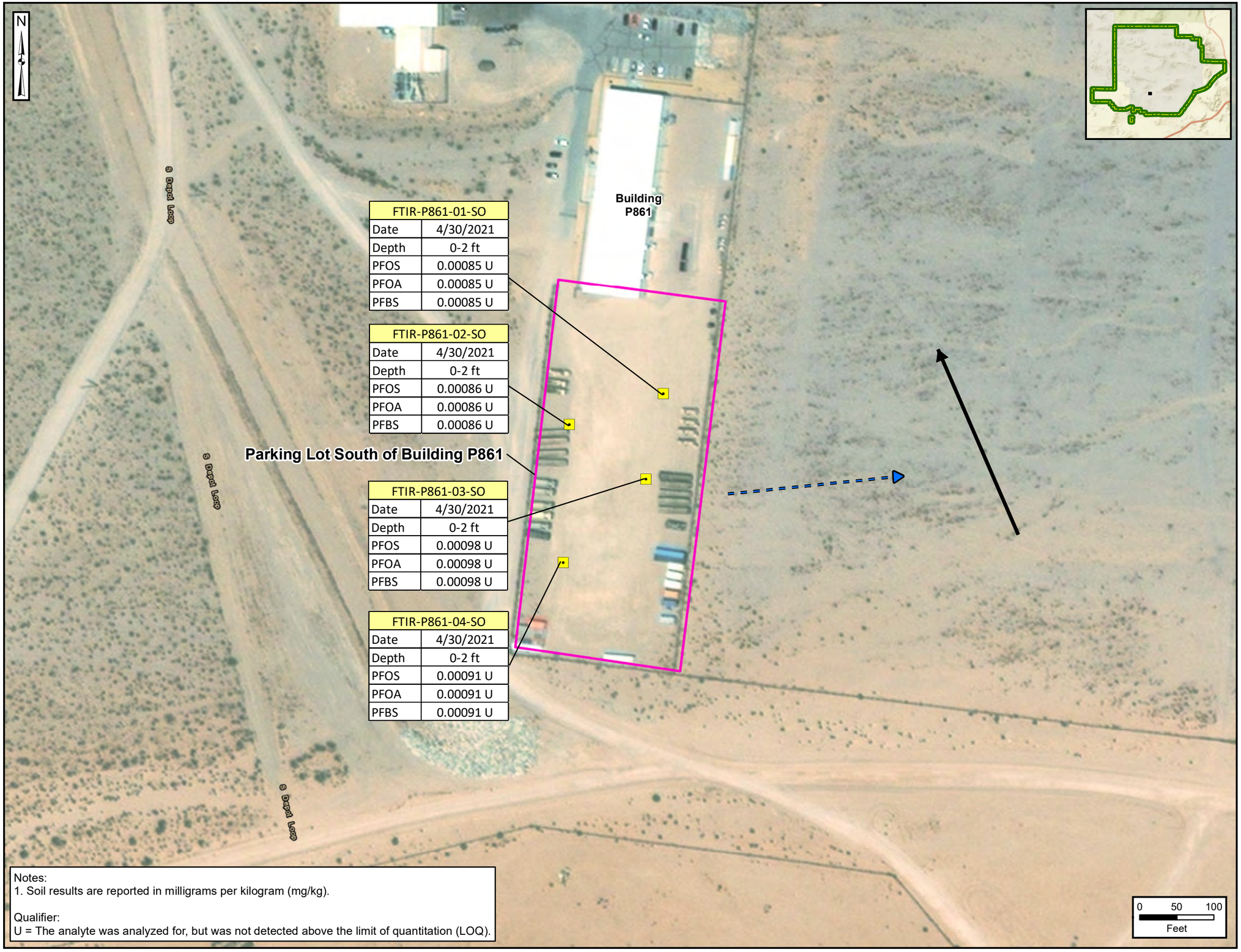
Sampling Locations

- Shallow Soil

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

Data Sources:
ESRI ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 11 North



Notes:
1. Soil results are reported in milligrams per kilogram (mg/kg).

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

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Figure 7-12
Parking Lot South of Building P861 AOPI
PFOS, PFOA, and PFBS Analytical Results

Legend

- Installation Boundary
- AOPI
- Approximate Groundwater Flow Direction
- Approximate Surface Runoff Flow Direction

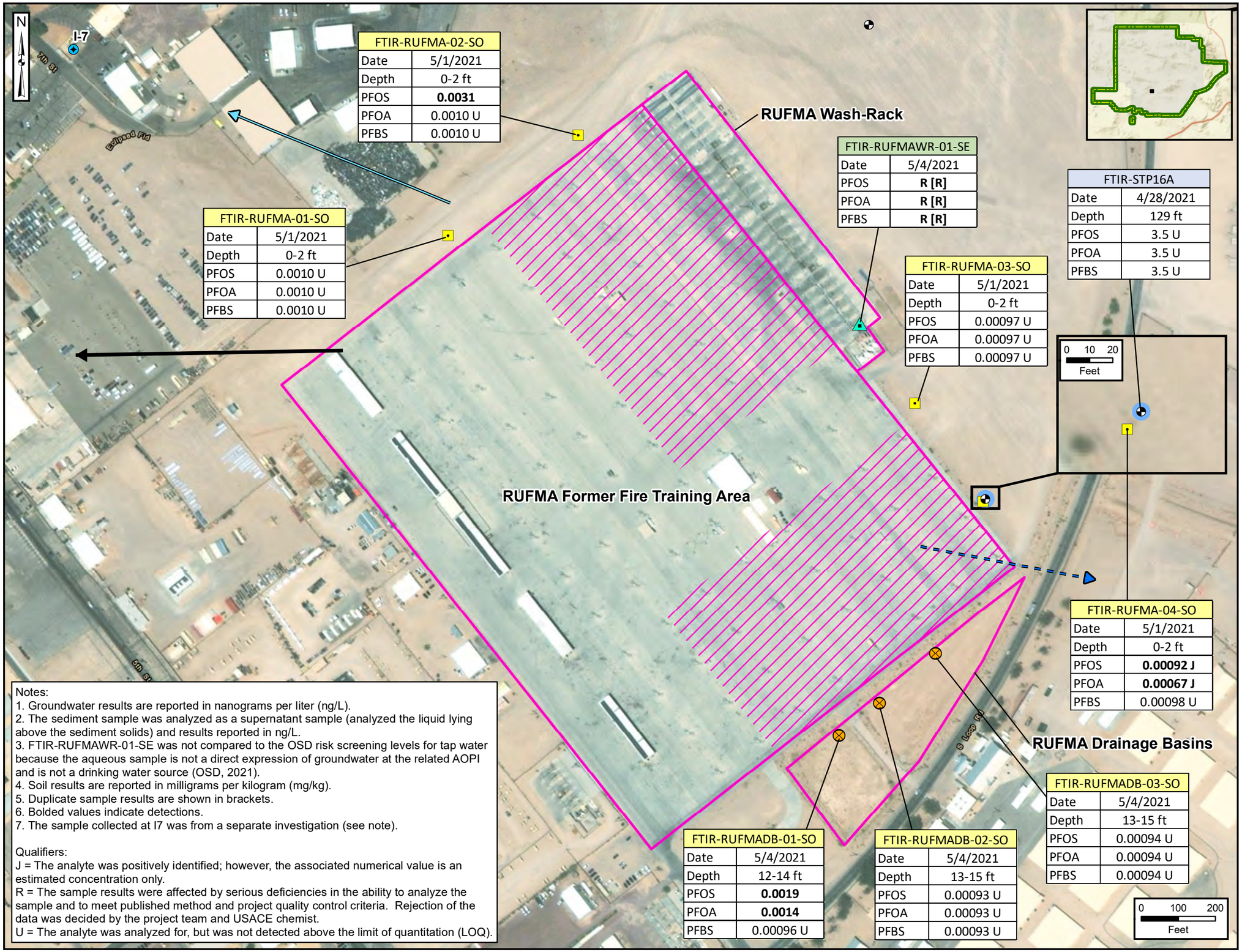
Sampling Locations

- Shallow Soil

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

Data Sources:
ESRI ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 11 North



Notes:
1. Groundwater results are reported in nanograms per liter (ng/L).
2. The sediment sample was analyzed as a supernatant sample (analyzed the liquid lying above the sediment solids) and results reported in ng/L.
3. FTIR-RUFMAWR-01-SE was not compared to the OSD risk screening levels for tap water because the aqueous sample is not a direct expression of groundwater at the related AOPI and is not a drinking water source (OSD, 2021).
4. Soil results are reported in milligrams per kilogram (mg/kg).
5. Duplicate sample results are shown in brackets.
6. Bolded values indicate detections.
7. The sample collected at I7 was from a separate investigation (see note).

Qualifiers:
J = The analyte was positively identified; however, the associated numerical value is an estimated concentration only.
R = The sample results were affected by serious deficiencies in the ability to analyze the sample and to meet published method and project quality control criteria. Rejection of the data was decided by the project team and USACE chemist.
U = The analyte was analyzed for, but was not detected above the limit of quantitation (LOQ).

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Figure 7-13
RUFMA AOPIs
PFOS, PFOA, and PFBS Analytical Results

Legend

- Installation Boundary
- AOPI
- Approximate AFFF Use Area
- Approximate Groundwater Flow Direction
- Alternate Groundwater Flow Direction when I-7 is Actively Pumping
- Approximate Surface Runoff Flow Direction
- Monitoring Well
- Drinking Water Production Well

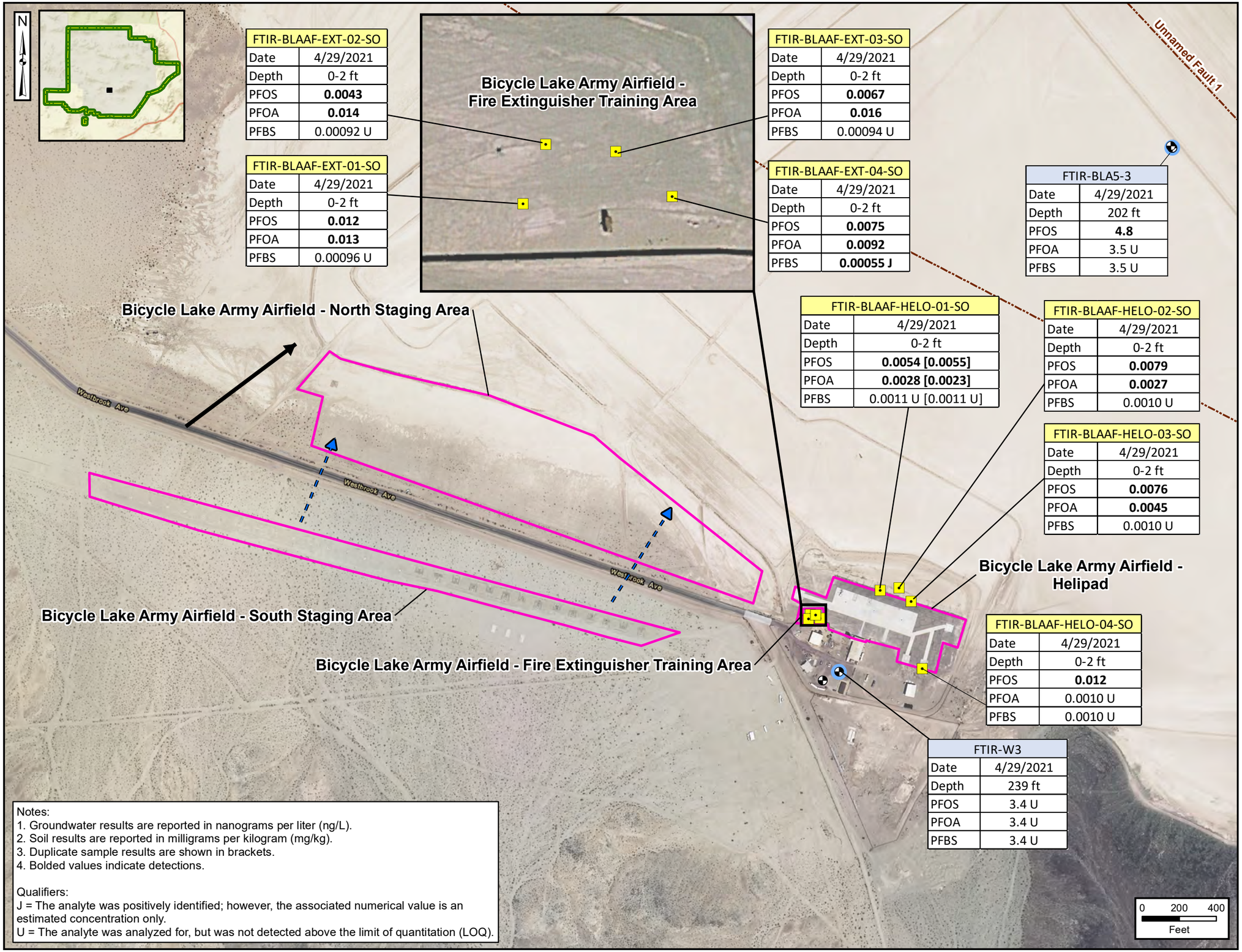
Sampling Locations

- Shallow Soil
- Soil Boring
- Groundwater (Existing Well)
- Sediment

AFFF = aqueous film-forming foam
AOPI = area of potential interest
ft = feet
bgs = below ground surface
OSD = Office of the Secretary of Defense
PFBS = perfluorobutanesulfonic acid
PFOA = perfluorooctanoic acid
PFOS = perfluorooctane sulfonate
RUFMA = Rotational Unit Field Maintenance Area
SE = sediment
SO = soil
USACE = United States Army Corps of Engineers

Data Sources:
ESRI ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 11 North



FTIR-BLAAF-EXT-02-SO	
Date	4/29/2021
Depth	0-2 ft
PFOS	**0.0043**
PFOA	**0.014**
PFBS	0.00092 U

FTIR-BLAAF-EXT-01-SO	
Date	4/29/2021
Depth	0-2 ft
PFOS	**0.012**
PFOA	**0.013**
PFBS	0.00096 U

FTIR-BLAAF-EXT-03-SO	
Date	4/29/2021
Depth	0-2 ft
PFOS	**0.0067**
PFOA	**0.016**
PFBS	0.00094 U

FTIR-BLAAF-EXT-04-SO	
Date	4/29/2021
Depth	0-2 ft
PFOS	**0.0075**
PFOA	**0.0092**
PFBS	**0.00055 J**

FTIR-BLA5-3	
Date	4/29/2021
Depth	202 ft
PFOS	**4.8**
PFOA	3.5 U
PFBS	3.5 U

FTIR-BLAAF-HELO-01-SO	
Date	4/29/2021
Depth	0-2 ft
PFOS	**0.0054 [0.0055]**
PFOA	**0.0028 [0.0023]**
PFBS	0.0011 U [0.0011 U]

FTIR-BLAAF-HELO-02-SO	
Date	4/29/2021
Depth	0-2 ft
PFOS	**0.0079**
PFOA	**0.0027**
PFBS	0.0010 U

FTIR-BLAAF-HELO-03-SO	
Date	4/29/2021
Depth	0-2 ft
PFOS	**0.0076**
PFOA	**0.0045**
PFBS	0.0010 U

FTIR-BLAAF-HELO-04-SO	
Date	4/29/2021
Depth	0-2 ft
PFOS	**0.012**
PFOA	0.0010 U
PFBS	0.0010 U

FTIR-W3	
Date	4/29/2021
Depth	239 ft
PFOS	3.4 U
PFOA	3.4 U
PFBS	3.4 U

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

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

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Figure 7-14
Bicycle Lake Army Airfield AOPIs PFOS, PFOA, and PFBS Analytical Results

Legend

- Installation Boundary
- AOPI
- Fault
- Approximate Groundwater Flow Direction
- Approximate Surface Runoff Flow Direction
- Monitoring Well

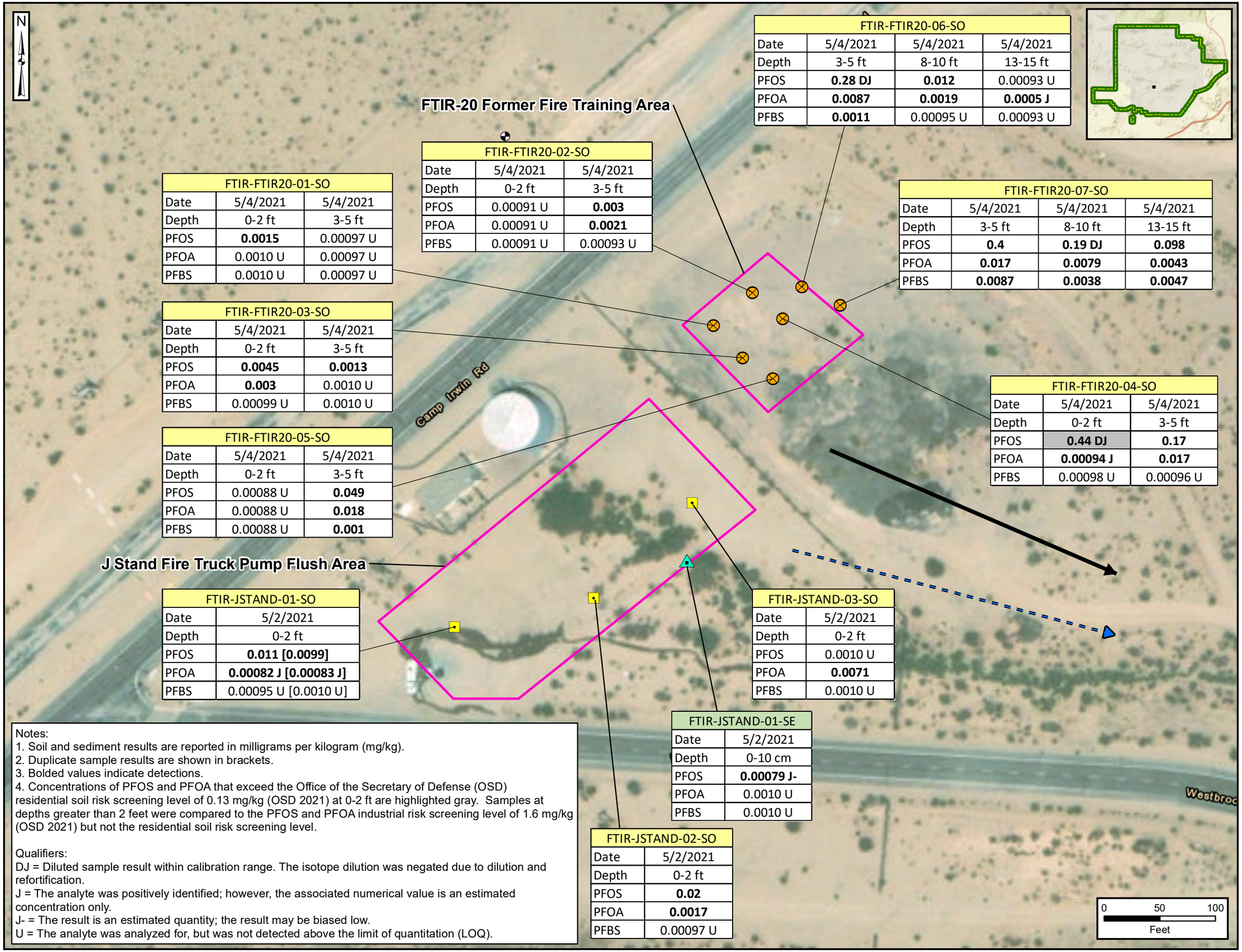
Sampling Locations

- Shallow Soil
- Groundwater (Existing Well)

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

Data Sources:
USGS, Scientific Investigations Report 2018-5067, Faults, 2018
USACE, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 11 North



FTIR-FTIR20-06-SO			
Date	5/4/2021	5/4/2021	5/4/2021
Depth	3-5 ft	8-10 ft	13-15 ft
PFOS	**0.28 DJ**	**0.012**	0.00093 U
PFOA	**0.0087**	**0.0019**	**0.0005 J**
PFBS	**0.0011**	0.00095 U	0.00093 U

FTIR-FTIR20-02-SO		
Date	5/4/2021	5/4/2021
Depth	0-2 ft	3-5 ft
PFOS	0.00091 U	**0.003**
PFOA	0.00091 U	**0.0021**
PFBS	0.00091 U	0.00093 U

FTIR-FTIR20-01-SO		
Date	5/4/2021	5/4/2021
Depth	0-2 ft	3-5 ft
PFOS	**0.0015**	0.00097 U
PFOA	0.0010 U	0.00097 U
PFBS	0.0010 U	0.00097 U

FTIR-FTIR20-07-SO			
Date	5/4/2021	5/4/2021	5/4/2021
Depth	3-5 ft	8-10 ft	13-15 ft
PFOS	**0.4**	**0.19 DJ**	**0.098**
PFOA	**0.017**	**0.0079**	**0.0043**
PFBS	**0.0087**	**0.0038**	**0.0047**

FTIR-FTIR20-03-SO		
Date	5/4/2021	5/4/2021
Depth	0-2 ft	3-5 ft
PFOS	**0.0045**	**0.0013**
PFOA	**0.003**	0.0010 U
PFBS	0.00099 U	0.0010 U

FTIR-FTIR20-04-SO		
Date	5/4/2021	5/4/2021
Depth	0-2 ft	3-5 ft
PFOS	**0.44 DJ**	**0.17**
PFOA	**0.00094 J**	**0.017**
PFBS	0.00098 U	0.00096 U

FTIR-FTIR20-05-SO		
Date	5/4/2021	5/4/2021
Depth	0-2 ft	3-5 ft
PFOS	0.00088 U	**0.049**
PFOA	0.00088 U	**0.018**
PFBS	0.00088 U	**0.001**

FTIR-JSTAND-01-SO	
Date	5/2/2021
Depth	0-2 ft
PFOS	**0.011 [0.0099]**
PFOA	**0.00082 J [0.00083 J]**
PFBS	0.00095 U [0.0010 U]

FTIR-JSTAND-03-SO	
Date	5/2/2021
Depth	0-2 ft
PFOS	0.0010 U
PFOA	**0.0071**
PFBS	0.0010 U

FTIR-JSTAND-01-SE	
Date	5/2/2021
Depth	0-10 cm
PFOS	**0.00079 J-**
PFOA	0.0010 U
PFBS	0.0010 U

FTIR-JSTAND-02-SO	
Date	5/2/2021
Depth	0-2 ft
PFOS	**0.02**
PFOA	**0.0017**
PFBS	0.00097 U

Notes:
1. Soil and sediment results are reported in milligrams per kilogram (mg/kg).
2. Duplicate sample results are shown in brackets.
3. Bolded values indicate detections.
4. Concentrations of PFOS and PFOA that exceed the Office of the Secretary of Defense (OSD) residential soil risk screening level of 0.13 mg/kg (OSD 2021) at 0-2 ft are highlighted gray. Samples at depths greater than 2 feet were compared to the PFOS and PFOA industrial risk screening level of 1.6 mg/kg (OSD 2021) but not the residential soil risk screening level.

Qualifiers:
DJ = Diluted sample result within calibration range. The isotope dilution was negated due to dilution and refortification.
J = The analyte was positively identified; however, the associated numerical value is an estimated concentration only.
J- = The result is an estimated quantity; the result may be biased low.
U = The analyte was analyzed for, but was not detected above the limit of quantitation (LOQ).

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Figure 7-15
FTIR-20 Former Fire Training Area and J Stand Fire Truck Pump Flush Area AOPIs PFOS, PFOA, and PFBS Analytical Results

Legend

- Installation Boundary
- AOPI
- Approximate Groundwater Flow Direction
- Approximate Surface Runoff Flow Direction
- Monitoring Well

Sampling Locations

- Shallow Soil
- Soil Boring
- Sediment

AOPI = area of potential interest
cm = centimeters
ft = feet
FTIR = Fort Irwin
PFBS = perfluorobutanesulfonic acid
PFOA = perfluorooctanoic acid
PFOS = perfluorooctane sulfonate
SE = sediment
SO = soil

Data Sources:
ESRI ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 11 North

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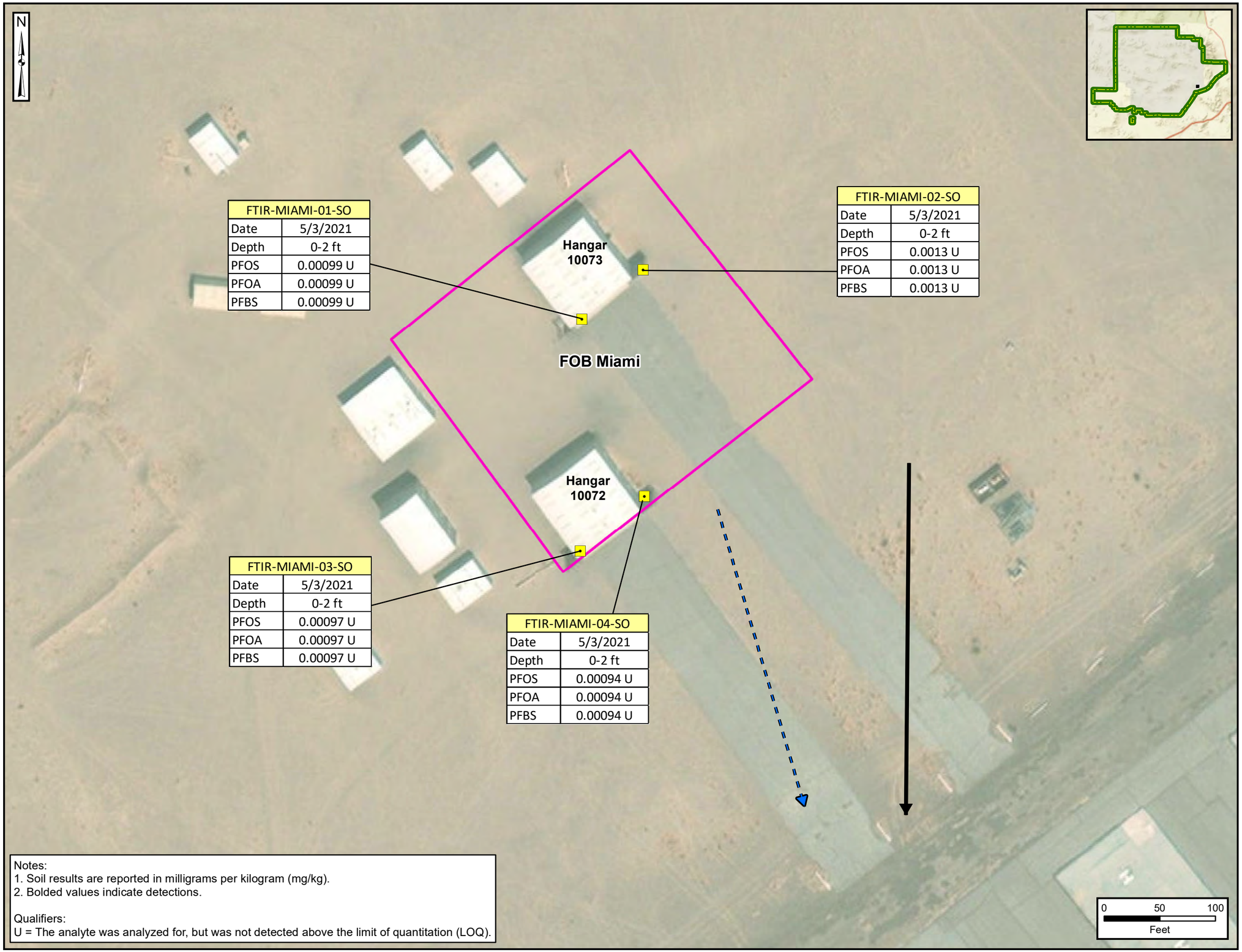
Figure 7-16
FOB Miami AOPI
PFOS, PFOA, and PFBS Analytical Results



Legend

- Installation Boundary
- AOPI
- Approximate Groundwater Flow Direction
- Approximate Surface Runoff Flow Direction

Sampling Locations

- Shallow Soil

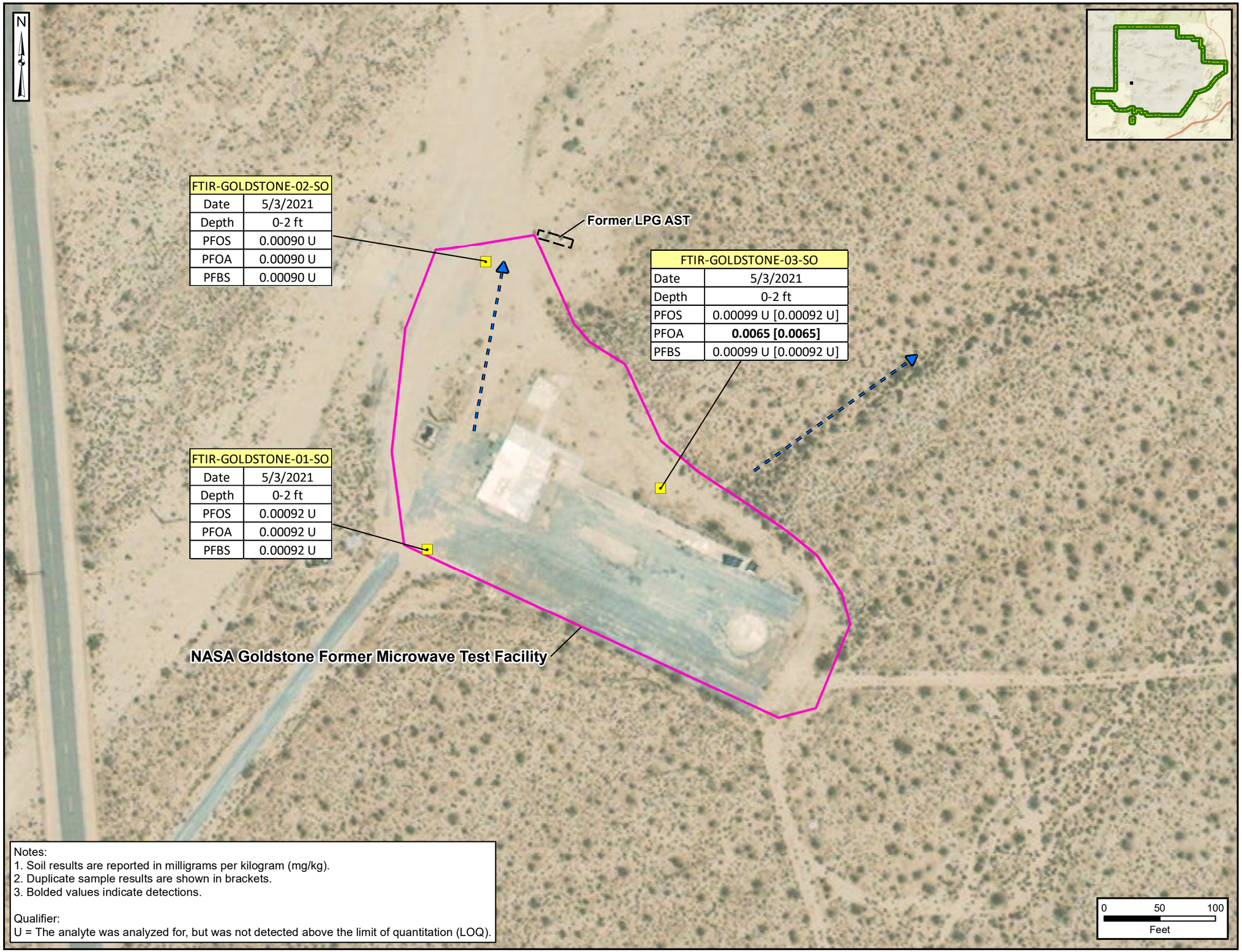
AOPI = area of potential interest
FOB = Forward Operating Base
ft = feet
PFBS = perfluorobutanesulfonic acid
PFOA = perfluorooctanoic acid
PFOS = perfluorooctane sulfonate
SO = soil

Notes:
1. Soil results are reported in milligrams per kilogram (mg/kg).
2. Bolded values indicate detections.

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

Data Sources:
ESRI, ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 11 North



Notes:
1. Soil results are reported in milligrams per kilogram (mg/kg).
2. Duplicate sample results are shown in brackets.
3. Bolded values indicate detections.

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

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Figure 7-17a
NASA Goldstone
Former Microwave Test Facility AOPI
PFOS, PFOA, and PFBS
Analytical Results

Legend

- Installation Boundary
- AOPI
- Approximate Surface Runoff Flow Direction
- Former AST Location

Sampling Locations

- Shallow Soil

AOPI = area of potential interest
AST = aboveground storage tank
ft = feet
Goldstone = Goldstone Deep Space Communications Complex
LPG = liquefied petroleum gases
NASA = National Aeronautics and Space Administration
PFBS = perfluorobutanesulfonic acid
PFOA = perfluorooctanoic acid
PFOS = perfluorooctane sulfonate
SO = soil

Data Sources:
ESRI ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 11 North

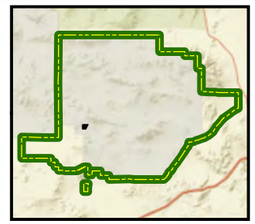

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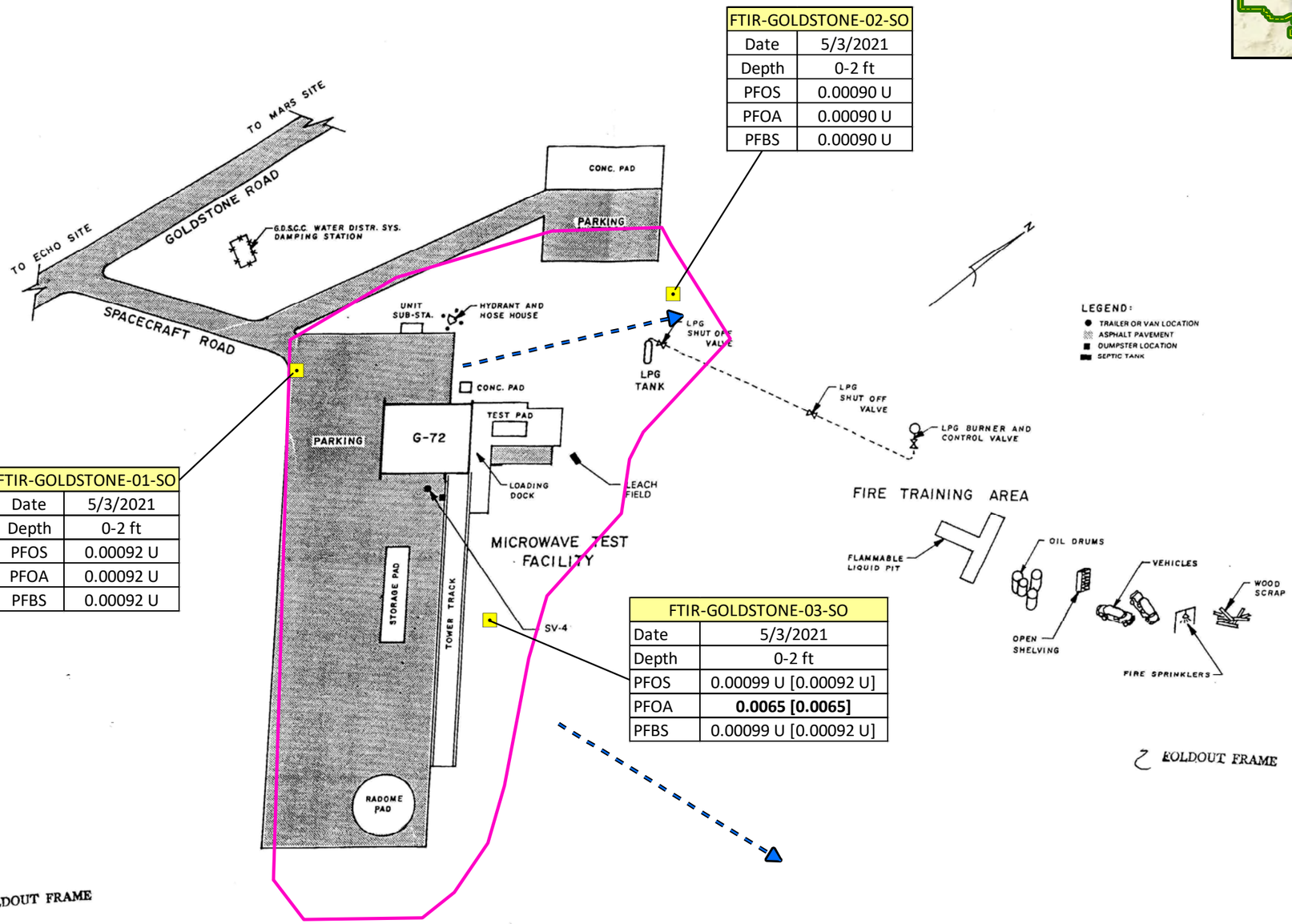
Figure 7-17b
NASA Goldstone
Former Microwave Test Facility AOPI
PFOS, PFOA, and PFBS
Analytical Results



FTIR-GOLDSTONE-02-SO	
Date	5/3/2021
Depth	0-2 ft
PFOS	0.00090 U
PFOA	0.00090 U
PFBS	0.00090 U

FTIR-GOLDSTONE-01-SO	
Date	5/3/2021
Depth	0-2 ft
PFOS	0.00092 U
PFOA	0.00092 U
PFBS	0.00092 U

FTIR-GOLDSTONE-03-SO	
Date	5/3/2021
Depth	0-2 ft
PFOS	0.00099 U [0.00092 U]
PFOA	**0.0065 [0.0065]**
PFBS	0.00099 U [0.00092 U]

Legend

- Installation Boundary
- AOPI Boundary
- Approximate Surface Runoff Flow Direction

Sampling Locations

- Shallow Soil

AOPI = area of potential interest
AST = aboveground storage tank
ft = feet
Goldstone = Goldstone Deep Space Communications Complex
LPG = liquefied petroleum gases
NASA = National Aeronautics and Space Administration
PFBS = perfluorobutanesulfonic acid
PFOA = perfluorooctanoic acid
PFOS = perfluorooctane sulfonate
SO = soil

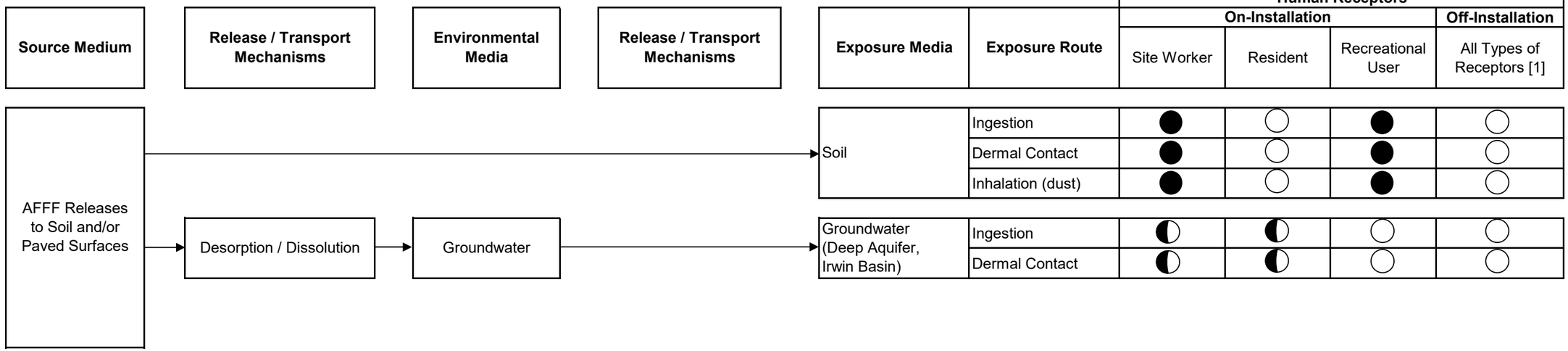
Note: The location of the fire training area is undetermined; this figure only indicates such training assets may have been present at the Former Microwave Test Facility.

Based on current and historical aerial imagery, the relative locations of other features in the figure are not drawn to scale, e.g. the former LGP AST was outside of the AOPI boundary.

Notes:
1. Soil results are reported in milligrams per kilogram (mg/kg).
2. Duplicate sample results are shown in brackets.
3. Bolded values indicate detections.

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

Source: Jet Propulsion Laboratory, *Environmental Projects: Volume 4, Asbestos Survey. Goldstone Deep Space Communications Complex. JPL Publication 87-4*, 1988



Legend:

- ● = Complete Exposure Pathway
- ◐ = Potentially Complete Exposure Pathway
- ○ = Incomplete Exposure Pathway

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

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

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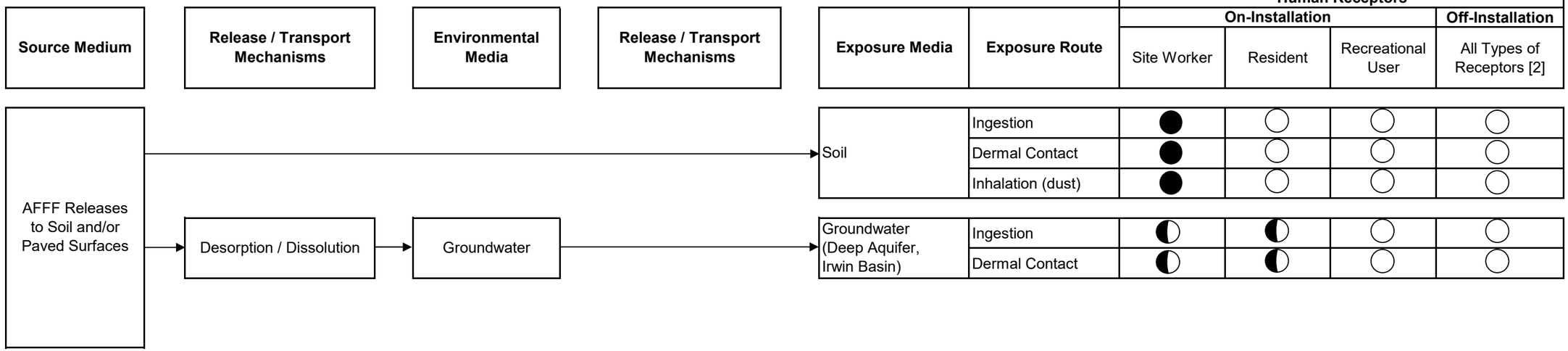
Conceptual Site Model for Active Recreational Ball Fields AOPI
USAEC PFAS Preliminary Assessment / Site Inspection
Fort Irwin, California

Figure 7-18



Legend:

● = Complete Exposure Pathway

◐ = Potentially Complete Exposure Pathway

○ = Incomplete Exposure Pathway

Notes:
[1] The 11 AOPIs addressed by this Conceptual Site Model are: AFFF Storage Shed (Building P358), Bulk POL Tanker Fire Response, Bulk POL Containment Basins, DES Training Complex, Fire Hose Pressure-Testing Area, Fire Station 1 (Building P400) and Former AFFF Storage (Building P411), Fire Station 2 (Building P6101), Former Fire Station, FTIR Helipad, RUFMA Drainage Basins, and RUFMA Former Firefighter Training Area.
[2] All types of off-installation human receptors include drinking water receptors and recreational users.

AFFF = aqueous film-forming foam
AOPI = area of potential interest
DES = Directorate of Emergency Services
POL = petroleum, oil, and lubricants
RUFMA = Rotational Unit Field Maintenance Area

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Conceptual Site Model for 11 AOPIs Located within the Irwin Groundwater Basin
USAEC PFAS Preliminary Assessment / Site Inspection
Fort Irwin, California

Figure 7-19

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

Legend:

● = Complete Exposure Pathway

◐ = Potentially Complete Exposure Pathway

○ = Incomplete Exposure Pathway

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

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

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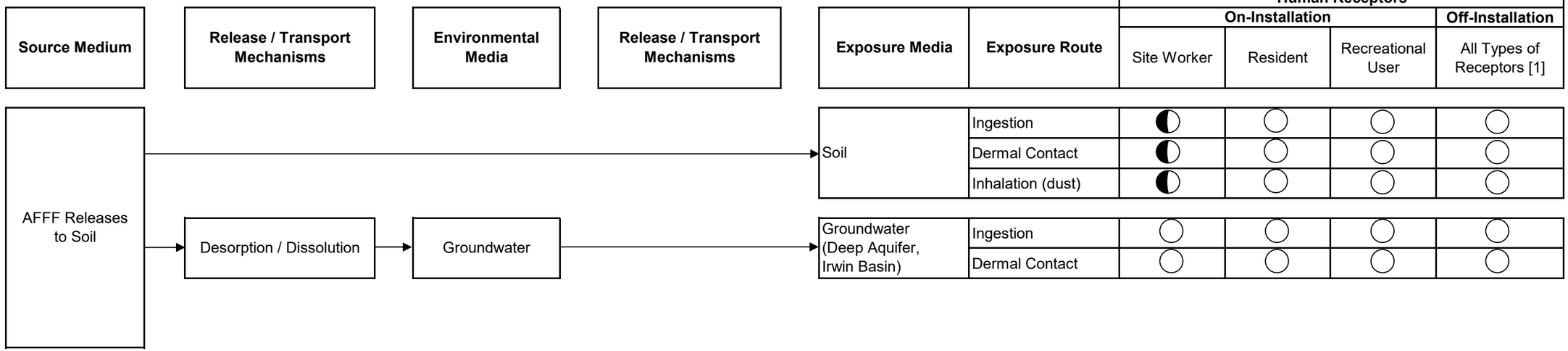
Conceptual Site Model for Area North of I Avenue near Building P817 and FTIR-01 Sanitary Landfill AOPIs
USAEC PFAS Preliminary Assessment / Site Inspection
Fort Irwin, California

Figure 7-20



Legend:

- ● = Complete Exposure Pathway
- ◐ = Potentially Complete Exposure Pathway
- ○ = Incomplete Exposure Pathway

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

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

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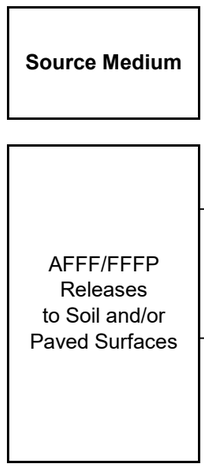
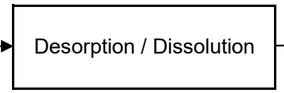
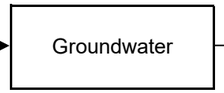
Conceptual Site Model for Land Farm Drying Pits AOPI
USAEC PFAS Preliminary Assessment / Site Inspection
Fort Irwin, California

Figure 7-21







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

Legend:

● = Complete Exposure Pathway

◐ = Potentially Complete Exposure Pathway

◯ = Incomplete Exposure Pathway

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

AOPI = area of potential interest
AFFF/FFFP = aqueous film-forming foam / film-forming fluoro protein
FOB = Forward Observation Base

Conceptual Site Model for Parking Lot South of Building P861 and FOB Miami AOPIs
USAEC PFAS Preliminary Assessment / Site Inspection
Fort Irwin, California

Figure 7-22

Source Medium	Release / Transport Mechanisms	Environmental Media	Release / Transport Mechanisms	Exposure Media	Exposure Route	Human Receptors: On-Installation: Site Worker	On-Installation: Resident	On-Installation: Recreational User	Off-Installation: All Types of Receptors [1]
AFFF releases during firefighting training activities on the paved RUFMA	Surface Runoff / Dissolution / Adsorption	Rinse Water and Entrained Sediments		Rinse Water (historically present)	Ingestion	○	○	○	○
					Dermal Contact	○	○	○	○
			Adsorption / Settling	Wash rack Sediments	Ingestion	◐	○	○	○
					Dermal Contact	◐	○	○	○
			Infiltration / Adsorption via Leaks in Concrete Drain	Subsurface Soil	Ingestion	◐	○	○	○
					Dermal Contact	◐	○	○	○
					Inhalation (dust)	◐	○	○	○
			Desorption / Dissolution	Groundwater (Deep Aquifer, Irwin Basin)	Ingestion	◐	◐	○	○
					Dermal Contact	◐	◐	○	○

Legend:

● = Complete Exposure Pathway

◐ = Potentially Complete Exposure Pathway

○ = Incomplete Exposure Pathway

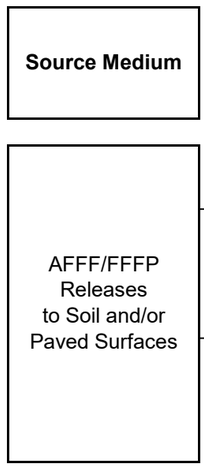
Notes:
[1] All types of off-installation human receptors include drinking water receptors and recreational users.

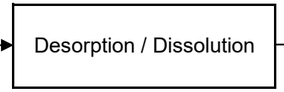
AOPI = area of potential interest
AFFF = aqueous film-forming foam
RUFMA = Rotational Unit Field Maintenance Area

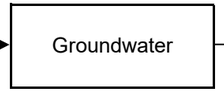
ARCADIS

Conceptual Site Model for RUFMA Wash-Rack AOPI
USAEC PFAS Preliminary Assessment / Site Inspection
Fort Irwin, California

Figure 7-23







Exposure Media	Exposure Route	Human Receptors: On-Installation: Site Worker	On-Installation: Resident	On-Installation: Recreational User	Off-Installation: All Types of Receptors [2]
Soil / Sediment	Ingestion	●	○	○	○
	Dermal Contact	●	○	○	○
	Inhalation (dust)	●	○	○	○
Groundwater (Deep Aquifer, Bicycle Basin)	Ingestion	◐	◐	○	○
	Dermal Contact	◐	◐	○	○

Legend:

● = Complete Exposure Pathway

◐ = Potentially Complete Exposure Pathway

○ = Incomplete Exposure Pathway

Notes:
[1] The 4 AOPIs addressed by this Conceptual Site Model are: BLAAF - Fire Extinguisher Training Area, BLAAF - Helipad, FTIR-20 Former Fire Training Area, and J Stand Fire Truck Pump Flush Area.
[2] All types of off-installation human receptors include drinking water receptors and recreational users.

AFFF/FFFP = aqueous film-forming foam / film-forming fluoro protein
AOPI = area of potential interest
BLAAF = Bicycle Lake Army Airfield
FTIR = Fort Irwin

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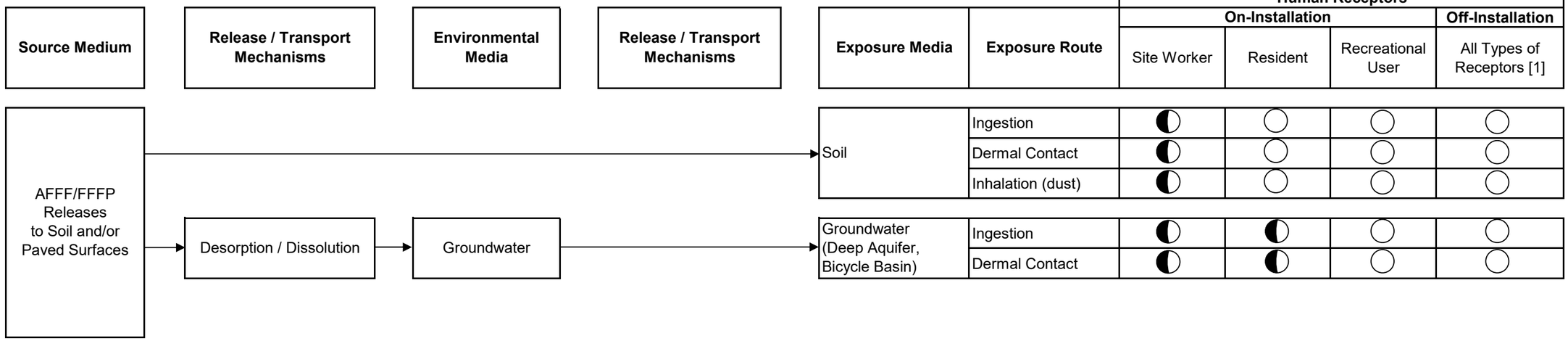
Conceptual Site Model for 4 AOPIs Located within the Bicycle Groundwater Basin
USAEC PFAS Preliminary Assessment / Site Inspection
Fort Irwin, California

Figure 7-24



Legend:

● = Complete Exposure Pathway

◐ = Potentially Complete Exposure Pathway

○ = Incomplete Exposure Pathway

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

AFFF/FFFP = aqueous film-forming foam / film-forming fluoro protein
AOPI = area of potential interest
BLAAF = Bicycle Lake Army Airfield

ARCADIS

Conceptual Site Model for BLAAF - North Staging Area and BLAAF - South Staging Area AOPIs
USAEC PFAS Preliminary Assessment / Site Inspection
Fort Irwin, California

Figure 7-25

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

Legend:

● = Complete Exposure Pathway

◐ = Potentially Complete Exposure Pathway

○ = Incomplete Exposure Pathway

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

AFFF/FFFP = aqueous film-forming foam/ film-forming fluoro protein
AOPI = area of potential interest
NASA = National Aeronautics and Space Administration
Goldstone = Goldstone Deep Space Communications Complex

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Conceptual Site Model for NASA Goldstone Former Microwave Test Facility AOPI
USAEC PFAS Preliminary Assessment / Site Inspection
Fort Irwin, California

Figure 7-26

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