Quality Assurance Project Plan
Former Fort Ord, California
Volume I, Appendix A

Addendum No. 1
Perfluorooctanoic Acid and Perfluorooctane Sulfonate Sampling and Analysis
Operable Unit 2, Former Fort Ord, California

Prepared for:

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On behalf of:

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USACE Contract No. W91238-14-C-0048

Task No. 5.4

Prepared by:

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Report Use and Limitations

Report Title: **Quality Assurance Project Plan, Former Fort Ord, California, Volume I, Appendix A, Addendum No. 1**

Perfluorooctanoic Acid and Perfluorooctane Sulfonate Sampling and Analysis, Operable Unit 2, Former Fort Ord, California

Prime Contractor: Ahtna Environmental, Inc.

USACE Contract No. W91238-14-C-0048

Task No. 5.4

Ahtna Environmental, Inc. (Ahtna) prepared this report at the direction of the U.S. Army Corps of Engineers (USACE) for the sole use of the U.S. Department of the Army (Army), the intended beneficiary. No other party should rely on the information contained herein without the prior written consent of the Army. This report and its interpretations, conclusions, and recommendations use the information presented in other documents, as cited in the text and listed in the references. Therefore, this report is subject to the limitations and qualifications presented in the referenced documents.

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Acronyms and Abbreviations

%	percent
%D	percent difference/percent drift
°C	degrees Celsius
µg/L	micrograms per liter
Ahtna	Ahtna Environmental, Inc.
Army	U.S. Department of the Army
BRAC	Base Realignment and Closure
CCRWQCB	Central Coast Regional Water Quality Control Board
CCV	continuing calibration verification
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
COC	chemical of concern
DL	detection limit
DoD	Department of Defense
DQI	data quality indicator
DQO	data quality objective
DTSC	California Department of Toxic Substances Control
EDD	electronic data deliverable
ELAP	Environmental Laboratory Accreditation Program
FODIS	Fort Ord Data Integration System
GAC	granular activated carbon
GIS	geographic information system
GWTP	groundwater treatment plant
HA	health advisory
HDPE	high-density polyethylene
ICAL	initial calibration
ICV	initial calibration verification
ID	identification
LCS	laboratory control samples
LCSD	LCS duplicate
LDPE	low-density polyethylene
LOD	limit of detection
LOQ	limit of quantitation
MEC	munitions and explosives of concern
MPC	measurement performance criteria
MS	matrix spike
ND	non-detect
OU1	Operable Unit 1

Acronyms and Abbreviations (continued)

OU2	Operable Unit 2
OUCTP	Operable Unit Carbon Tetrachloride Plume
PARCCS	precision, accuracy, representativeness, comparability, completeness, sensitivity
PFOA	perfluorooctanoic acid
PFOS	perfluorooctane sulfonate
PFOT	total sum of PFOA and PFOS concentrations
QA	quality assurance
QAPP	Quality Assurance Project Plan
QC	quality control
QSM	Quality Systems Manual
SOP	standard operating procedure
USACE	U.S. Army Corps of Engineers
USEPA	U.S. Environmental Protection Agency
Wood	Wood Environment & Infrastructure Solutions, Inc. (formerly Amec Foster Wheeler)

1.0 Introduction

On behalf of the U.S. Army Corps of Engineers (USACE), Sacramento District, Ahtna Environmental, Inc. (Ahtna) prepared this Quality Assurance Project Plan (QAPP) Addendum[1] under Contract Number W91238-14-C-0048. The QAPP Addendum describes perfluorooctanoic acid (PFOA) and perfluorooctane sulfonate (PFOS) sampling and analysis activities to be conducted for Operable Unit 2 (OU2) at the former Fort Ord (Figure 1). The QAPP Addendum includes:

- A description of sampling and analysis activities, including standard operating procedures (SOPs), and quality control (QC) and quality assurance (QA) protocols
- A sampling activity hazard analysis (Appendix A)
- Tables and figures with the proposed sample locations
- A project schedule
- A list of project oversight personnel

The QAPP Addendum is the governing guidance document for PFOA/PFOS sampling associated with OU2 at the former Fort Ord. The QAPP Addendum ensures the data generated are accurate, precise, complete, representative of field conditions, and of sufficient quality to support project decisions.

PFOA and PFOS are part of a larger group of chemicals called per- and polyfluoroalkyl substances that are human-made compounds and do not occur naturally in the environment. PFOA and PFOS are mobile chemicals which bioaccumulate in humans and wildlife, are stable in the environment and resist typical environmental degradation processes. Production of these compounds began in the 1940s and they were used in firefighting foam, protective coatings, and stain and water-resistant products until the 2000s (ITRC, 2017).[2] They were found in the blood of occupationally exposed workers in the 1970s and the general public in the 1990s. PFOA and PFOS were released into the environment through air emissions, spills, and disposal of wastes. They then mobilized into the surrounding soil and water environment and have been found in sediment and surface water from landfill leachate and downstream of production and wastewater facilities (USEPA, 2017). In 2016, the U.S. Environmental Protection Agency (USEPA) established lifetime health advisory (HA) levels for PFOA and PFOS of 0.07 micrograms per liter (µg/L) to provide a margin of protection from a lifetime of exposure to PFOA and PFOS from drinking water. When both PFOA and PFOS are found in drinking water, USEPA recommends the combined concentrations of PFOA and PFOS be compared with the 0.07 µg/L HA level (USEPA, 2016). No Federal or State of California Maximum Contaminant Levels for PFOA or PFOS in drinking water have been established.

[1] This document is an addendum to Appendix A to the *Quality Assurance Project Plan, Superfund Response Actions, Former Fort Ord, California, Volume I*. Volume I is also the governing document for sampling and analysis of soil (Appendix B), soil gas (Appendix C), and landfill gas (Appendix D). Volume II of the QAPP pertains to the former Fort Ord military munitions response program.

[2] PFOA and PFOS can also be found in a range of products and processes including, but not limited to: paper products, textiles, leathers, metal plating/etching, wire manufacturing, carpeting, fabric softeners, polishes, waxes, personal care products, sporting equipment, paints, adhesives, medical products, nonstick cookware, industrial resins/surfactants/molds/plastics, and the semiconductor industry.

2.0 Project Management

2.1 Worksheets #1 and #2: Title and Approval Page

Site/Project Name: OU2 Former Fort Ord/PFOA and PFOS Sampling

Site Location: OU2, Former Fort Ord, California

Document Title: Quality Assurance Project Plan, Former Fort Ord, California, Volume I, Appendix A, Addendum No. 1, Perfluorooctanoic Acid and Perfluorooctane Sulfonate Sampling and Analysis, Operable Unit 2, Former Fort Ord, California

Lead Organization: U.S. Army Corps of Engineers

Preparer's Name: Holly Dillon

Organization: Ahtna, 296 12th St, Marina, CA 93933

Contact Info: (831) 384-3735
hdillon@ahtna.net

Preparation Date: November 5, 2018

APPROVALS

Project Role	Name and Organization	Signature	Date
Investigative Organization's Project Manager	Derek Lieberman Ahtna		
Investigative Organization's Program Chemist	Christopher Ohland Ahtna		
Lead Organization's Technical Lead	Alex Kan USACE		
Lead Organization's Project Chemist	Bonnie McNeill USACE		

Plans and reports from previous investigations relevant to this project:

Site/Project Name: OU2 Former Fort Ord/PFOA and PFOS Sampling

Site Location: Monterey County, California

Site Number/Code: Not Applicable (N/A)

Operable Units: OU2

Contractor Name: Ahtna Environmental, Inc.

Contract Number: W91238-14-C-0048 P00008

Contract Title: Supplemental Performance Work Statement for the Former Fort Ord Basewide Groundwater and Soil Vapor Treatment and Monitoring, Former Fort Ord, California

Work Assignment Number: N/A

Guidance used to prepare QAPP: Uniform Federal Policy for Quality Assurance Project Plans, Optimized UFP-QAPP Worksheets, March 2012, Revision 1. Department of Defense (DoD) Quality Systems Manual (QSM) for Environmental Laboratories, Version 5.1, 2017

Regulatory Program: Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) as amended by the Superfund Amendment and Reauthorization Act (SARA)

Approval Entities: U.S. Environmental Protection Agency (USEPA), California Department of Toxic Substance Control (DTSC), and Central Coast Regional Water Quality Control Board (CCRWQCB)

Data Users: U.S. Department of the Army (Army), USACE, USEPA (and its consultant TechLaw, Inc.), DTSC, CCRWQCB, Army/USACE contractors, citizen groups, and members of the public

Organizational partners (stakeholders) and connection with lead organization:

USACE, Army (lead agency/owner), USEPA (lead oversight agency), DTSC (support agency), and CCRWQCB (support agency)

The QAPP is (select one): Generic: __ Project Specific: X

DATES AND TITLES OF QAPP DOCUMENTS WRITTEN FOR PREVIOUS SITE WORK:

Title	Approval Date
Quality Assurance Project Plan, Superfund Response Actions, Former Fort Ord, California, Volume I, Groundwater, Appendix A, Final Revision 6	March 2018
Quality Assurance Project Plan, Superfund Response Actions, Former Fort Ord, California, Volume I, Groundwater, Appendix A, Final Revision 5	June 2017
Quality Assurance Project Plan, Superfund Response Actions, Former Fort Ord, California, Volume I, Groundwater, Appendix A, Final Revision 4	March 2016
Quality Assurance Project Plan, Superfund Response Actions, Former Fort Ord, California, Volume I, Groundwater, Appendix A, Final Revision 3	June 2015
Quality Assurance Project Plan, Superfund Response Actions, Former Fort Ord, California, Volume I, Groundwater, Appendix A, Final Revision 2	February 2014
Quality Assurance Project Plan, Superfund Response Actions, Former Fort Ord, California, Volume I, Groundwater, Appendix A, Final Revision 1	December 21, 2012
Draft Final Quality Assurance Project Plan, Former Fort Ord, California, Volume I, Groundwater, Appendix A, Groundwater Extraction and Treatment Systems at Operable Unit 2 and Sites 2 and 12; Groundwater Monitoring Program at Sites 2 and 12, Operable Unit 1, Operable Unit 2, and Operable Unit Carbon Tetrachloride Plume	May 31, 2011
Draft Final, QAPP/CDQMP Groundwater Monitoring Program, Sites 2 and 12, OU2 and OUCTP	January 20, 2010
Final Sampling and Analysis Plan, Operable Unit 2 and Sites 2 and 12 Groundwater Treatment Systems, Former Fort Ord	August 20, 2009

2.2 Worksheets #3 and #5: Project Organization and QAPP Distribution

Information for this worksheet is included in QAPP Revision 6 (Ahtna, 2018).

2.3 Worksheets #4, #7, and #8: Personnel Qualifications and Sign-Off Sheet

ORGANIZATION: AHTNA

Name	Project Title/Role	Education/ Experience[1]	Specialized Training/ Certifications[2]	Signature[3]	Date
Chuck Holman	Program Manager	Resume on file	HAZWOPER		
Derek Lieberman	Project Manager	Resume on file	First aid, CPR, MEC, PE, H&S, HAZWOPER, CQM		
Christopher Ohland	Program Chemist	Resume on file	H&S, HAZWOPER		
Eric Schmidt	Project Chemist	Resume on file	HAZWOPER, CQM		
Holly Dillon	Task Lead	Resume on file	First aid, CPR, MEC, H&S, HAZWOPER, CQM		
Mark Fisler	Field Supervisor	Resume on file	First aid, CPR, MEC, HAZWOPER, CQM		
Sylvester Kosowski	QC Manager	Resume on file	HAZWOPER, CQM		

Notes:

[1] Resumes available in QAPP Revision 6 (Ahtna, 2018).

[2] Specialized Training/Certifications Key:

CPR	cardiopulmonary resuscitation
CQM	Construction Quality Management.
H&S	health and safety training, including, but not limited to: hazard communication, fire extinguisher use, defensive driving, behavior-based safety, confined spaces.
HAZWOPER	40-hour and current 8-hour annual refresher Hazardous Waste Operations and Emergency Response
MEC	munitions and explosives of concern recognition and safety training
PE	registered Professional Engineer

[3] Signatures indicate personnel have read and agree to implement this QAPP Addendum as written.

Worksheets #4, #7, and #8: Personnel Qualifications and Sign-Off Sheet (Continued)

ORGANIZATION: WOOD ENVIRONMENT & INFRASTRUCTURE SOLUTIONS, INC. (WOOD)

Name	Project Title/Role	Education/ Experience[1]	Specialized Training/ Certifications[2]	Signature[3]	Date
Jeff Fenton	Project Manager	Resume on file	HAZWOPER		
Scott Graham	Field Task Manager	Resume on file	HAZWOPER, first aid, CPR, MEC, CQM		
Kevin Garrett	Project Chemist	Resume on file	Not applicable		
Zachary Carroll	Data Validation Specialist	Resume on file	Not applicable		

Notes:

[1] Resumes available in QAPP Revision 6 (Ahtna, 2018).

[2] Specialized Training/Certifications Key:

CPR	cardiopulmonary resuscitation
CQM	Construction Quality Management.
HAZWOPER	40-hour and current 8-hour annual refresher Hazardous Waste Operations and Emergency Response
MEC	munitions and explosives of concern recognition and safety training

[3] Signatures indicate personnel have read and agree to implement this QAPP Addendum as written.

Worksheets #4, #7, and #8: Personnel Qualifications and Sign-Off Sheet (Continued)

ORGANIZATION: SGS (ORLANDO, FLORIDA)

Name	Project Title/Role	Education/ Experience[1]	Specialized Training/ Certifications	Signature[2]	Date
Elvin Kumar	Project Manager	Resume on file	Not applicable		
Svetlana Izosimova	QA Officer	Resume on file	Not applicable		
Caitlin Brice	General Manager	Resume on file	Not applicable		
Norman Farmer	Corporate Technical Director	Resume on file	Not applicable		

Notes:
[1] Resumes available in QAPP Revision 6 (Ahtna, 2018).
[2] Signatures indicate personnel have read and agree to implement this QAPP Addendum as written.

2.4 Worksheet #6: Communication Pathways

Information for this worksheet is included in QAPP Revision 6 (Ahtna, 2018).

2.5 Worksheet #9: Project Planning Session Summary

Project Name: OU2 PFOA and PFOS Sampling, Former Fort Ord

Projected Start Date: December 10, 2018

Project Manager: Derek Lieberman, Ahtna

Site Name: Operable Unit 2

Site Location: Former Fort Ord, CA

Date of Session: July 10, 2018

Scoping Session Purpose: Define the scope of work to be included in the QAPP Addendum

PLANNING PARTICIPANTS

Name	Title	Affiliation	Telephone #	E-mail Address
Derek Lieberman	Project Manager	Ahtna	(831) 384-3735	dlieberman@ahtna.net
Holly Dillon	Task Lead	Ahtna	(831) 384-3735	hdillon@ahtna.net
Alex Kan	Technical Lead	USACE	(916) 557-7578	Alexander.Kan@usace.army.mil
Bonnie McNeill	Project Chemist	USACE	(916) 557-7366	Bonnie.J.McNeill@usace.army.mil
Jonathan Whipple	Environmental Chemist	USACE	(916) 557-5302	Jonathan.P.Whipple@usace.army.mil
Bridget Floyd	Geologist	USACE	(916) 557-7328	Bridget.M.Floyd@usace.army.mil
Amber Ginorio-Dean	Student Trainee – Geology	USACE	(916) 557-7066	Amber.Ginorio-Dean@usace.army.mil
Tom Ghigliotto	Field Oversight Inspector	Chenega	(831) 824-2318	Thomas.F.Ghigliotto@usace.army.mil

Planning Session Summary:

Reviewed DoD 2007 Policy and Guidelines for Acquisitions Involving Environmental Sampling or Testing to determine the PFOA/PFOS QAPP Addendum format requirements.

Action Items:

Based on this review, USACE will:

- Review the UFP-QAPP 2012 Optimized Worksheets to determine which worksheets will be included in the PFOA/PFOS QAPP Addendum.

Based on this review and information from USACE, Ahtna will:

- Initiate development of the PFOA/PFOS QAPP Addendum.
- Revise the document to the UFP-QAPP format and make it an Addendum to QAPP Revision 6 (Ahtna 2018a).

3.0 Project Quality Objectives

3.1 Worksheet #10: Conceptual Site Model

Information for this worksheet is included in QAPP Revision 6 (Ahtna, 2018).

3.2 Worksheet #11: Project/Data Quality Objectives

Data quality objectives (DQO) are qualitative and quantitative statements that outline the decision-making process and specify the data required to support corrective actions. DQOs specify the level of uncertainty that will be accepted in results derived from data. The DQO process used for developing data quality criteria and performance specifications for decision-making is consistent with the *Guidance on Systematic Planning Using the Data Quality Objectives Process*, EPA QA/G-4 (USEPA, 2006). The DQO process consists of the following seven steps:

Step 1: State the problem

Step 2: Identify the goals of the study

Step 3: Identify information inputs

Step 4: Define the boundaries of the study

Step 5: Develop the analytical approach

Step 6: Specify performance or acceptance criteria

Step 7: Develop the plan for obtaining data

The DQOs steps are presented below for OU2 PFOA/PFOS sampling.

3.2.1 Step 1: State the Problem

Upon reviewing the Draft QAPP Revision 5 (Ahtna, 2017), DTSC recommended sampling groundwater at the former Fort Ord for emerging contaminants PFOA and PFOS analysis because these compounds were detected at low concentrations at Operable Unit 1 (OU1) during the site closure process. In response, and in accordance with Army policy (Army, 2016), the Army proposed to screen for PFOA and PFOS in groundwater at OU2 because products containing PFOA and PFOS may have been disposed of at the Fort Ord Landfills (Ahtna, 2017).[3] PFOA and PFOS data have not been collected at OU2.

3.2.2 Step 2: Identify the Goals of the Study

The primary goals associated with the OU2 PFOA/PFOS sampling are to determine if measurable amounts of PFOA or PFOS are in groundwater at OU2 and, if so:

- Do the detected concentrations exceed the USEPA lifetime HA level (USEPA, 2017)?
- Does the OU2 groundwater treatment plant (GWTP) effectively remove PFOA/PFOS from groundwater (i.e., are concentrations of PFOS/PFOS at the GWTP effluent less than concentrations at the GWTP influent [if detected] and by how much?)?

3.2.3 Step 3: Identify Information Inputs

Inputs to decisions for the OU2 PFOA/PFOS sampling include PFOA and PFOS concentration data generated from analysis of groundwater samples collected at OU2.

[3] There is no evidence of activities that would contribute to PFOA and PFOS contamination occurring at Sites 2 and 12 (Sites 2/12) and Operable Unit Carbon Tetrachloride Plume (OUCTP). Therefore, no sampling will be conducted for PFOA and PFOS at Sites 2/12 and OUCTP (Ahtna, 2017).

3.2.4 Step 4: Define the Boundaries of the Study

The physical study boundaries for the OU2 PFOA/PFOS sampling are described below and shown in Figure 1. Study boundaries are based on the zone of groundwater with chemical of concern (COC) concentrations above aquifer cleanup levels.

Study boundaries at OU2 are as follows:

- The overall geographic boundary for the site is the Main Garrison area and the Fort Ord Landfills at the former Fort Ord.
- The lateral boundary is defined by the zone of groundwater impacted by COCs. The vertical boundary is defined by the zone of contaminated groundwater in the A-Aquifer and Upper 180-Foot Aquifer.

3.2.5 Step 5: Develop the Analytical Approach

Regulatory limits for the emerging contaminants PFOA and PFOS in groundwater have not been established. The HA values issued by the USEPA for PFOA and PFOS will be used as screening level concentrations to determine the need for further action. The USEPA HA for PFOA, PFOS, and the total sum of PFOA and PFOS concentrations (PFOT) is 0.07 µg/L (USEPA, 2017).

3.2.6 Step 6: Specify Performance or Acceptance Criteria

The null hypothesis for OU2 PFOA and PFOS sampling is PFOA and PFOS exist in groundwater at concentrations above the USEPA HA. The two types of decision errors that could result are a false acceptance decision error and a false rejection decision error.

A false acceptance decision error for the null hypothesis would be to assume a measured concentration is above the USEPA HA when in fact it is not. Consequences of the false acceptance error would be to incur unnecessary expense to study, monitor, and remediate and extent of contamination that does not exist.

A false rejection error for the null hypothesis would be to assume a measured concentration is not above the USEPA HA when in fact it is. Consequences of the false rejection error would be to not study, monitor, or remediate the full extent of contamination. This scenario may pose a potential threat to groundwater quality.

Decision errors are most likely to occur when the measured concentration is near the USEPA HA, when the measured concentration is estimated between the limit of quantitation (LOQ) and detection limit (DL), or in the case of non-detects (ND), when the LOQ is near the USEPA HA. To control decision errors when the LOQ is near the USEPA HA, the laboratory is required to report any detections below the LOQ (but above the DL), thereby giving the data user additional information regarding trace level contamination. To control decision errors, decisions will only be based on data that have been reviewed through the data validation process and determined to be acceptable for use.[4]

3.2.7 Step 7: Develop the Plan for Obtaining Data

As a result of the DQO process, the optimum sampling design is derived for OU2. Sample collection locations and rationales were established to screen for the presence of PFOA and PFOS at OU2 and

[4] See Worksheet #15 for laboratory LOQ and DL values. Because these limits are all less than the USEPA HA, these decision errors are not expected to occur.

evaluate whether detected concentrations, if any, are above the USEPA HA. The sampling design is discussed in Worksheets #17a and #17b. The modified USEPA Method 537 analytical procedure for this project was selected to accurately quantify PFOA and PFOS at the levels of concern. Method performance criteria for modified USEPA Method 537 are presented in Worksheets #24 and #28.

The overall sampling network design is described in Worksheet #17a and #17b. HydraSleeves™ will be used to collect the samples from the monitoring wells. The HydraSleeves™ will be placed after the COC sample has been collected and allowed to equilibrate for 48 hours or longer before the PFOA/PFOS sample is collected. GWTP samples will be collected using designated GWTP process sampling ports to discharge water directly from the sample port to the appropriate sample containers.

3.3 Worksheet #12: Measurement Performance Criteria

The measurement performance criteria (MPC) for chemical analysis being performed are summarized in the table below. The MPCs follow those defined in the referenced USEPA method or laboratory SOPs and the DoD QSM. The quality of the data to be collected for this project will be verified through appropriate MPCs established for both sampling procedures and analytical methods. The criteria relate to data quality indicators (DQI) consisting of precision, accuracy, representativeness, comparability, completeness, and sensitivity, commonly referred to as PARCCS parameters. The DQIs are defined as follows:

- Precision refers to the reproducibility of measurements. Precision is usually expressed as standard deviation, variance, percent difference, or range, in either absolute or relative terms.
- Accuracy refers to the degree of agreement between an observed value (such as sample results) and an accepted reference value. A measurement is considered accurate when the reported value agrees with the true value or known concentration of the spike or standard within acceptable limits.
- Representativeness describes the extent to which a sampling design adequately reflects the environmental conditions of a site. Representativeness is determined by appropriate program design, with consideration of elements such as proper well locations, drilling and installation procedures, operations process locations, and sampling locations.
- Comparability addresses the degree to which different methods or data agree or can be represented as similar. Comparability is achieved by using standard methods for sampling and analysis, reporting data in standard units, normalizing results to standard conditions, and using standard and comprehensive reporting formats.
- Completeness is a measure of the amount of valid data collected using a measurement system. Completeness is expressed as a percentage of the number of measurements that are specified in this QAPP.
- Sensitivity is the ability of a method or instrument to detect the target analytes at the level of interest. Sensitivity can be measured by calculating the percent recovery of the analytes at the LOQ, which is the minimum concentration of an analyte that can be reliably identified and quantified above the method LOQ by a laboratory.

The quality of the sampling procedures and laboratory results will be evaluated for compliance with project DQOs through a review of overall PARCCS, in accordance with procedures described in Worksheet #37 (Data Usability Assessment). The results will be summarized in an overall data usability report.

Analytical Group/Method: PFOA and PFOS by Modified USEPA Method 537

Matrix: Groundwater (µg/L)

S&A SOPs	MPC	QC Sample or Activity Used to Assess MPC	QC Sample Assesses (S, A, or S&A)
Precision			
S: SOPs #1–3	RPD ≤30%	Field Duplicate	S
A: SGS SOP #MS019.2	Analyte RPD PFOA ≤30% PFOS ≤30%	LCS and MS	A
Accuracy/Precision[5]			
A: SGS SOP #MS019.2	Analyte Recovery PFOA 74-137% PFOS 70-134%	LCS and MS	A
Bias			
A: SGS SOP #MS019.2	Analyte Recovery 13C-PFOA 50-150% 13C-PFOS 50-150%	Extracted and Injection Internal Standard	A
Bias/Contamination			
S: SOPs #1–3 A: SGS SOP #MS019.2	No analytes >½ LOQ, >10% the amount measured in a sample, >10% the regulatory limit, whichever is greater.	Method blank, field blank, trip blank	S&A
Representativeness			
S: SOPs #1–3	>0°C ≤10°C first 48 hours, at lab >0°C ≤6°C	Cooler Temperature Blank	S
Comparability			
S: SOPs #1–3 A: SGS SOP #MS019.2	Reasonableness	DoD acceptable laboratory methods and historical data[6]	S&A
	Qualitative measure for field sampling procedures	LCS/LCSD and MS	A
Completeness			
S: SOPs #1–3	≥95% field completeness	Number of samples collected out of total samples planned	S
A: SGS SOP #MS019.2	≥90% analytical completeness	Evaluation of the number of rejected results out of the total	A
Sensitivity			
A: SGS SOP #MS019.2	Evidence of a shift in instrument response or zero setting	LCS, ICAL, CCAL	A
	Limit of quantitation	LOQ studies	

Notes: see next page

[5] Recoveries are established in-house laboratory-derived limits.

[6] There are no historical OU2 PFOA/PFOS data for comparison; therefore, comparability is not a primary consideration. However, the sampling and analytical methods are based on standard and documented procedures and it will be possible to obtain comparable data if future sampling efforts at this site are performed.

Notes:

≤	less than or equal to
>	greater than
%	percent
°C	degrees Celsius
CCAL	continuing calibration
A	analytical
DQI	data quality indicator
ICAL	initial calibration
LCS	laboratory control samples
LCSD	laboratory control sample duplicate
LOQ	limit of quantitation
MPC	measurement performance criteria
MS	matrix spike
QC	quality control
RPD	relative percent difference
S	sampling
S&A	sampling and analytical
SOP	standard operating procedure

3.4 Worksheet #13: Secondary Data Uses and Limitations

Information for this worksheet is included in QAPP Revision 6 (Ahtna, 2018).

3.5 Worksheets #14 and #16: Project Tasks & Schedule

3.5.1 Project Tasks

Applicable SOPs for the project tasks outlined in this worksheet are listed in Worksheet #21 and provided in detail in Appendices C, D, and E. The sampling tasks are described in Worksheets #17 and #18.

3.5.2 Waste and Equipment Decontamination

Wastewater generated during decontamination will be disposed of at the OU2 or Sites 2/12 GWTS and treated with the influent groundwater. Personal protective equipment and miscellaneous waste will be placed in large garbage bags, sealed, and disposed of in facility trash receptacles.

3.5.3 Quality Control Tasks

Implement field SOPs. Field QC samples will be collected at the frequency indicated in Worksheet #20. Samples will be analyzed by the laboratory in accordance with the stated method and the DoD QSM and this QAPP Addendum. For items related to QC, see Worksheets #11, #12, #15, #22, #24, #25, #27, and #28.

3.5.4 Secondary Data

See Worksheet #13.

3.5.5 Data Management Tasks

The following are the team members and their responsibilities for the data management process:

Program Chemist. Responsible for reviewing chain of custody forms and establishing the sample tracking system. Oversees the proper use of Ahtna's sample management system and accuracy of the information entered. Reviews laboratory data for accuracy and quality and compares electronic outputs for accuracy to laboratory electronic copies. Conducts tracking of samples, forwards tracking information and received data to the database manager, and identifies the data inputs (for example, sample numbers) to use in generating tables and figures.

Database Manager. Responsible for setting up the data management system in consultation with the program chemist at the beginning of the data evaluation task. Also oversees the data management process, including data conversion/manual entry into the data management system, QC of the entered data, and preparation of the required tables and plots of the data. Coordinates with the person responsible for reviewing the entered data for QC purposes. Forwards all deliverables to the Project Manager.

Geographic Information System (GIS) Manager. Responsible for coordinating with the Project Manager to set up the geodatabase prior to sampling. Maintains spatial layers and overall geodatabase integrity and accuracy, and provides GIS-related outputs for reports.

3.5.6 Sample Tracking

The program chemist is responsible for tracking samples in the sample tracking database to ensure that the analytical results for all samples sent for analysis are received. Copies of chains of custody from the

field team are used to enter in sample identifications (IDs), collect data, and for analyses. Upon notice of sample receipt from the laboratory, the date received by the laboratory and date the electronic copy is due will be entered. Likewise, upon receipt of the electronic copy and electronic data deliverable (EDD), the date they are received will also be entered. The EDDs will be uploaded when received from the laboratory and will be tracked in the sample tracking table. Validation qualifiers will be added to the database and results qualified accordingly.

3.5.7 Data Types

The data will be added to the project database as they become available. The data will include new data collected in the laboratory and validated by Ahtna or Wood. The data source will be noted in the database.

3.5.8 Data Tracking and Management

Every data set received from analytical laboratories will be tracked individually. Analytical laboratory reports of chemical analysis results will be tracked consistently. Every data set will be assigned a unique identifier. The date of receipt, status of data validation, and status of the database entry for each data set will all be tracked and recorded in the project database.

Hard/Electronic Copy. Measurements made during field data collection activities will be recorded in field logbooks and sample processing logs. Field data will be reduced and summarized, tabulated, and stored along with the field logbooks and sample processing logs. All raw analytical laboratory data are stored electronically.

Data Input Procedures. Sampling information, analytical results, applicable QA/QC data, data validation qualifiers, and other field-related information will be entered into the project database for storage and retrieval during data evaluation and report development. The analytical data will be loaded into the database using EDD files received from the analytical laboratory. Validation qualifiers will be entered manually. Other available field-related data collected will be manually entered onto standard EDD templates for loading into the database. Historical data, either in hard copy or electronic form, will be manually entered on or formatted to standard EDD templates for database loading.

3.5.9 Computer Database

The technical data, field observations, laboratory analytical results, and analytical data validation will be managed using Ahtna's and Wood's database to store and analyze project data submissions.

The database must be protected from unauthorized access, tampering, accidental deletions or additions, and data or program loss that can result from power outages or hardware failure. The following procedures will be adopted to ensure protection:

- The master database will be stored on a network file server local to the installation of the Ahtna and Wood data management system. Members of the data management team involved in loading, modifying, or querying the database will be given access through user accounts and passwords, as well as the appropriate network server permissions.
- Copies of the master database will be stored on the local area network for access by project staff through reporting tools developed to minimize possible database corruption by users.

Whenever the master database is updated or modified, it will be recopied to the local area network to ensure that the current copy is available to users.

- Backups of the master database and its copies will be made to ensure that the data will not be lost due to problems with the network.

In addition to the internal computer database, EDDs will be uploaded to the Base Realignment and Closure (BRAC) Fort Ord Data Integration System (FODIS) database and the CCRWQCB GeoTracker database.

3.5.10 Geographic Information System Description

A project geodatabase will be set up prior to sampling by the Project Manager, database technician, and GIS technician. Ahtna will adhere to all applicable federal, DoD, and Army geospatial data standards for tasks and deliverables in this QAPP and will meet the minimum requirements for spatial data in accordance with Spatial Data Standards for Facilities, Infrastructure, and Environment, current version whenever possible. Ahtna will submit the native GIS files that will include map data (.mxd) and geodatabase (.dbf) format. Ahtna will provide validated geospatial data to USACE for submission by BRAC to the FODIS database.

Each geospatial data set shall be accompanied by metadata conforming to the Federal Geographic Data Committee Content Standard for Digital Geospatial Metadata and the Army Installation Geospatial Information & Services Metadata Standard, v1. The horizontal accuracy of any geospatial data created shall be tested and reported in accordance with the National Standard for Spatial Data Accuracy, and the results shall be recorded in the metadata. All data will have a datum of Geographic Coordinate System North American 1983 and a projection of North American Datum 1983 State Plane California Zone 4. The sea level datum used will be the National Geodetic Vertical Datum 1929 to conform to historical former Fort Ord data.

In addition to laboratory data, other physical data will be collected during field efforts. The information will be stored in the project database. Other types of data elements may be added as the field investigation needs and activities evolve.

3.5.11 Documentation

Documentation of data management activities is critical because it provides the following:

- An electronic copy record of project data management activities
- Reference information critical for database users
- Evidence that the activities have been properly planned, executed, and verified
- Continuity of data management operations when personnel changes occur

The data management plan will serve as the initial general documentation of the project data management efforts. Additional documentation will be maintained to document specific issues such as database structure definitions, database inventories, database maintenance, user requests, database issues and problems, and client contact.

3.5.12 Presentation of Data

Depending on data user needs, data presentation may consist of any of the following formats:

- Tabulated results of data summaries or raw data
- Figures showing concentration isopleths or location-specific concentrations
- Tables providing statistical evaluation or calculation results
- Presentation tools, such as ArcMap or similar analysis/presentation aids

In addition to laboratory data, other physical data will be collected during field efforts. The information will be stored in the project database. Other types of data elements may be added as the field investigation needs and activities evolve.

3.5.13 Assessment and Audit Tasks

See Worksheets #31, #32, and #33 in QAPP Revision 6 (Ahtna, 2018).

3.5.14 Data Review Tasks

The laboratory will make sure that the data are accurate and complete for all samples received. Laboratory data will be validated by Ahtna or Wood. Validated data and field logs will be reviewed to assess total measurement error and determine the overall usability of the data for project purposes. Final data are placed in the database with qualifiers. See Worksheets #34 through #37 for the tasks.

3.5.15 Documentation and Records

Records and field measurements of all samples will be collected in notebooks. Chains of custody and sample logs will be prepared and retained for each sample. A copy of the final QAPP will be kept at the Ahtna Marina office. Field forms are shown in the QAPP Revision 6 (Ahtna, 2018).

3.5.16 Project Schedule

A general project schedule for OU2 PFOA/PFOS monitoring is presented below.

Task	Task Begins	Task Completed
OU2 PFOA/PFOS QAPP Addendum	June 2018	November 2018
Sampling[1]	December 2018	December 2018
Sample Laboratory Analysis	December 2018	January 2019
Data Validation	January 2019	February 2019
OU2 PFOA/PFOS Sampling Results Technical Memorandum	January 2019	February 2019

Note:
[1] Start date may be determined by OU2 GWTP operations.

3.6 Worksheet #15: Laboratory-Specific Detection/Quantitation Limits

Analytical Group/Method: PFOA and PFOS by Modified USEPA Method 537

Matrix: Groundwater (µg/L)

Analyte	CAS #	USEPA HA[1]			Achievable Laboratory Limits[2] (µg/L)		
		(ppt)	(ng/L)	(µg/L)	DL	LOD	LOQ
PFOA	335-67-1	70	70	0.07	0.002	0.004	0.008[4]
PFOS	1763-23-1	70	70	0.07	0.004	0.008	0.016
PFOT[3]	N/A	70	70	0.07	N/A	N/A	N/A

Notes:

[1] USEPA, 2017.

[2] Achievable DLs, LODs, and LOQs are limits that an individual laboratory can achieve when performing a specific analytical method. An analyte is ND at the LOD, and a measurable detection above the DL and less than the LOQ is estimated ("J-qualified").

[3] When PFOA and PFOS co-occur at the same time and location, USEPA recommends comparing the sum of the concentrations (PFOA + PFOS) to the HA level of 0.07 µg/L (USEPA, 2016).

[4] There is a discrepancy between the PFOA LOQ with SGS SOP #MS019.2 Section 1.1.3 which lists the range of Lower Limit of Quantitation (LLOQ) of 0.010-0.040 µg/L for aqueous samples. The LLOQ range in SGS SOP #MS019.2 is a holdover from a previous version of the SOP and is expected to be updated in the next revision. The LOQs listed in Worksheet #15 are correct.

µg/L micrograms per liter
CAS # Chemical Abstracts Service Number
DL detection limit
LOD limit of detection
LOQ limit of quantitation
N/A not applicable
ng/L nanograms per liter
PFOA perfluorooctanoic acid
PFOS perfluorooctane sulfonate
PFOT total sum of PFOA and PFOS concentrations
ppt parts per trillion

4.0 Sample Design

4.1 Worksheet #17: Sampling Design and Rationale

A summary of monitoring locations is listed in the worksheets below.

4.1.1 Worksheet #17a: OU2 GWTP PFOA/PFOS Screening

Sampling Location	Activity	Test Methods	Description	Comments/Rationale	SOP Reference
SP-IN-01	GWTP Screening	Modified USEPA Method 537	GWTP Influent Eastern Main	To measure influent concentrations and evaluate GWTP effectiveness.	SOP #1, #3 and #MS019.2
SP-IN-02			GWTP Influent Western Main		
SP-1A-EF[1]			Lead GAC Vessel Effluent for GAC Train #1	To measure concentrations downstream from the lead GAC unit and evaluate GAC effectiveness.	
SP-2A-EF[1]			Lead GAC Vessel Effluent for GAC Train #2		
SP-EF-01			GWTP Effluent	To measure concentrations downstream from the GAC units and evaluate GWTP effectiveness.	

Notes:

[1] Sample will be collected from the effluents of whichever GAC vessels are in the lead positions for GAC Train #1 and GAC Train #2 at the time of the sampling event.

EF effluent
GAC granular activated carbon
GWTP groundwater treatment plant
IN influent
SOP standard operating procedure
SP sample port

4.1.2 Worksheet #17b: OU2 Monitoring Well PFOA/PFOS Screening

Well Name	Aquifer	PFOA/PFOS Analysis (Modified USEPA Method 537)	Sampling Methods/SOP	Rationale
MW-OU2-06-AR	A	X	HydraSleeves™ [1] SOP #1 and #2	It is expected PFOA and PFOS, if present, would follow the same groundwater flow paths as OU2 COCs via advection and dispersion with limited adsorption due to low total organic carbon content in soils at the former Fort Ord (ITRC, 2018 and NGWA, 2017).[2,3] Accordingly, the twelve wells were selected based on the distribution of OU2 COCs in groundwater at concentrations above their respective aquifer cleanup levels.
MW-OU2-08-A	A	X		
MW-OU2-27-A	A	X		
MW-OU2-40-A	A	X		
MW-OU2-44-A	A	X		
MW-OU2-73-A	A	X		
MW-OU2-75-A	A	X		
EW-OU2-01-180	Upper 180	X		
MW-OU2-23-180	Upper 180	X		
MW-OU2-24-180	Upper 180	X		
MW-OU2-44-180	Upper 180	X		
MW-OU2-56-180	Upper 180	X		

Notes:

[1] High-density polyethylene (HDPE) HydraSleeves™ will be deployed for a minimum of 48 hours before sampling to allow conditions in the water column to stabilize, and will be placed at the sample depth shown in Table 1. Low-density polyethylene (LDPE) HydraSleeves™ shall not be used.

[2] OU2 COCs are primarily chlorinated solvents (e.g., tetrachloroethene, trichloroethene, vinyl chloride, and carbon tetrachloride).

[3] See HLA, 1995 and MACTEC, 2006 for discussion about total organic carbon in soil at the former Fort Ord.

EW extraction well
MW monitoring well
PFOA perfluorooctanoic acid
PFOS perfluorooctane sulfonate
SOP standard operating procedure
X sample collected

4.2 Worksheet #18: Sampling Locations and Methods

Information for this worksheet is included in Worksheets #17a and #17b and shown in Figures 2 through 4.

5.0 Sampling Requirements

5.1 Worksheets #19 & #30: Sample Container, Preservation, and Hold Times

Laboratory SGS
4405 Vineland Rd, Suite C15
Orlando, FL 32811

Certificate of Accreditation ISO/IEC 17025:2005 and DoD QSM Version 5.1, Certificate Number L2229 valid to December 15, 2018

Telephone 407-425-6700

Point of Contact Svetlana Izosimova

E-mail Svetlana.Izosimova@sgs.com

Sample Delivery Method Courier to San Jose, CA distribution center or FedEx overnight shipment to Orlando, FL

Data Package Turnaround 15 business days

Matrix	Analytical Group	Preparation and Analytical Method	Sample Volume	Containers	Preservation	Holding Time
Water	PFOA/PFOS	Modified USEPA Method 537	500 mL	Two 250-mL HDPE	Sample temp >0°C ≤10°C first 48 hours, lab >0°C ≤6°C	28 days until extraction, 40 days until analysis

Notes:
°C degrees Celsius
HDPE high-density polyethylene
mL milliliter
PFOA perfluorooctanoic acid
PFOS perfluorooctane sulfonate

5.2 Worksheet #20: Field Quality Control Summary

Matrix	Analytical Group (Method)	Frequency of Field Duplicate Samples	Frequency of Trip Blanks	Frequency of Field Blanks	Frequency of Equipment Blanks	Frequency of MS
Water	PFOS/PFOS (Modified USEPA Method 537)	10% of field samples collected (2 total for the sampling event)	1 set per cooler per day	1 for the sampling event	1 for the sampling event [1]	1 set for the sampling event

Notes:
MS matrix spike
PFOA perfluorooctanoic acid
PFOS perfluorooctane sulfonate
[1] The equipment blank will be prepared by pouring laboratory supplied PFOA/PFOS-free deionized water into an unused HDPE HydraSleeve™ that is then suspended in a monitoring well above the water column for a minimum of 48 hours prior to sample collection.

5.3 Worksheet #21: Field SOPs/Methods

SOP Reference Number	Title	Organization	Revision Date	Equipment Type	Modified for Project Work?	Comments
SOP #1	Sampling for Per- and Polyfluoroalkyl Substances	Ahtna	2018	Various	Yes	PFOA/PFOS Sampling SOP
SOP #2	HydraSleeves™ Field Manual	GeoInsight	2006	HydraSleeves™	No	SOP#3 from QAPP Revision 6
SOP #3	OU2 and Sites 2/12 GWTSs and OUCTP EISB Extraction Well Sample Handling and Custody Requirements	Ahtna	2016	Sampling Ports	Yes	GWTS project-specific procedures, SOP #5 from QAPP Revision 6

Note:
SOPs are provided in Appendices D (SOP #1) and E (SOPs #2 and #3).

5.4 Worksheet #22: Field Equipment Calibration, Maintenance, Testing, and Inspection

Information for this worksheet is included in QAPP Revision 6 (Ahtna, 2018).

6.0 Analytical Requirements

6.1 Worksheet #23: Analytical SOPs

The SOP referenced below is the laboratory-specific procedures for the tests for which the laboratory is certified under DoD Environmental Laboratory Accreditation Program (ELAP). Laboratories with the DoD ELAP certificate undergo annual audits by the independent accrediting bodies responsible for the DoD ELAP certification. Copies of certifications, including the specifically referenced methods, are included in Appendix B.

Data will be evaluated based on the guidance provided in the DoD QSM Version 5.1, the published methods, and the laboratory QA Manual.

SOP Reference Number	Title	Organization	Revision Date	Equipment Type	Modified for Project Work?	Comments
SGS SOP# MS019.2	Analysis of Per- and Polyfluoroalkyl Substances by LC/MS/MS and Isotope Dilution	SGS	April 9, 2018	Analytical Instruments	No	None

6.2 Worksheet #24: Analytical Instrument Calibration

Instrument/ Analysis	Calibration Requirements	Frequency of Calibration	Acceptance Criteria	Corrective Action	Responsible Person
LC/MS/MS PFOA and PFOS by Modified USEPA Method 537	Instrument Sensitivity Check (ISC)	Prior to analysis and at least once every 12 hours.	Analyte concentrations must be at LOQ; concentrations must be within ±30% of their true values.	Correct problem and rerun. If problem persists, repeat ICAL.	Analyst
	Initial Calibration (ICAL)	At instrument set-up and after ICV or CCV failure, prior to sample analysis.	The isotopically labeled analog of an analyte (Extracted Internal Standard Analyte) must be used for quantitation of commercially available (Isotope Dilution Quantitation). If a labeled analog is not commercially available, the Extracted Internal Standard Analyte with the closest retention time to the analyte must be used for quantitation (Internal Standard Quantitation). The %RSD of the response factors (RFs) for all analytes must be <20%. Linear or non-linear calibrations must have r2≥0.99 for each analyte. Analytes must be within 70-130% of their true value for each calibration standard.	Correct problem, then repeat ICAL.	Analyst
LC/MS/MS	Initial Calibration Verification (ICV)	Once after each ICAL, analysis of a second source standard prior to sample analysis.	Each target compound %D ≤30%.	Evaluate system, rerun ICV. If problem persists, repeat ICAL.	Analyst

Instrument/ Analysis	Calibration Requirements	Frequency of Calibration	Acceptance Criteria	Corrective Action	Responsible Person
PFOA and PFOS by Modified USEPA Method 537	Continuing Calibration Verification (CCV)	Before sample analysis, after every ten samples, and at the end of the analysis sequence.	Each target compound %D≤30%. Concentration of analytes must range from the LOQ to the mid-level calibration concentration.	Analyze two additional consecutive CCVs. If both pass, samples may be reported without reanalysis. If either or both fail, or two consecutive CCVs can't be run; perform corrective action(s) and repeat CCV and all associates samples since last successful CCV. Alternatively, recalibrate if necessary; then reanalyze all associated samples since the last acceptable CCV.	Analyst
	Instrument Tuning	Prior to initial calibration and after any mass calibration or maintenance is performed.	Performed according to instrument manufacturers specifications. Tuning standard must contain analytes of interest or appropriate substitute. Mass assignments of tuning standard within 0.5 atomic mass units of true value.	Halt analytical sequence, evaluate system, retune and perform mass calibration as necessary.	Analyst

Instrument/ Analysis	Calibration Requirements	Frequency of Calibration	Acceptance Criteria	Corrective Action	Responsible Person
LC/MS/MS PFOA and PFOS by Modified USEPA Method 537	Instrument Blanks	Immediately following the highest standard analyzed and daily prior to sample analysis.	Concentration of each analyte must be ≤ ½ the LOQ.	If acceptance criteria are not met after the highest calibration standard, calibration must be performed using a lower concentration for the highest standard until acceptance criteria is met. If acceptance criteria are not met after the highest standard which is not included in the calibration, the standard cannot be used to determine the highest concentration in samples at which carryover does not occur. If acceptance criteria are not met after sample, additional instrument blanks must be analyzed until acceptance criteria are met. Additional samples shall not be analyzed until acceptance criteria are met.	Analyst
LC/MS/MS PFOA and PFOS by Modified USEPA Method 537	Extracted Internal Standard Analytes	Every field sample, standard, blank, and QC sample.	Added to sample prior to extraction. For aqueous samples prepared by serial dilution instead of SPE, added to samples prior to analysis. Extracted internal standard analyte recoveries must be within 50% to 150% of the true value.	If recoveries are acceptable for QC samples, but not field samples, the field samples must be reprepped and reanalyzed (greater dilution may be needed). If recoveries are unacceptable for QC samples, correct problem, and reanalyze all associated failed field samples.	Analyst

Instrument/ Analysis	Calibration Requirements	Frequency of Calibration	Acceptance Criteria	Corrective Action	Responsible Person
LC/MS/MS PFOA and PFOS by Modified USEPA Method 537	Injection Internal Standard Analytes	Every field sample, standard, blank, and QC sample.	Added to aliquot of sample dilutions, QC samples, and standards just prior to analysis. Peak areas must be within -50% to +50% of the area measured in the ICAL midpoint standard. On days when ICAL is not performed, the peak areas must be within -50% to +50% of the peak area measured in daily initial CCV.	If peak areas are unacceptable, analyze a second aliquot of the extract or sample if enough extract remains. If there is not enough extract, reanalyze the first aliquot. If second analysis meets acceptance criteria, report the second analysis. If it fails, either analysis may be reported with the appropriate flags.	Analyst

Notes:

≤ less than or equal to
% percent
%D percent difference/percent drift
CCV continuing calibration verification
ICAL initial calibration
ICV initial calibration verification
RF response factor
RSD relative standard deviation

6.3 Worksheet #25: Analytical Instrument and Equipment Maintenance, Testing and Inspection

Information for this worksheet is included in QAPP Revision 6 (Ahtna, 2018).

6.4 Worksheets #26 and #27: Sample Handling, Custody, and Disposal

Information for this worksheet is included in QAPP Revision 6 (Ahtna, 2018).

6.5 Worksheet #28: Analytical Quality Control and Corrective Action

Matrix: Groundwater (µg/L)

Analytical Group/Test Method: PFOA and PFOS by Modified USEPA Method 537

QC Sample	Frequency	Acceptance Limits	Source of Acceptance Limits	Corrective Action	Responsible Person	Data Quality Indicator
Method Blank	1 per analytical batch	No analytes detected >½ LOQ or >10% the amount measured in any sample or 10% the regulatory limit, whichever is greater. Common contaminants must not be detected > LOQ.	DoD QSM 5.1 Table B-15	Correct problem. If required, reprep and reanalyze method blank and all QC samples and field samples processed with the blank contamination.	Analyst	Accuracy/ Bias Contamination
LCS	1 set per analytical batch. Spike target compounds.	Analyte / Recovery / RPD PFOA 74-137% ≤30% PFOS 70-134% ≤30%	Lab-derived	Correct problem. Reprep and reanalyze LCS and associated batch samples if sufficient material available.	Analyst	Bias Accuracy/ Precision
MS	1 per analytical batch. Spike target compounds.	Same as LCS acceptance limits.	Lab-derived	If MS results are outside the LCS limits, the data shall be evaluated to determine the source of difference and to determine if there is a matrix effect or analytical error. If the concentration in parent sample is >4x the spiked amount, include in case narrative. No CA required.	Analyst	Bias/Precision

QC Sample	Frequency	Acceptance Limits	Source of Acceptance Limits	Corrective Action	Responsible Person	Data Quality Indicator
Post Spike Sample	For samples prepared by serial dilution that have reported value <LOQ	Spike aliquots of sample at the final dilution(s) reported for sample with all analytes that have reported value of <LOQ in the final dilution. The spike must be at the LOQ concentration to be reported with the sample (the <LOQ value). When analyte concentrations are calculated as <LOQ, the spike must recover within 70-130% of its true value.	DoD QSM 5.1 Table B-15	When analyte concentrations are calculated as <LOQ, and the spike recovery does not meet the 70-130% acceptance criteria, the sample, sample duplicate, and post spike sample must be reanalyzed at consecutively higher dilutions until the criteria is met.	Analyst	Bias/Precision

Notes:

%	percent
CCV	continuing calibration verification
DoD	Department of Defense
ICAL	initial calibration
LCS	laboratory control sample
LCSD	laboratory control sample duplicate
LOQ	limit of quantitation
MS	matrix spike
QC	quality control
QSM	Quality Systems Manual
RPD	relative percent difference

7.0 Data Management and Data Review

7.1 Worksheet #29: Project Documentation and Records

Information for this worksheet is included in QAPP Revision 6 (Ahtna, 2018).

7.2 Worksheet #31, 32, & 33: Assessments and Corrective Action

Information for this worksheet is included in QAPP Revision 6 (Ahtna, 2018).

7.3 Worksheet #34: Data Verification and Validation Inputs

Information for this worksheet is included in QAPP Revision 6 (Ahtna, 2018).

7.4 Worksheet #35: Data Verification Procedures

Information for this worksheet is included in QAPP Revision 6 (Ahtna, 2018).

7.5 Worksheet #36: Data Validation Procedures

Information for this worksheet is included in QAPP Revision 6 (Ahtna, 2018).

7.6 Worksheet #37: Data Usability Assessment

Information for this worksheet is included in QAPP Revision 6 (Ahtna, 2018).

8.0 References[7]

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U.S. Department of the Army (Army), Assistant Secretary of the Army, Installations, Energy and Environment, 2016. *Memorandum for Commander, Army Material Command; Director, National Guard*

[7] At the end of references included in the Fort Ord Administrative Record are the Administrative Record Numbers (AR#s) (e.g. BW-1234). To find the referenced document, this number may be typed into the online search tool at: http://www.fortordcleanup.com/documents/search/. Please note the referenced documents were available in the Fort Ord Administrative Record at the time this document was issued; however, some may have been superseded by more current versions and were subsequently withdrawn.

Bureau; Chief, U.S. Army Reserve; Assistant Chief of Staff for Installation Management Commander, Installation Management Command. Perfluorinated Compound (PFC) Contamination Assessment. June 10. https://www.denix.osd.mil/army-pfas/the-army-addresses-pfos-pfoa/the-army-addresses-pfos-and-pfoa/perfluorinated-compound-pfc-contamination-assessment1/.

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USEPA, 2016. *Fact Sheet PFOA & PFOS Drinking Water Health Advisories*. November. EPA 800-F-16-003.

USEPA, 2017. *Technical Fact Sheet – Perfluorooctane Sulfonate (PFOS) and Perfluorooctanoic Acid (PFOA)*. November. EPA 505-F-17-001.

TABLE

Table 1. Monitoring Well Details

Well ID*	Aquifer	Casing Diameter (inches)	Screen Top (ft btoc)	Screen Bottom (ft btoc)	Sample Depth (ft btoc)	2018-1Q DTW (ft btoc)	2018-1Q TCE (µg/L)	Notes
MW-OU2-06-AR	A	4	90	120	118	104.28	1.4	
MW-OU2-08-A	A	4	98	128	125	100.73	**6.1**	
MW-OU2-27-A	A	5	94	124	113	101.98	ND	
MW-OU2-40-A	A	4	99	119	118	106.82	4.6	
MW-OU2-44-A	A	3	70	100	90	82.23	**5.9**	
MW-OU2-73-A	A	5	104	134	122	89.25	ND	
MW-OU2-75-A	A	3	93	123	116	87.19	2.7	
EW-OU2-01-180	Upper 180	10	143	173	158	105.63	**11.8**	Inoperable extraction well
MW-OU2-23-180	Upper 180	5	210	240	219	187.73	**16.2**	
MW-OU2-24-180	Upper 180	5	201	231	214	187.73	**11.9**	
MW-OU2-44-180	Upper 180	3.75	174	194	188	170.43	**15.5**	
MW-OU2-56-180	Upper 180	5	215.5	235.5	225	202.05	**5.4**	

Notes:

* One duplicate sample will be collected

Results in **bold** font are above the TCE aquifer cleanup level of 5.0 µg/L

Acronyms and Abbreviations:

2018-1Q: First Quarter 2018 Groundwater Monitoring Program

µg/L: micrograms per liter

btoc: below top of casing

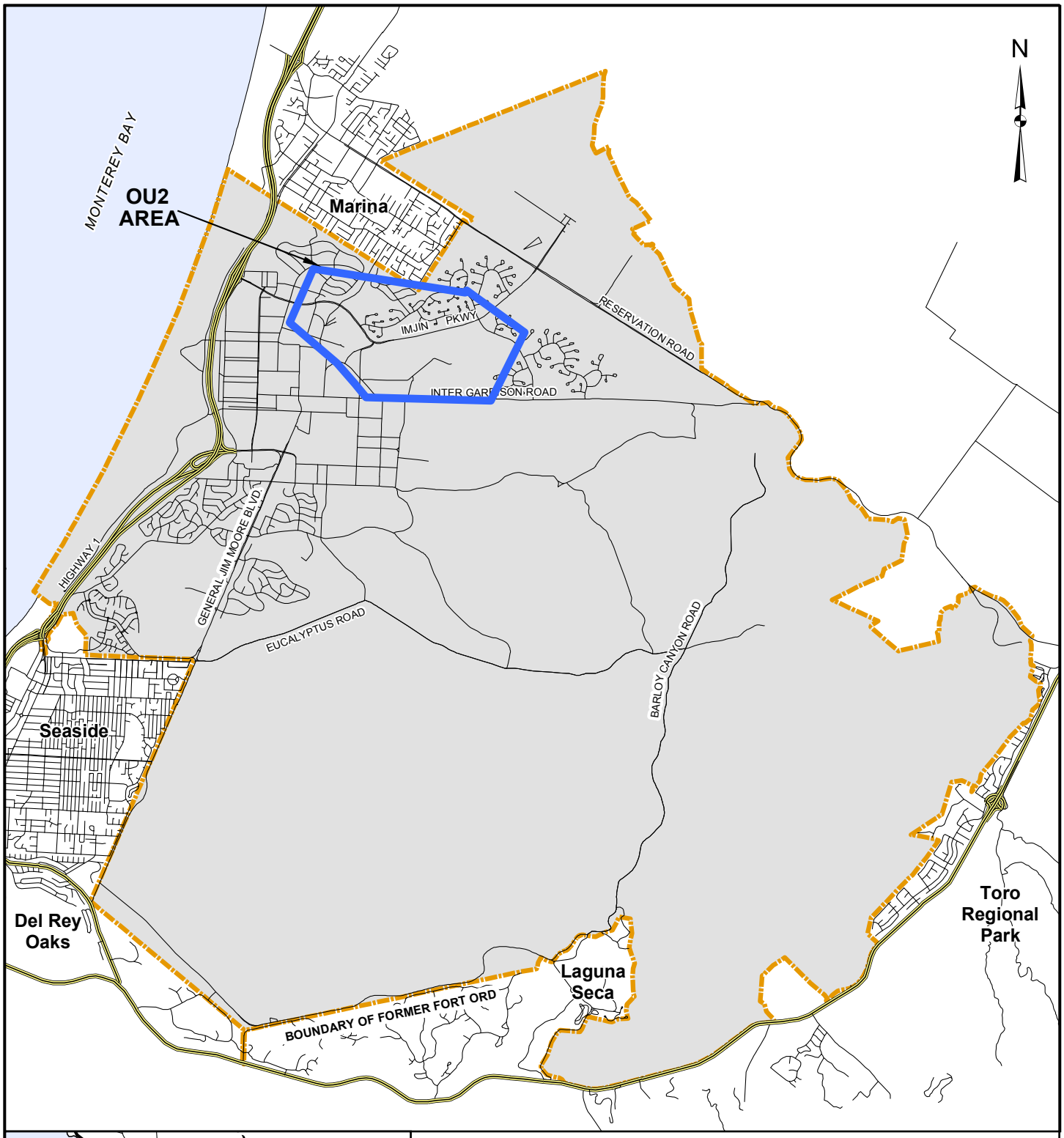
DTW: depth to water

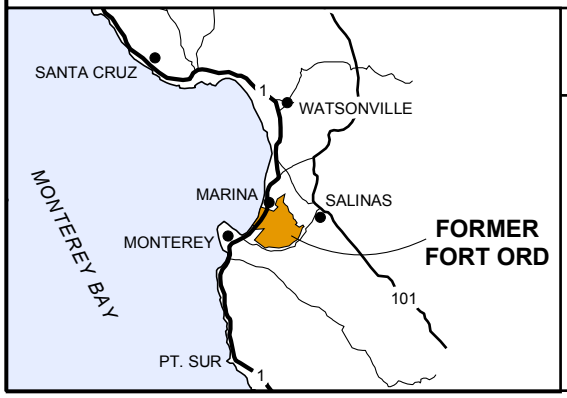
ft: feet

ND: not detected

TCE: trichloroethene

FIGURES





0 5,000 10,000 FEET

Site Vicinity

Operable Unit 2 PFOA/PFOS Sampling and Analysis
Former Fort Ord, California

Ahtna

Figure

1

MW-OU2-37-A
EW-OU2-01-A
EW-OU2-03-A
MW-OU2-20-A
OU2 GWTP-E
MW-BW-13-A
MW-BW-11-A
EW-OU2-02-A
EW-OU2-05-A
EW-OU2-04-A
MW-OU2-79-A
MW-OU2-40-A
EW-OU2-06-A
MW-OU2-41-A
MW-OU2-05-A
MW-OU2-07-A
MW-OU2-08-A
MW-OU2-06-AR
MW-OU2-04-A
EW-OU2-12-A
EW-OU2-13-A
EW-OU2-11-AR
MW-OU2-21-A
MW-OU2-25-A
MW-OU2-09-A
MW-OU2-34-A
EW-OU2-07-A
EW-OU2-10-A
EW-OU2-09-A
MW-OU2-03-A
MW-OU2-23-A
MW-OU2-76-A
MW-OU2-81-A
MW-OU2-75-A
EW-OU2-19-A
MW-OU2-30-A
MW-OU2-44-A
EW-OU2-20-A
EW-OU2-16-A
EW-OU2-17-A
MW-OU2-46-A
MW-OU2-73-A
EW-OU2-18-A
MW-OU2-02-A
MW-OU2-74-A
MW-OU2-27-A
OU2 GWTP-N
MW-OU2-80-A
MW-OU2-57-A
MW-OU2-01-A
MW-OU2-26-A
MW-OU2-35-A
MW-OU2-29-A

Legend

- OU2 GWTP-E: existing Operable Unit 2 Groundwater Treatment Plant in operation until late 2018 when transition to GWTP-N begins
- OU2 GWTP-N: new Operable Unit 2 Groundwater Treatment Plant operation expected to start in late 2018
- Extraction Well - Sample for PFOA/PFOS
- Monitoring Well - Sample for PFOA/PFOS
- Extraction Well
- Monitoring Well
- Groundwater Divide

GWMP A-Aquifer COCs 2018-1Q

- 1,1-DCA (5.0 ug/L)
- 1,2-DCA (0.5 ug/L)
- PCE (3.0 ug/L)
- TCE (5.0 ug/L)
- Vinyl Chloride (0.1 ug/L)

N

0 375 750 1,500 Feet

OU2 A-Aquifer Well Sampling Locations

Operable Unit 2
PFOA/PFOS Sampling and Analysis
Former Fort Ord, California

Ahtna

Figure 2

Legend

- OU2 GWTP-E: existing Operable Unit 2 Groundwater Treatment Plant in operation until late 2018 when transition to GWTP-N begins
- OU2 GWTP-N: new Operable Unit 2 Groundwater Treatment Plant operation expected to start in late 2018
- Extraction Well - Sample for PFOA/PFOS
- Monitoring Well - Sample for PFOA/PFOS
- Extraction Well
- Monitoring Well

GWMP Upper 180-Foot Aquifer COCs

- TCE (5.0 ug/L) 2018-1Q

N

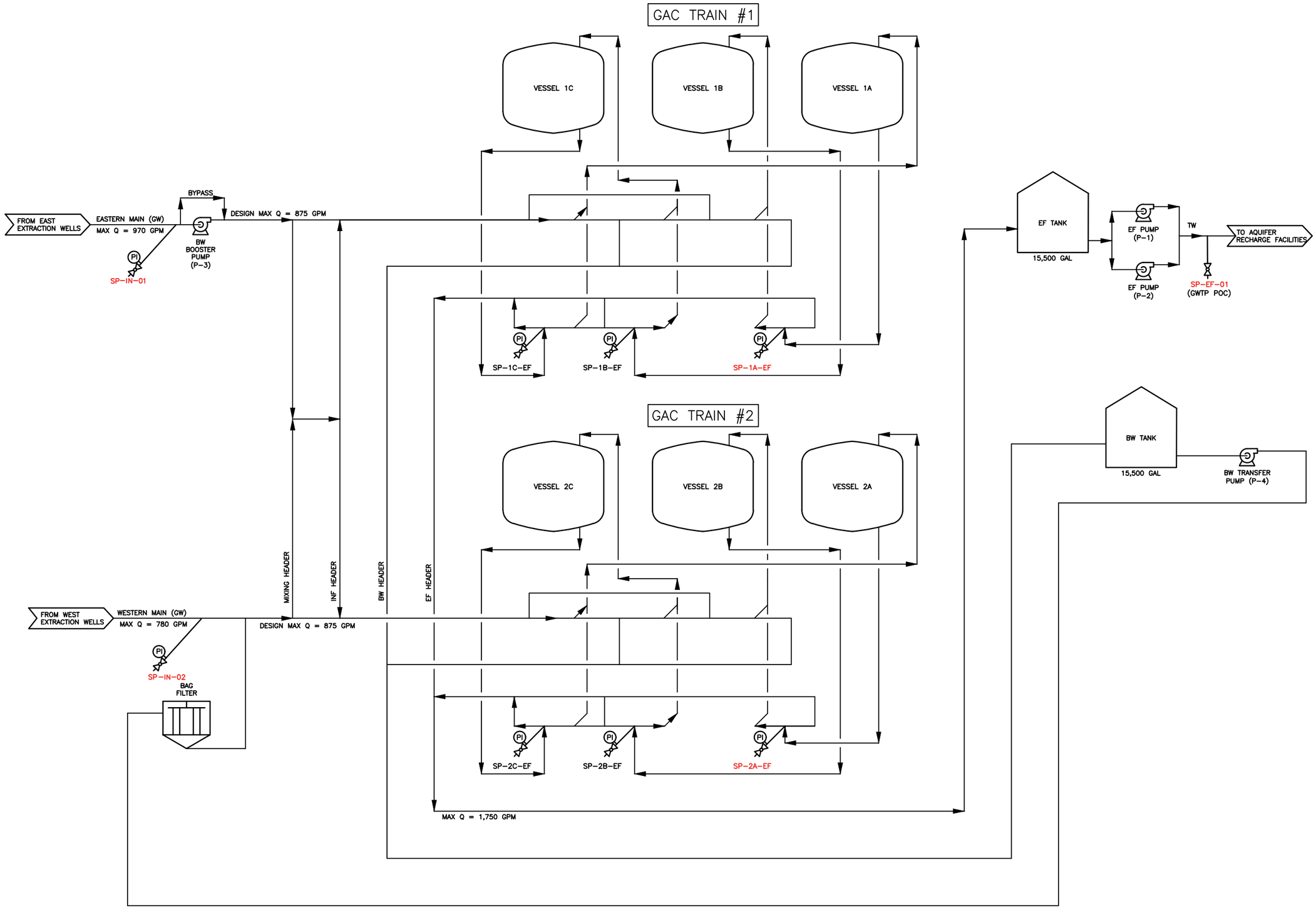
0 350 700 1,400 Feet

OU2 Upper 180-Foot Aquifer Well Sampling Locations

Operable Unit 2
PFOA/PFOS Sampling and Analysis
Former Fort Ord, California

Ahtna

Figure 3



Legend

ABBREVIATIONS

BW	BACKWASH
EF	EFFLUENT
GAC	GRANULAR ACTIVATED C
GAL	GALLONS
GPM	GALLONS PER MINUTE
GW	GROUNDWATER (UNTREA
GWTP	GROUNDWATER TREATME
MAX	MAXIMUM
PI	PRESSURE INDICATOR
POC	POINT OF COMPLIANCE
Q	FLOW RATE
SP	SAMPLE PORT
TW	TREATED WATER

NOTES

1. VALVES ARE NOT INDICATED.
2. FLOW ARROWS INDICATE NORI OPERATION, WITH VESSEL SEC A-B-C IN EACH GAC TRAIN.

Locations in red font are sample locations for PFOA/PFOS.

Note: The lead GAC vessel effluent will be sampled at the time of the sampling event

OU2 GWTP Sampling Locations

Operable Unit 2 PFOA/PFOS Sampling and Analysis
Former Fort Ord, California

Ahtna RORE ITSI

Figure **4**

APPENDICES

APPENDIX A

Sampling Activity Hazard Analysis
(from the 2015 Well Sampling Activity Hazard Analysis)

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Activity Hazard Analysis (AHA) Former Fort Ord

Activity/Work Task: Monitoring Well Sampling	Overall Risk Assessment Code (RAC) (Use highest code)					**L**
Project Location: Former Fort Ord, California	**Risk Assessment Code (RAC) Matrix**					
Contract Number: W91238-14-C-0048	**Severity**	**Probability**				
Date Prepared: March 9, 2015 (Revision #1)		Frequent	Likely	Occasional	Seldom	Unlikely
Prepared by: Holly Dillon, Site Safety and Health Officer Mark Fisler, Treatment Plant Operator	Catastrophic	**E**	**E**	**H**	**H**	**M**
	Critical	**E**	**H**	**H**	**M**	**L**
Reviewed by (Name/Title): Derek Lieberman, Project Manager	Marginal	**H**	**M**	**M**	**L**	**L**
	Negligible	**M**	**L**	**L**	**L**	**L**

Notes: (Field Notes, Review Comments, etc.)
Primary references for this AHA are those specified in EM 385-1-1 (USACE, 2014) Sections 5 and 33, and applicable sections of Federal OSHA and Cal/OSHA.

Step 1: Review each **"Hazard"** with identified safety **"Controls"** and determine RAC (See above)

"Probability" is the likelihood to cause an incident, near miss, or accident and identified as: Frequent, Likely, Occasional, Seldom or Unlikely.

"Severity" is the outcome/degree if an incident, near miss, or accident did occur and identified as: Catastrophic, Critical, Marginal, or Negligible

Step 2: Identify the RAC (Probability/Severity) as E, H, M, or L for each "Hazard" on AHA. Annotate the overall highest RAC at the top of AHA.

RAC Chart

E = Extremely High Risk

H = High Risk

M = Moderate Risk

L = Low Risk

Site Safety and Health Officer (SSHO)	**Alternate SSHO**
Holly Dillon (831) 384-3735 office (831) 324-3299 cell	Derek Lieberman (831) 384-3735 office (831) 224-3327

Collateral Duty Safety Officer (CDSO)	**Competent or Qualified Persons**
Mark Fisler (831) 224-3133 cell	Holly Dillon and Mark Fisler

The AHA shall be reviewed and modified as necessary to address changing site conditions, operations, or change of competent/qualified person.

Activity Hazard Analysis Former Fort Ord

AHA Title: Monitoring Well Sampling

DATE: March 9, 2015 **Revision #: 1**

PRINCIPAL STEPS	POTENTIAL SAFETY/ HEALTH HAZARDS	RECOMMENDED CONTROL	RISK ASSESSMENT CODE
Staging	Chemical Biological Traffic vehicles Slip/trip/fall Lifting	Inspect the area to be sampled for potential safety/health hazards. Follow applicable guidelines in the APP for identified hazards prior to entry into the sampling area. The sampler must wear chemical resistant PPE including disposable nitrile gloves and eye protection. Wear chemical resistant gloves when handling acid preserved sample bottles and inspect for any leaks. Use a sample tray to keep acid preserved sample bottles from tipping over and spilling. If in a traffic area the sampler must wear a high visibility vest. Use traffic cones around the work area. Do not leave an open well vault unattended. Secure well vault lid bolts so they are not a tripping hazard. Place well vault lid out of the way so it is not a tripping hazard. Use a second person to help setup Westbay equipment for multi-port wells.	L
Sampling	Ergonomic Physical Chemical Slips/Trips/Falls	Position body to use appropriate lifting techniques when lifting PDB sampler, Westbay equipment, water quality meter, or rolling up the depth to water reel. Do not allow the depth to water tape or PDB sampling rope to free-fall, drop slowly using gloves as to prevent sliding of the rope or tape on hand. Consult the appropriate SDS for chemical spills or contact. Use correct lifting, vault entry/exit, and posture techniques while sampling. If sampling from a spigot control overspray. Sampler must wear safety glasses and chemical resistant gloves. Monitor PPE for correct and effective use during sampling.	
Packaging and Shipping	Traffic vehicles Lifting Chemical	Wear chemical resistant gloves to package samples securely in coolers. Use appropriate lifting techniques when moving sample coolers. Inspect vehicle daily before use for mechanical or visibility hazards. Use defensive driving techniques.	

Activity Hazard Analysis Former Fort Ord

AHA Title: Monitoring Well Sampling

EQUIPMENT TO BE USED/ TRAINING REQUIRED:

EQUIPMENT	INSPECTION REQUIREMENTS	TRAINING REQUIREMENTS
Sampling equipment including Westbay equipment, water quality meter, VOA vials with HCl preservative	Inspect before each use for leaks while wearing chemical resistant gloves.	Onsite training required.
Monitoring wells	Inspect for maintenance needs for safety and quality issues	40-Hour HAZWOPER and 8-Hour Annual HAZWOPER Refresher training.
PPE	Inspect daily prior to use for effectiveness and wear or tear.	PPE donning/doffing, uses, limitations, and replacement.
Vehicle	Inspect daily prior to use.	Defensive driving training (Ahtna only) and valid state driver's license.

Note:

AHA = Activity Hazard Analysis **APP = Accident Prevention Plan**

PPE = personal protective equipment **HAZWOPER = Hazardous Waste Operations and Emergency Response**

SDS = Safety Data Sheet

Note: All hazards cannot be recognized and addressed in the documented Activity Hazard Analysis, as site conditions may be different than anticipated. The on-site team member(s) are responsible for surveying the area to identify potential site hazards and reporting them to the SSHO or Treatment Plant Operator who will evaluate those hazards in cooperation with the Safety and Health Manager to develop appropriate controls for those hazards and document the hazards and controls on the field copy of the AHA.

Activity Hazard Analysis Former Fort Ord

AHA Title: Monitoring Well Sampling

ACTIVITY HAZARD ANALYSIS ACKNOWLEDGEMENT

I have been informed on the hazards and safe work practices associated with this Activity Hazard Analysis to include training and protective equipment requirements. I have also been given the opportunity to ask questions and receive informed answers.

NAME	DATE	COMPANY	SIGNATURE

APPENDIX B

Analytical Laboratory Certifications

CERTIFICATE OF ACCREDITATION

ANSI-ASQ National Accreditation Board
500 Montgomery Street, Suite 625, Alexandria, VA 22314, 877-344-3044

This is to certify that

SGS North America Inc. - Orlando
4405 Vineland Road, Suite C-15
Orlando, FL 32811

has been assessed by ANAB
and meets the requirements of international standard

ISO/IEC 17025:2005

and DoD Quality Systems Manual for Environmental Laboratories (DoD QSM V 5.1)

while demonstrating technical competence in the fields of

TESTING

Refer to the accompanying Scope of Accreditation for information regarding the types of calibrations and/or tests to which this accreditation applies.

L2229
Certificate Number

ANAB Approval

Certificate Valid: 03/22/2018-12/15/2018
Version No. 002 Issued: 03/22/2018

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2005. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communiqué dated April 2017).

ANSI-ASQ National Accreditation Board

SCOPE OF ACCREDITATION TO ISO/IEC 17025:2005 AND DOD QUALITY SYSTEMS MAUAL FOR ENVIRONMENTAL LABORATORIES (DOD QSM V5.1)

SGS North America Inc. - Orlando

4405 Vineland Road, Suite C-15
Orlando, FL 32811
Svetlana Izosimova, Ph. D., QA Officer
407-425-6700

TESTING

Valid to: **December 15, 2018** Certificate Number: **L2229**

Environmental

Drinking Water		
Technology	**Method**	**Analyte**
LC/MS/MS	EPA 537	Perfluorohexanoic Acid
LC/MS/MS	EPA 537	Perfluoroheptanoic Acid
LC/MS/MS	EPA 537	Perfluorooctanoic Acid
LC/MS/MS	EPA 537	Perfluorononanoic Acid
LC/MS/MS	EPA 537	Perfluorodecanoic Acid
LC/MS/MS	EPA 537	Perfluoroundecanoic Acid
LC/MS/MS	EPA 537	Perfluorododecanoic Acid
LC/MS/MS	EPA 537	Perfluorotridecanoic Acid
LC/MS/MS	EPA 537	Perfluorotetradecanoic Acid
LC/MS/MS	EPA 537	Perfluorobutanesulfonic Acid
LC/MS/MS	EPA 537	Perfluorohexanesulfonic Acid
LC/MS/MS	EPA 537	Perfluorooctanesulfonic Acid
LC/MS/MS	EPA 537	N-Methyl perfluorooctanesulfonamidoacetic acid
LC/MS/MS	EPA 537	N-Ethyl perfluorooctanesulfonamidoacetic acid

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/ECD	EPA 8011	1,2-Dibromoethane (EDB)
GC/ECD	EPA 8011	1,2-Dibromo-3-Chloropropane (DBCP)
GC/ECD	EPA 504.1	1,2-Dibromoethane (EDB)
GC/ECD	EPA 504.1	1,2-Dibromo-3-Chloropropane (DBCP)
GC/ECD	EPA 504.1	1,2,3-Trichloropropane (1,2,3-TCP)
GC/FID	EPA 8015C/D	Diesel range organics (DRO)
GC/FID	EPA 8015C/D	Oil Range Organics (ORO)
GC/FID	EPA 8015C/D	Gasoline range organics (GRO)
GC/FID	EPA 8015C/D	Ethanol
GC/FID	EPA 8015C/D	2-Ethoxyethanol
GC/FID	EPA 8015C/D	Isobutyl alcohol (2-Methyl-1-propanol)
GC/FID	EPA 8015C/D	Isopropyl alcohol (2-Propanol)
GC/FID	EPA 8015C/D	Methanol
GC/FID	EPA 8015C/D	n-Butyl alcohol
GC/FID	EPA 8015C/D	n-Propanol
GC/PID	EPA 602; EPA 8021B	Benzene
GC/PID	EPA 602; EPA 8021B	Ethylbenzene
GC/PID	EPA 602; EPA 8021B	Chlorobenzene
GC/PID	EPA 602; EPA 8021B	Toluene
GC/PID	EPA 602; EPA 8021B	1,2-Dichlorobenzene (o-Dichlorobenzene)
GC/PID	EPA 602; EPA 8021B	1,3-Dichlorobenzene (m-Dichlorobenzene)
GC/PID	EPA 602; EPA 8021B	1,4-Dichlorobenzene (p-Dichlorobenzene)
GC/PID	EPA 602; EPA 8021B	m,p-Xylene
GC/PID	EPA 602; EPA 8021B	o-Xylene
GC/PID	EPA 602; EPA 8021B	Methyl-tert-Butyl Ether
GC/ECD	EPA 608; EPA 8081B	4,4`-DDD
GC/ECD	EPA 608; EPA 8081B	4,4`-DDE
GC/ECD	EPA 608; EPA 8081B	4,4`-DDT
GC/ECD	EPA 608; EPA 8081B	Aldrin
GC/ECD	EPA 608; EPA 8081B	alpha-BHC (alpha-Hexachlorocyclohexane)
GC/ECD	EPA 608; EPA 8081B	beta-BHC (beta-Hexachlorocyclohexane)
GC/ECD	EPA 608; EPA 8081B	delta-BHC
GC/ECD	EPA 608; EPA 8081B	gamma-BHC (Lindane gamma-Hexachlorocyclohexane)
GC/ECD	EPA 608; EPA 8081B	Chlordane (tech.)
GC/ECD	EPA 608; EPA 8081B	alpha-Chlordane

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/ECD	EPA 608; EPA 8081B	gamma-Chlordane
GC/ECD	EPA 608; EPA 8081B	Dieldrin
GC/ECD	EPA 608; EPA 8081B	Endosulfan I
GC/ECD	EPA 608; EPA 8081B	Endosulfan II
GC/ECD	EPA 608; EPA 8081B	Endosulfan sulfate
GC/ECD	EPA 608; EPA 8081B	Endrin
GC/ECD	EPA 608; EPA 8081B	Endrin aldehyde
GC/ECD	EPA 608; EPA 8081B	Endrin ketone
GC/ECD	EPA 608; EPA 8081B	Heptachlor
GC/ECD	EPA 608; EPA 8081B	Heptachlor epoxide
GC/ECD	EPA 608; EPA 8081B	Methoxychlor
GC/ECD	EPA 608; EPA 8081B	Toxaphene (Chlorinated camphene)
GC/ECD	EPA 608; EPA 8082A	Aroclor-1016 (PCB-1016)
GC/ECD	EPA 608; EPA 8082A	Aroclor-1221 (PCB-1221)
GC/ECD	EPA 608; EPA 8082A	Aroclor-1232 (PCB-1232)
GC/ECD	EPA 608; EPA 8082A	Aroclor-1242 (PCB-1242)
GC/ECD	EPA 608; EPA 8082A	Aroclor-1248 (PCB-1248)
GC/ECD	EPA 608; EPA 8082A	Aroclor-1254 (PCB-1254)
GC/ECD	EPA 608; EPA 8082A	Aroclor-1260 (PCB-1260)
GC/ECD	EPA 8082A	Aroclor-1262 (PCB-1262)
GC/ECD	EPA 8082A	Aroclor-1268 (PCB-1268)
GC/FPD	EPA 8141B	Azinphos-methyl (Guthion)
GC/FPD	EPA 8141B	Bolstar (Sulprofos)
GC/FPD	EPA 8141B	Carbophenothion
GC/FPD	EPA 8141B	Chlorpyrifos
GC/FPD	EPA 8141B	Coumaphos
GC/FPD	EPA 8141B	Demeton-o
GC/FPD	EPA 8141B	Demeton-s
GC/FPD	EPA 8141B	Diazinon
GC/FPD	EPA 8141B	Dichlorovos (DDVP Dichlorvos)
GC/FPD	EPA 8141B	Dimethoate
GC/FPD	EPA 8141B	Disulfoton
GC/FPD	EPA 8141B	EPN
GC/FPD	EPA 8141B	Ethion
GC/FPD	EPA 8141B	Ethoprop
GC/FPD	EPA 8141B	Famphur
GC/FPD	EPA 8141B	Fensulfothion

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/FPD	EPA 8141B	Fenthion
GC/FPD	EPA 8141B	Malathion
GC/FPD	EPA 8141B	Merphos
GC/FPD	EPA 8141B	Methyl parathion (Parathion methyl)
GC/FPD	EPA 8141B	Mevinphos
GC/FPD	EPA 8141B	Monocrotophos
GC/FPD	EPA 8141B	Naled
GC/FPD	EPA 8141B	Parathion ethyl
GC/FPD	EPA 8141B	Phorate
GC/FPD	EPA 8141B	Ronnel
GC/FPD	EPA 8141B	Stirofos
GC/FPD	EPA 8141B	Sulfotepp
GC/FPD	EPA 8141B	Tetraethyl pyrophosphate (TEPP)
GC/FPD	EPA 8141B	Thionazin (Zinophos)
GC/FPD	EPA 8141B	Tokuthion (Prothiophos)
GC/FPD	EPA 8141B	Trichloronate
GC/FPD	EPA 8141B	O,O,O-Triethyl phosphorothioate
GC/ECD	EPA 8151A	2,4,5-T
GC/ECD	EPA 8151A	2,4-D
GC/ECD	EPA 8151A	2,4-DB
GC/ECD	EPA 8151A	Dalapon
GC/ECD	EPA 8151A	Dicamba
GC/ECD	EPA 8151A	Dichloroprop (Dichlorprop)
GC/ECD	EPA 8151A	Dinoseb (2-sec-butyl-4,6-dinitrophenol DNBP)
GC/ECD	EPA 8151A	MCPA
GC/ECD	EPA 8151A	MCPP
GC/ECD	EPA 8151A	Pentachlorophenol
GC/ECD	EPA 8151A	Silvex (2,4,5-TP)
GC/FID	RSK-175	Acetylene
GC/FID	RSK-175	Methane
GC/FID	RSK-175	Ethane
GC/FID	RSK-175	Ethene
GC/FID	RSK-175	Propane
GC/FID	FL-PRO	Total Petroleum Hydrocarbons (TPH)
GC/FID	MA-VPH	Volatile petroleum range organics (VPH)

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/FID	MA-EPH	Extractable petroleum range organics (EPH)
GC/FID	IA-OA1	Gasoline range organics (GRO)
GC/FID	IA-OA2	Diesel range organics (DRO)
GC/FID	TN-GRO	Gasoline range organics (GRO)
GC/FID	TN-EPH	Extractable petroleum range organics (EPH)
GC/FID	WI-DRO	Diesel range organics (DRO)
GC/FID	AK-101	Gasoline range organics (GRO)
GC/FID	AK-102	Diesel range organics (DRO)
GC/FID	OK-GRO	Gasoline range organics (GRO)
GC/FID	OK-DRO	Diesel range organics (DRO)
GC/FID	TX-1005	Total Petroleum Hydrocarbons (TPH)
GC/FID	KS LRH	Low-Range Hydrocarbons (LRH)
GC/FID	KS MRH	Mid-Range Hydrocarbons (MRH)
GC/FID	KS HRH	High-Range Hydrocarbons (HRH)
GC/MS	EPA 624; SM 6200B-11; EPA 8260B/C	1,1,1,2-Tetrachloroethane
GC/MS	EPA 624; SM 6200B-11; EPA 8260B/C	1,1,1-Trichloroethane
GC/MS	EPA 624; SM 6200B-11; EPA 8260B/C	1,1,2,2-Tetrachloroethane
GC/MS	EPA 624; SM 6200B-11; EPA 8260B/C	1,1,2-Trichloroethane
GC/MS	EPA 624; SM 6200B-11; EPA 8260B/C	1,1-Dichloroethane
GC/MS	EPA 624; SM 6200B-11; EPA 8260B/C	1,1-Dichloroethylene
GC/MS	EPA 624; SM 6200B-11; EPA 8260B/C	1,1-Dichloropropene
GC/MS	EPA 624; EPA 8260B/C	1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)
GC/MS	EPA 624; SM 6200B-11; EPA 8260B/C	1,2,3-Trichlorobenzene
GC/MS	EPA 624; SM 6200B-11; EPA 8260B/C	1,2,3-Trichloropropane
GC/MS	EPA 624; SM 6200B-11; EPA 8260B/C	1,2,4-Trichlorobenzene
GC/MS	EPA 624; SM 6200B-11; EPA 8260B/C	1,2,4-Trimethylbenzene
GC/MS	EPA 624; SM 6200B-11; EPA 8260B/C	1,2-Dibromo-3-chloropropane (DBCP)
GC/MS	EPA 624; SM 6200B-11; EPA 8260B/C	1,2-Dibromoethane (EDB Ethylene dibromide)
GC/MS	EPA 624; SM 6200B-11; EPA 8260B/C	1,2-Dichlorobenzene (o-Dichlorobenzene)
GC/MS	EPA 624; SM 6200B-11; EPA 8260B/C	1,2-Dichloroethane
GC/MS	EPA 624; SM 6200B-11; EPA 8260B/C	1,2-Dichloropropane
GC/MS	EPA 8260B/C	1,2-Dichlorotrifluoroethane (Freon 123)
GC/MS	EPA 624; SM 6200B-11; EPA 8260B/C	1,3,5-Trimethylbenzene
GC/MS	EPA 624; SM 6200B-11; EPA 8260B/C	1,3-Dichlorobenzene (m-Dichlorobenzene)

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	EPA 624; SM 6200B-11; EPA 8260B/C	1,3-Dichloropropane
GC/MS	EPA 624; SM 6200B-11; EPA 8260B/C	1,4-Dichlorobenzene (p-Dichlorobenzene)
GC/MS	EPA 8260B/C	1-Chlorohexane
GC/MS	EPA 624; SM 6200B-11; EPA 8260B/C	2,2-Dichloropropane
GC/MS	EPA 624; SM 6200B-11; EPA 8260B/C	2-Butanone (Methyl ethyl ketone MEK)
GC/MS	EPA 624; EPA 8260B/C	2-Chloroethyl vinyl ether
GC/MS	EPA 624; SM 6200B-11; EPA 8260B/C	2-Chlorotoluene
GC/MS	EPA 624; SM 6200B-11; EPA 8260B/C	2-Hexanone
GC/MS	EPA 8260B/C	2-Nitropropane
GC/MS	EPA 624; SM 6200B-11; EPA 8260B/C	4-Chlorotoluene
GC/MS	EPA 624; SM 6200B-11; EPA 8260B/C	4-Methyl-2-pentanone (MIBK)
GC/MS	EPA 624; SM 6200B-11; EPA 8260B/C	Acetone
GC/MS	EPA 8260B/C	Acetonitrile
GC/MS	EPA 624; EPA 8260B/C	Acrolein (Propenal)
GC/MS	EPA 624; EPA 8260B/C	Acrylonitrile
GC/MS	EPA 8260B/C	Allyl chloride (3-Chloropropene)
GC/MS	EPA 624; SM 6200B-11; EPA 8260B/C	Benzene
GC/MS	EPA 8260B/C	Benzyl Chloride
GC/MS	EPA 624; SM 6200B-11; EPA 8260B/C	Bromobenzene
GC/MS	EPA 624; SM 6200B-11; EPA 8260B/C	Bromochloromethane
GC/MS	EPA 624; SM 6200B-11; EPA 8260B/C	Bromodichloromethane
GC/MS	EPA 624; SM 6200B-11; EPA 8260B/C	Bromoform
GC/MS	EPA 624; SM 6200B-11; EPA 8260B/C	n-Butylbenzene
GC/MS	EPA 624; SM 6200B-11; EPA 8260B/C	sec-Butylbenzene
GC/MS	EPA 624; SM 6200B-11; EPA 8260B/C	tert-Butylbenzene
GC/MS	EPA 624; SM 6200B-11; EPA 8260B/C	Carbon disulfide
GC/MS	EPA 624; SM 6200B-11; EPA 8260B/C	Carbon tetrachloride
GC/MS	EPA 624; SM 6200B-11; EPA 8260B/C	Chlorobenzene
GC/MS	EPA 624; SM 6200B-11; EPA 8260B/C	Chloroethane
GC/MS	EPA 624; SM 6200B-11; EPA 8260B/C	Chloroform
GC/MS	EPA 8260B/C	Chloroprene
GC/MS	EPA 624; EPA 8260B,C	Cyclohexane
GC/MS	EPA 8260B/C	Cyclohexanone
GC/MS	EPA 624; SM 6200B-11; EPA 8260B/C	cis-1,2-Dichloroethylene
GC/MS	EPA 624; SM 6200B-11; EPA 8260B/C	trans-1,2-Dichloroethylene
GC/MS	EPA 624; SM 6200B-11; EPA 8260B/C	cis-1,3-Dichloropropene

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	EPA 624; SM 6200B-11; EPA 8260B/C	trans-1,3-Dichloropropylene
GC/MS	EPA 8260B/C	cis-1,4-Dichloro-2-butene
GC/MS	EPA 8260B/C	trans-1,4-Dichloro-2-butene
GC/MS	EPA 624; SM 6200B-11; EPA 8260B/C	Di-isopropylether (DIPE)
GC/MS	EPA 624; SM 6200B-11; EPA 8260B/C	Dibromochloromethane
GC/MS	EPA 624; SM 6200B-11; EPA 8260B/C	Dibromomethane (Methylene Bromide)
GC/MS	EPA 624; SM 6200B-11; EPA 8260B/C	Dichlorodifluoromethane
GC/MS	EPA 8260B/C	Diethyl ether
GC/MS	EPA 624, EPA 8260B/C, EPA 8260B/C SIM	p-Dioxane (1,4-Dioxane)
GC/MS	EPA 624; SM 6200B-11; EPA 8260B/C	Ethanol (Ethyl Alcohol)
GC/MS	EPA 8260B/C	Ethyl acetate
GC/MS	EPA 8260B/C	Ethyl methacrylate
GC/MS	EPA 8260B/C	Ethyl tert-butyl alcohol (ETBA)
GC/MS	EPA 624; SM 6200B-11; EPA 8260B/C	Ethyl tert-butyl ether (ETBE)
GC/MS	EPA 624; SM 6200B-11; EPA 8260B/C	Ethylbenzene
GC/MS	EPA 8260B/C	Ethylene Oxide
GC/MS	EPA 624; SM 6200B-11; EPA 8260B/C	Hexachlorobutadiene
GC/MS	EPA 8260B/C	Hexane
GC/MS	EPA 8260B/C	Iodomethane (Methyl iodide)
GC/MS	EPA 8260B/C	Isobutyl alcohol (2-Methyl-1-propanol)
GC/MS	EPA 624; SM 6200B-11; EPA 8260B/C	p-Isopropyltoluene
GC/MS	EPA 624; SM 6200B-11; EPA 8260B/C	Isopropylbenzene
GC/MS	EPA 8260B/C	Methacrylonitrile
GC/MS	EPA 624; EPA 8260B/C	Methyl Acetate
GC/MS	EPA 624; SM 6200B-11; EPA 8260B/C	Methyl bromide (Bromomethane)
GC/MS	EPA 624; SM 6200B-11; EPA 8260B/C	Methyl chloride (Chloromethane)
GC/MS	EPA 624; EPA 8260B,C	Methylcyclohexane
GC/MS	EPA 8260B/C	Methyl methacrylate
GC/MS	EPA 624; SM 6200B-11; EPA 8260B/C	Methyl tert-butyl ether (MTBE)
GC/MS	EPA 624; SM 6200B-11; EPA 8260B/C	Methylene chloride
GC/MS	EPA 624; SM 6200B-11; EPA 8260B/C	Naphthalene
GC/MS	EPA 8260B/C	Pentachloroethane
GC/MS	EPA 8260B/C	Propionitrile (Ethyl cyanide)
GC/MS	EPA 624; SM 6200B-11; EPA 8260B/C	n-Propylbenzene
GC/MS	EPA 624; SM 6200B-11; EPA 8260B/C	Styrene
GC/MS	EPA 624; SM 6200B-11; EPA 8260B/C	tert-Amyl alcohol (TAA)

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	EPA 624; SM 6200B-11; EPA 8260B/C	tert-Amyl methyl ether (TAME)
GC/MS	EPA 624; SM 6200B-11; EPA 8260B/C	tert-Butyl alcohol (TBA)
GC/MS	EPA 624; SM 6200B-11; EPA 8260B/C	tert-Butyl formate (TBF)
GC/MS	EPA 624; SM 6200B-11; EPA 8260B/C	Tetrachloroethylene (Perchloroethylene)
GC/MS	EPA 8260B/C	Tetrahydrofuran
GC/MS	EPA 624; SM 6200B-11; EPA 8260B/C	Toluene
GC/MS	EPA 624; SM 6200B-11; EPA 8260B/C	Trichloroethene (Trichloroethylene)
GC/MS	EPA 624; SM 6200B-11; EPA 8260B/C	Trichlorofluoromethane
GC/MS	EPA 624; SM 6200B-11; EPA 8260B/C	Vinyl acetate
GC/MS	EPA 624; SM 6200B-11; EPA 8260B/C	Vinyl chloride
GC/MS	EPA 624; SM 6200B-11; EPA 8260B/C	Xylene (total)
GC/MS	EPA 624; SM 6200B-11; EPA 8260B/C	m,p-Xylene
GC/MS	EPA 624; SM 6200B-11; EPA 8260B/C	o-Xylene
GC/MS	EPA 8260B/C	1-Bromopropane
GC/MS	EPA 8260B/C	Isopropyl Alcohol
GC/MS	EPA 8260B/C	n-Butyl Alcohol
GC/MS	EPA 625; EPA 8270D	1,2,4,5-Tetrachlorobenzene
GC/MS	EPA 625; EPA 8270D	1,2,4-Trichlorobenzene
GC/MS	EPA 625; EPA 8270D	1,2-Dichlorobenzene (o-Dichlorobenzene)
GC/MS	EPA 625; EPA 8270D	1,2-Diphenylhydrazine
GC/MS	EPA 8270D	1,3,5-Trinitrobenzene (1,3,5-TNB)
GC/MS	EPA 625; EPA 8270D	1,3-Dichlorobenzene (m-Dichlorobenzene)
GC/MS	EPA 8270D	1,3-Dinitrobenzene (1,3-DNB)
GC/MS	EPA 625; EPA 8270D	1,4-Dichlorobenzene (p-Dichlorobenzene)
GC/MS	EPA 8270D	1,4-Dithiane
GC/MS	EPA 8270D	1,4-Oxathiane
GC/MS	EPA 8270D	1,4-Naphthoquinone
GC/MS	EPA 8270D	1,4-Phenylenediamine
GC/MS	EPA 8270D	1-Chloronaphthalene
GC/MS	EPA 625; EPA 8270D; EPA 8270D SIM	1-Methylnaphthalene
GC/MS	EPA 8270D	1-Naphthylamine
GC/MS	EPA 625; EPA 8270D	2,3,4,6-Tetrachlorophenol
GC/MS	EPA 625; EPA 8270D	2,4,5-Trichlorophenol
GC/MS	EPA 625; EPA 8270D	2,4,6-Trichlorophenol
GC/MS	EPA 625; EPA 8270D	2,4-Dichlorophenol
GC/MS	EPA 625; EPA 8270D	2,4-Dimethylphenol
GC/MS	EPA 625; EPA 8270D	2,4-Dinitrophenol

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	EPA 625; EPA 8270D	2,4-Dinitrotoluene (2,4-DNT)
GC/MS	EPA 8270D	2,6-Dichlorophenol
GC/MS	EPA 625; EPA 8270D	2,6-Dinitrotoluene (2,6-DNT)
GC/MS	EPA 8270D	2-Acetylaminofluorene
GC/MS	EPA 625; EPA 8270D	2-Chloronaphthalene
GC/MS	EPA 625; EPA 8270D	2-Chlorophenol
GC/MS	EPA 625; EPA 8270D	2-Methyl-4,6-dinitrophenol (4,6-Dinitro-o-cresol)
GC/MS	EPA 625; EPA 8270D; EPA 8270D SIM	2-Methylnaphthalene
GC/MS	EPA 625; EPA 8270D	2-Methylphenol (o-Cresol)
GC/MS	EPA 8270D	2-Naphthylamine
GC/MS	EPA 625; EPA 8270D	2-Nitroaniline
GC/MS	EPA 625; EPA 8270D	2-Nitrophenol
GC/MS	EPA 8270D	2-Picoline (2-Methylpyridine)
GC/MS	EPA 625; EPA 8270D	3,3`-Dichlorobenzidine
GC/MS	EPA 8270D	3,3`-Dimethylbenzidine
GC/MS	EPA 8270D	3-Methylcholanthrene
GC/MS	EPA 625; EPA 8270D	3&4-Methylphenol (m,p-Cresol)
GC/MS	EPA 625; EPA 8270D	3-Nitroaniline
GC/MS	EPA 8270D	4-Aminobiphenyl
GC/MS	EPA 625; EPA 8270D	4-Bromophenyl phenyl ether
GC/MS	EPA 625; EPA 8270D	4-Chloro-3-methylphenol
GC/MS	EPA 625; EPA 8270D	4-Chloroaniline
GC/MS	EPA 625; EPA 8270D	4-Chlorophenyl phenylether
GC/MS	EPA 8270D	4-Dimethyl aminoazobenzene
GC/MS	EPA 625; EPA 8270D	4-Nitroaniline
GC/MS	EPA 625; EPA 8270D	4-Nitrophenol
GC/MS	EPA 8270D	4,4'-methylene-bis(2-chloroaniline)
GC/MS	EPA 8270D	5-Nitro-o-toluidine
GC/MS	EPA 8270D	7,12-Dimethylbenz(a) anthracene
GC/MS	EPA 625; EPA 8270D; EPA 8270D SIM	Acenaphthene
GC/MS	EPA 625; EPA 8270D; EPA 8270D SIM	Acenaphthylene
GC/MS	EPA 625; EPA 8270D	Acetophenone
GC/MS	EPA 625; EPA 8270D	Aniline
GC/MS	EPA 8270D	Anilazine
GC/MS	EPA 625; EPA 8270D; EPA 8270D SIM	Anthracene
GC/MS	EPA 8270D	Aramite

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	EPA 625; EPA 8270D	Atrazine
GC/MS	EPA 625; EPA 8270D	Benzaldehyde
GC/MS	EPA 625; EPA 8270D	Benzidine
GC/MS	EPA 625; EPA 8270D; EPA 8270D SIM	Benzo(a)anthracene
GC/MS	EPA 625; EPA 8270D; EPA 8270D SIM	Benzo(a)pyrene
GC/MS	EPA 625; EPA 8270D; EPA 8270D SIM	Benzo(b)fluoranthene
GC/MS	EPA 625; EPA 8270D; EPA 8270D SIM	Benzo(g,h,i)perylene
GC/MS	EPA 625; EPA 8270D; EPA 8270D SIM	Benzo(k)fluoranthene
GC/MS	EPA 625; EPA 8270D	Benzoic acid
GC/MS	EPA 625; EPA 8270D	Benzyl alcohol
GC/MS	EPA 625; EPA 8270D	Biphenyl (1,1'-Biphenyl)
GC/MS	EPA 625; EPA 8270D	bis(2-Chloroethoxy)methane
GC/MS	EPA 625; EPA 8270D	bis(2-Chloroethyl) ether
GC/MS	EPA 625; EPA 8270D	bis(2-Chloroisopropyl) ether (2,2`-Oxybis(1-chloropropane))
GC/MS	EPA 625; EPA 8270D	bis(2-Ethylhexyl) phthalate (DEHP)
GC/MS	EPA 625; EPA 8270D	Butyl benzyl phthalate
GC/MS	EPA 625; EPA 8270D	Carbazole
GC/MS	EPA 625; EPA 8270D	Caprolactam
GC/MS	EPA 8270D	Chlorobenzilate
GC/MS	EPA 625; EPA 8270D; EPA 8270D SIM	Chrysene
GC/MS	EPA 8270D	Diallate
GC/MS	EPA 8270D	Dinoseb
GC/MS	EPA 625; EPA 8270D	Di-n-butyl phthalate
GC/MS	EPA 625; EPA 8270D	Di-n-octyl phthalate
GC/MS	EPA 625; EPA 8270D; EPA 8270D SIM	Dibenz(a,h)anthracene
GC/MS	EPA 8270D	Dibenz(a,j)acridine
GC/MS	EPA 625; EPA 8270D	Dibenzofuran
GC/MS	EPA 625; EPA 8270D	Diethyl phthalate
GC/MS	EPA 625; EPA 8270D	Dimethyl phthalate
GC/MS	EPA 8270D	a,a-Dimethylphenethylamine
GC/MS	EPA 8270D	Diphenyl Ether
GC/MS	EPA 8270D	p-Dioxane (1,4-Dioxane)
GC/MS	EPA 8270D	Ethyl methanesulfonate
GC/MS	EPA 625; EPA 8270D; EPA 8270D SIM	Fluoranthene
GC/MS	EPA 625; EPA 8270D; EPA 8270D SIM	Fluorene
GC/MS	EPA 625; EPA 8270D	Hexachlorobenzene

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	EPA 625; EPA 8270D	Hexachlorobutadiene
GC/MS	EPA 625; EPA 8270D	Hexachlorocyclopentadiene
GC/MS	EPA 625; EPA 8270D	Hexachloroethane
GC/MS	EPA 8270D	Hexachlorophene
GC/MS	EPA 8270D	Hexachloropropene
GC/MS	EPA 625; EPA 8270D; EPA 8270D SIM	Indeno(1,2,3-cd)pyrene
GC/MS	EPA 8270D	Isodrin
GC/MS	EPA 625; EPA 8270D	Isophorone
GC/MS	EPA 8270D	Isosafrole
GC/MS	EPA 8270D	Kepone
GC/MS	EPA 8270D	Methapyrilene
GC/MS	EPA 8270D	Methyl methanesulfonate
GC/MS	EPA 625; EPA 8270D; EPA 8270D SIM	Naphthalene
GC/MS	EPA 8270D	Nicotine
GC/MS	EPA 625; EPA 8270D	Nitrobenzene
GC/MS	EPA 8270D	Nitroquinoline-1-oxide
GC/MS	EPA 8270D	n-Nitroso-di-n-butylamine
GC/MS	EPA 625; EPA 8270D	n-Nitrosodi-n-propylamine
GC/MS	EPA 8270D	n-Nitrosodiethylamine
GC/MS	EPA 625; EPA 8270D	n-Nitrosodimethylamine
GC/MS	EPA 625; EPA 8270D	n-Nitrosodiphenylamine
GC/MS	EPA 8270D	n-Nitrosodiphenylamine/Diphenylamine (analyte pair)
GC/MS	EPA 8270D	n-Nitrosomethylethylamine
GC/MS	EPA 8270D	n-Nitrosomorpholine
GC/MS	EPA 8270D	n-Nitrosopiperidine
GC/MS	EPA 8270D	n-Nitrosopyrrolidine
GC/MS	EPA 8270D	Pentachlorobenzene
GC/MS	EPA 8270D	Pentachloroethane
GC/MS	EPA 8270D	Pentachloronitrobenzene
GC/MS	EPA 625; EPA 8270D; EPA 8270D SIM	Pentachlorophenol
GC/MS	EPA 8270D	Phenacetin
GC/MS	EPA 625; EPA 8270D; EPA 8270D SIM	Phenanthrene
GC/MS	EPA 625; EPA 8270D	Phenol
GC/MS	EPA 8270D	Pronamide (Kerb)
GC/MS	EPA 8270D	Propazine
GC/MS	EPA 625; EPA 8270D; EPA 8270D SIM	Pyrene

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	EPA 625; EPA 8270D	Pyridine
GC/MS	EPA 8270D	Resorcinol
GC/MS	EPA 8270D	Safrole
GC/MS	EPA 8270D	Simazine
GC/MS	EPA 8270D	Thionazin (Zinophos)
GC/MS	EPA 8270D	o-Toluidine
GC/MS	EPA 8270D	Dimethoate
GC/MS	EPA 8270D	Disulfoton
GC/MS	EPA 8270D	Famphur
GC/MS	EPA 8270D	Methyl parathion (Parathion methyl)
GC/MS	EPA 8270D	Parathion ethyl
GC/MS	EPA 8270D	Phorate
GC/MS	EPA 8270D	O,O,O-Triethyl phosphorothioate
HPLC	EPA 610; EPA 8310	1-Methylnaphthalene
HPLC	EPA 610; EPA 8310	2-Methylnaphthalene
HPLC	EPA 610; EPA 8310	Acenaphthene
HPLC	EPA 610; EPA 8310	Acenaphthylene
HPLC	EPA 610; EPA 8310	Anthracene
HPLC	EPA 610; EPA 8310	Benzo(a)anthracene
HPLC	EPA 610; EPA 8310	Benzo(a)pyrene
HPLC	EPA 610; EPA 8310	Benzo(b)fluoranthene
HPLC	EPA 610; EPA 8310	Benzo(g h i)perylene
HPLC	EPA 610; EPA 8310	Benzo(k)fluoranthene
HPLC	EPA 610; EPA 8310	Chrysene
HPLC	EPA 610; EPA 8310	Dibenz(a,h)anthracene
HPLC	EPA 610; EPA 8310	Fluoranthene
HPLC	EPA 610; EPA 8310	Fluorene
HPLC	EPA 610; EPA 8310	Indeno(1,2,3-cd)pyrene
HPLC	EPA 610; EPA 8310	Naphthalene
HPLC	EPA 610; EPA 8310	Phenanthrene
HPLC	EPA 610; EPA 8310	Pyrene
HPLC	EPA 8330A/B	1,3,5-Trinitrobenzene (1,3,5-TNB)
HPLC	EPA 8330A/B	1,3-Dinitrobenzene (1,3-DNB)
HPLC	EPA 8330A/B	2,4,6-Trinitrotoluene (2,4,6-TNT)
HPLC	EPA 8330A/B	2,4-Dinitrotoluene (2,4-DNT)
HPLC	EPA 8330A/B	2,6-Dinitrotoluene (2,6-DNT)
HPLC	EPA 8330A/B	2-Amino-4,6-dinitrotoluene (2-am-dnt)

Non-Potable Water		
Technology	**Method**	**Analyte**
HPLC	EPA 8330A/B	2-Nitrotoluene
HPLC	EPA 8330A/B	3,5-Dinitroaniline
HPLC	EPA 8330A/B	3-Nitrotoluene
HPLC	EPA 8330A/B	4-Amino-2,6-dinitrotoluene (4-am-dnt)
HPLC	EPA 8330A/B	4-Nitrotoluene
HPLC	EPA 8330A/B	Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)
HPLC	EPA 8330A/B	Nitrobenzene
HPLC	EPA 8330A/B; EPA 8332	Nitroglycerin
HPLC	EPA 8330A/B	Methyl-2,4,6-trinitrophenylnitramine (Tetryl)
HPLC	EPA 8330A/B	Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)
HPLC	EPA 8330A/B; EPA 8332	Pentaerythritoltetranitrate (PETN)
HPLC	EPA 8330A	2,2’,6,6’-Tetranitro-4,4’-azoxytoluene
HPLC	EPA 8330A/B	2-amino-6-Nitrotoluene
HPLC	EPA 8330A/B	4-amino-2-Nitrotoluene
HPLC	EPA 8330A/B	2-amino-4-Nitrotoluene
HPLC	EPA 8330A/B	2,4-diamino-6-Nitrotoluene
HPLC	EPA 8330A/B	2,6-diamino-4-Nitrotoluene
HPLC	EPA 8330A/B	DNX
HPLC	EPA 8330A/B	MNX
HPLC	EPA 8330A/B	TNX
HPLC	EPA 8330A	Nitroguanidine
HPLC	EPA 8330A	Guanidine Nitrate
LC/MS/MS	EPA 6850	Perchlorate
LC/MS/MS	EPA 537 MOD[2]	Perfluorobutanoic Acid
LC/MS/MS	EPA 537 MOD[2]	Perfluoropentanoic Acid
LC/MS/MS	EPA 537 MOD[2]	Perfluorohexanoic Acid
LC/MS/MS	EPA 537 MOD[2]	Perfluoroheptanoic Acid
LC/MS/MS	EPA 537 MOD[2]	Perfluorooctanoic Acid
LC/MS/MS	EPA 537 MOD[2]	Perfluorononanoic Acid
LC/MS/MS	EPA 537 MOD[2]	Perfluorodecanoic Acid
LC/MS/MS	EPA 537 MOD[2]	Perfluoroundecanoic Acid
LC/MS/MS	EPA 537 MOD[2]	Perfluorododecanoic Acid
LC/MS/MS	EPA 537 MOD[2]	Perfluorotridecanoic Acid
LC/MS/MS	EPA 537 MOD[2]	Perfluorotetradecanoic Acid

Non-Potable Water		
Technology	**Method**	**Analyte**
LC/MS/MS	EPA 537 MOD[2]	Perfluorobutanesulfonic Acid
LC/MS/MS	EPA 537 MOD[2]	Perfluorohexanesulfonic Acid
LC/MS/MS	EPA 537 MOD[2]	Perfluorooctanesulfonic Acid
LC/MS/MS	EPA 537 MOD[2]	Perfluorodecanesulfonic Acid
LC/MS/MS	EPA 537 MOD[2]	Perfluorooctanesulfonic Acid
LC/MS/MS	EPA 537 MOD[2]	Perfluorononanesulfonic Acid
LC/MS/MS	EPA 537 MOD[2]	Perfluorodecanesulfonic Acid
LC/MS/MS	EPA 537 MOD[2]	Perfluoroheptanesulfonic acid
LC/MS/MS	EPA 537 MOD[2]	Perfluoropentanesulfonic Acid
LC/MS/MS	EPA 537 MOD[2]	Perfluorooctane sulfonamide
LC/MS/MS	EPA 537 MOD[2]	N-Methyl perfluorooctane sulfonamide
LC/MS/MS	EPA 537 MOD[2]	N-Ethyl perfluorooctane sulfonamide
LC/MS/MS	EPA 537 MOD[2]	Perfluoro-1-octanesulfonamidoacetic acid
LC/MS/MS	EPA 537 MOD[2]	N-Methyl perfluorooctanesulfonamidoacetic acid
LC/MS/MS	EPA 537 MOD[2]	N-Ethyl perfluorooctanesulfonamidoacetic acid
LC/MS/MS	EPA 537 MOD[2]	N-Methyl perfluorooctane sulfonamidoethanol
LC/MS/MS	EPA 537 MOD[2]	N-Ethyl perfluorooctane sulfonamidoethanol
LC/MS/MS	EPA 537 MOD[2]	4:2 Fluorotelomer Sulfonate
LC/MS/MS	EPA 537 MOD[2]	6:2 Fluorotelomer Sulfonate
LC/MS/MS	EPA 537 MOD[2]	8:2 Fluorotelomer Sulfonate
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluorobutanoic Acid (PFBA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluoropentanoic Acid (PFPeA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluorohexanoic Acid (PFHxA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluoroheptanoic Acid (PFHpA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluorooctanoic Acid (PFOA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluorononanoic Acid (PFNA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluorodecanoic Acid (PFDA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluoroundecanoic Acid (PFUnA)

Non-Potable Water		
Technology	**Method**	**Analyte**
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluorododecanoic Acid(PFDoA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluorotridecanoic Acid (PFTrDA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluorotetradecanoic Acid (PFTA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluorobutanesulfonic Acid (PFBS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluorohexanesulfonic Acid(PFHxS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluorooctanesulfonic Acid(PFOS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluorononanesulfonic Acid(PFNS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluorodecanesulfonic Acid(PFDS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluoroheptanesulfonic acid(PFHpS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluoropentanesulfonic Acid(PFPeS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluorooctane sulfonamide (PFOSA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	N-Methyl perfluorooctanesulfonamidoacetic acid (MeFOSAA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	N-Ethyl perfluorooctanesulfonamidoacetic acid (EtFOSAA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	4:2 Fluorotelomer Sulfonate (FTS 4:2)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	6:2 Fluorotelomer Sulfonate(FTS 6:2)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	8:2 Fluorotelomer Sulfonate (FTS 8:2)
ICP	EPA 200.7; EPA 6010C/D	Aluminum
ICP	EPA 200.7; EPA 6010C/D	Antimony
ICP	EPA 200.7; EPA 6010C/D	Arsenic
ICP	EPA 200.7; EPA 6010C/D	Barium
ICP	EPA 200.7; EPA 6010C/D	Beryllium
ICP	EPA 200.7; EPA 6010C/D	Cadmium
ICP	EPA 200.7; EPA 6010C/D	Calcium
ICP	EPA 200.7; EPA 6010C/D	Chromium

Non-Potable Water		
Technology	**Method**	**Analyte**
ICP	EPA 200.7; EPA 6010C/D	Cobalt
ICP	EPA 200.7; EPA 6010C/D	Copper
ICP	EPA 200.7; EPA 6010C/D	Iron
ICP	EPA 200.7; EPA 6010C/D	Lead
ICP	EPA 200.7; EPA 6010C/D	Magnesium
ICP	EPA 200.7; EPA 6010C/D	Manganese
ICP	EPA 200.7; EPA 6010C/D	Molybdenum
ICP	EPA 200.7; EPA 6010C/D	Nickel
ICP	EPA 200.7; EPA 6010C/D	Potassium
ICP	EPA 200.7; EPA 6010C/D	Selenium
ICP	EPA 200.7; EPA 6010C/D	Silver
ICP	EPA 200.7; EPA 6010C/D	Sodium
ICP	EPA 200.7; EPA 6010C/D	Strontium
ICP	EPA 200.7; EPA 6010C/D	Thallium
ICP	EPA 200.7; EPA 6010C/D	Tin
ICP	EPA 200.7; EPA 6010C/D	Titanium
ICP	EPA 200.7; EPA 6010C/D	Vanadium
ICP	EPA 200.7; EPA 6010C/D	Zinc
ICP/MS	EPA 200.8; EPA 6020A/B	Aluminum
ICP/MS	EPA 200.8; EPA 6020A/B	Antimony
ICP/MS	EPA 200.8; EPA 6020A/B	Arsenic
ICP/MS	EPA 200.8; EPA 6020A/B	Barium
ICP/MS	EPA 200.8; EPA 6020A/B	Beryllium
ICP/MS	EPA 200.8; EPA 6020A/B	Cadmium
ICP/MS	EPA 200.8; EPA 6020A/B	Calcium
ICP/MS	EPA 200.8; EPA 6020A/B	Chromium
ICP/MS	EPA 200.8; EPA 6020A/B	Cobalt
ICP/MS	EPA 200.8; EPA 6020A/B	Copper
ICP/MS	EPA 200.8; EPA 6020A/B	Iron
ICP/MS	EPA 200.8; EPA 6020A/B	Lead
ICP/MS	EPA 200.8; EPA 6020A/B	Magnesium
ICP/MS	EPA 200.8; EPA 6020A/B	Manganese
ICP/MS	EPA 200.8; EPA 6020A/B	Molybdenum
ICP/MS	EPA 200.8; EPA 6020A/B	Nickel
ICP/MS	EPA 200.8; EPA 6020A/B	Potassium
ICP/MS	EPA 200.8; EPA 6020A/B	Selenium
ICP/MS	EPA 200.8; EPA 6020A/B	Silver

Non-Potable Water		
Technology	**Method**	**Analyte**
ICP/MS	EPA 200.8; EPA 6020A/B	Sodium
ICP/MS	EPA 200.8; EPA 6020A/B	Strontium
ICP/MS	EPA 200.8; EPA 6020A/B	Thallium
ICP/MS	EPA 200.8; EPA 6020A/B	Tin
ICP/MS	EPA 200.8; EPA 6020A/B	Titanium
ICP/MS	EPA 200.8; EPA 6020A/B	Vanadium
ICP/MS	EPA 200.8; EPA 6020A/B	Zinc
CVAA	EPA 7470A	Mercury
CVAA	EPA 245.1	Mercury
UV/VIS	EPA 7196A	Hexavalent Chromium (Cr6+)
UV/VIS	EPA 9012B	Cyanide (Total)
IC	EPA 300; EPA 9056A	Bromide
IC	EPA 300; EPA 9056A	Chloride
IC	EPA 300; EPA 9056A	Fluoride
IC	EPA 300; EPA 9056A	Nitrate
IC	EPA 300; EPA 9056A	Nitrite
IC	EPA 300; EPA 9056A	Sulfate
IC	EPA 300; EPA 9056A	Total nitrate-nitrite
Automated Colorimetry	EPA 350.1	Ammonia
Automated Colorimetry	EPA 350.1	Ammonia, Gas Diffusion Option
Automated Colorimetry	EPA 351.2	Total Kjeldahl Nitrogen
Automated Colorimetry	EPA 420.4	Total Phenolics
Automated Colorimetry	EPA 353.2	Nitrate
Automated Colorimetry	EPA 353.2	Nitrite
Automated Colorimetry	EPA 353.2	Nitrate+Nitrite
Manual Colorimetry	EPA 365.3	Orthophosphate
Manual Colorimetry	EPA 365.3	Total Phosphorus
Titrimetric	SM 2320B-11	Alkalinity, Total
Titrimetric	SM 4500-S2 F-11	Sulfide, Iodometric
Gravimetric Methods	EPA 1664A; EPA 9070A	Oil and Grease
Gravimetric Methods	SM 2540B-11	Total Residue (Total Solids)
Gravimetric Methods	SM 2540C-11	Filterable Residue (Total Dissolved Solids)
Gravimetric Methods	SM 2540D-11	Non-Filterable Residue (Total Suspended Solids)
Electrometric Methods	SM 4500H+B-11; EPA 9040C	Hydrogen Ion (Ph)
Electrometric Methods	EPA 120.1	Specific conductivity

Non-Potable Water		
Technology	**Method**	**Analyte**
Combustion	EPA 9060A	Total Organic Carbon
Ignitability	EPA 1010A	Flash Point
Waste Characterization	EPA Ch.7	Reactive Cyanide and Reactive Sulfide
Waste Characterization	EPA Section 7.3	Reactive Cyanide
Waste Characterization	EPA Section 7.3	Reactive Sulfide
Preparation	**Method**	**Type**
Organic Preparation	EPA 3510C	Separatory Funnel Liquid-Liquid Extraction
Organic Preparation	EPA 3511	Micro-extraction
Organic Preparation	EPA 3535A; EPA 3535A MOD	Solid Phase Extraction
Organic Preparation	EPA 8015C/D	Non-Halogenated Organics (Alcohols), direct injection
Organic Preparation	EPA 8151A	Chlorinated Herbicides, Liquid-Liquid Extraction
Organic Preparation	EPA 608; EPA 610; EPA 625	Separatory Funnel Liquid-Liquid Extraction
Volatile Organic Preparation	SW836 5030B	Closed System Purge and Trap
Volatile Organic Preparation	EPA 624	Closed System Purge and Trap
Volatile Organic Preparation	SM 6200B-11	Closed System Purge and Trap
Lachat MicroDistillation	EPA 9012B	Cyanide MicroDistillation; proprietary method
Inorganic Preparation	EPA 3010A	Metals Acid Digestion by Hotblock
Inorganic Preparation	EPA 7470A	CVAA Digestion by Hotblock
Organics Cleanup	EPA 3660B	Sulfur Cleanup
Organics Cleanup	EPA 3665A	Sulfuric Acid Cleanup

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/ECD	EPA 8011	1,2-Dibromoethane (EDB)
GC/ECD	EPA 8011	1,2-Dibromo-3-Chloropropane (DBCP)
GC/FID	EPA 8015C/D	Diesel range organics (DRO)
GC/FID	EPA 8015C/D	Oil Range Organics (ORO)
GC/FID	EPA 8015C/D	Gasoline range organics (GRO)
GC/FID	EPA 8015C/D	Ethanol
GC/FID	EPA 8015C/D	2-Ethoxyethanol

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/FID	EPA 8015C/D	Isobutyl alcohol (2-Methyl-1-propanol)
GC/FID	EPA 8015C/D	Isopropyl alcohol (2-Propanol)
GC/FID	EPA 8015C/D	Methanol
GC/FID	EPA 8015C/D	n-Butyl alcohol
GC/FID	EPA 8015C/D	n-Propanol
GC/ECD	EPA 8081B	4,4`-DDD
GC/ECD	EPA 8081B	4,4`-DDE
GC/ECD	EPA 8081B	4,4`-DDT
GC/ECD	EPA 8081B	Aldrin
GC/ECD	EPA 8081B	alpha-BHC (alpha-Hexachlorocyclohexane)
GC/ECD	EPA 8081B	beta-BHC (beta-Hexachlorocyclohexane)
GC/ECD	EPA 8081B	delta-BHC
GC/ECD	EPA 8081B	gamma-BHC (Lindane gamma-Hexachlorocyclohexane)
GC/ECD	EPA 8081B	Chlordane (tech.)
GC/ECD	EPA 8081B	alpha-Chlordane
GC/ECD	EPA 8081B	gamma-Chlordane
GC/ECD	EPA 8081B	Dieldrin
GC/ECD	EPA 8081B	Endosulfan I
GC/ECD	EPA 8081B	Endosulfan II
GC/ECD	EPA 8081B	Endosulfan sulfate
GC/ECD	EPA 8081B	Endrin
GC/ECD	EPA 8081B	Endrin aldehyde
GC/ECD	EPA 8081B	Endrin ketone
GC/ECD	EPA 8081B	Heptachlor
GC/ECD	EPA 8081B	Heptachlor epoxide
GC/ECD	EPA 8081B	Methoxychlor
GC/ECD	EPA 8081B	Toxaphene (Chlorinated camphene)
GC/ECD	EPA 8082A	Aroclor-1016 (PCB-1016)
GC/ECD	EPA 8082A	Aroclor-1221 (PCB-1221)
GC/ECD	EPA 8082A	Aroclor-1232 (PCB-1232)
GC/ECD	EPA 8082A	Aroclor-1242 (PCB-1242)
GC/ECD	EPA 8082A	Aroclor-1248 (PCB-1248)
GC/ECD	EPA 8082A	Aroclor-1254 (PCB-1254)
GC/ECD	EPA 8082A	Aroclor-1260 (PCB-1260)
GC/ECD	EPA 8082A	Aroclor-1262 (PCB-1262)

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/ECD	EPA 8082A	Aroclor-1268 (PCB-1268)
GC/FPD	EPA 8141B	Azinphos-methyl (Guthion)
GC/FPD	EPA 8141B	Bolstar (Sulprofos)
GC/FPD	EPA 8141B	Carbophenothion
GC/FPD	EPA 8141B	Chlorpyrifos
GC/FPD	EPA 8141B	Coumaphos
GC/FPD	EPA 8141B	Demeton-o
GC/FPD	EPA 8141B	Demeton-s
GC/FPD	EPA 8141B	Diazinon
GC/FPD	EPA 8141B	Dichlorovos (DDVP Dichlorvos)
GC/FPD	EPA 8141B	Dimethoate
GC/FPD	EPA 8141B	Disulfoton
GC/FPD	EPA 8141B	EPN
GC/FPD	EPA 8141B	Ethion
GC/FPD	EPA 8141B	Ethoprop
GC/FPD	EPA 8141B	Famphur
GC/FPD	EPA 8141B	Fensulfothion
GC/FPD	EPA 8141B	Fenthion
GC/FPD	EPA 8141B	Malathion
GC/FPD	EPA 8141B	Merphos
GC/FPD	EPA 8141B	Methyl parathion (Parathion methyl)
GC/FPD	EPA 8141B	Mevinphos
GC/FPD	EPA 8141B	Monocrotophos
GC/FPD	EPA 8141B	Naled
GC/FPD	EPA 8141B	Parathion ethyl
GC/FPD	EPA 8141B	Phorate
GC/FPD	EPA 8141B	Ronnel
GC/FPD	EPA 8141B	Stirofos
GC/FPD	EPA 8141B	Sulfotepp
GC/FPD	EPA 8141B	Tetraethyl pyrophosphate (TEPP)
GC/FPD	EPA 8141B	Thionazin (Zinophos)
GC/FPD	EPA 8141B	Tokuthion (Prothiophos)
GC/FPD	EPA 8141B	Trichloronate
GC/FPD	EPA 8141B	O,O,O-Triethyl phosphorothioate
GC/ECD	EPA 8151A	2,4,5-T
GC/ECD	EPA 8151A	2,4-D
GC/ECD	EPA 8151A	2,4-DB

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/ECD	EPA 8151A	Dalapon
GC/ECD	EPA 8151A	Dicamba
GC/ECD	EPA 8151A	Dichloroprop (Dichlorprop)
GC/ECD	EPA 8151A	Dinoseb (2-sec-butyl-4,6-dinitrophenol DNBP)
GC/ECD	EPA 8151A	MCPA
GC/ECD	EPA 8151A	MCPP
GC/ECD	EPA 8151A	Pentachlorophenol
GC/ECD	EPA 8151A	Silvex (2,4,5-TP)
GC/FID	FL-PRO	Total Petroleum Hydrocarbons (TPH)
GC/FID	MA-VPH	Volatile petroleum range organics (VPH)
GC/FID	MA-EPH	Extractable petroleum range organics (EPH)
GC/FID	IA-OA1	Gasoline range organics (GRO)
GC/FID	IA-OA2	Diesel range organics (DRO)
GC/FID	TN-GRO	Gasoline range organics (GRO)
GC/FID	TN-EPH	Extractable petroleum range organics (EPH)
GC/FID	AK-101	Gasoline range organics (GRO)
GC/FID	AK-102	Diesel range organics (DRO)
GC/FID	AK-103	Residual range organics (RRO)
GC/FID	OK-GRO	Gasoline range organics (GRO)
GC/FID	OK-DRO	Diesel range organics (DRO)
GC/FID	TX-1005	Total Petroleum Hydrocarbons (TPH)
GC/FID	KS LRH	Low-range Hydrocarbons (LRH)
GC/FID	KS MRH	Mid-Range Hydrocarbons (MRH)
GC/FID	KS HRH	High-Range Hydrocarbons (HRH)
GC/MS	EPA 8260B/C	1,1,1,2-Tetrachloroethane
GC/MS	EPA 8260B/C	1,1,1-Trichloroethane
GC/MS	EPA 8260B/C	1,1,2,2-Tetrachloroethane
GC/MS	EPA 8260B/C	1,1,2-Trichloroethane
GC/MS	EPA 8260B/C	1,1-Dichloroethane
GC/MS	EPA 8260B/C	1,1-Dichloroethylene
GC/MS	EPA 8260B/C	1,1-Dichloropropene
GC/MS	EPA 8260B/C	1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)
GC/MS	EPA 8260B/C	1,2,3-Trichlorobenzene
GC/MS	EPA 8260B/C	1,2,3-Trichloropropane

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/MS	EPA 8260B/C	1,2,4-Trichlorobenzene
GC/MS	EPA 8260B/C	1,2,4-Trimethylbenzene
GC/MS	EPA 8260B/C	1,2-Dibromo-3-chloropropane (DBCP)
GC/MS	EPA 8260B/C	1,2-Dibromoethane (EDB Ethylene dibromide)
GC/MS	EPA 8260B/C	1,2-Dichlorobenzene (o-Dichlorobenzene)
GC/MS	EPA 8260B/C	1,2-Dichloroethane
GC/MS	EPA 8260B/C	1,2-Dichloropropane
GC/MS	EPA 8260B/C	1,2-Dichlorotrifluoroethane (Freon 123)
GC/MS	EPA 8260B/C	1,3,5-Trimethylbenzene
GC/MS	EPA 8260B/C	1,3-Dichlorobenzene (m-Dichlorobenzene)
GC/MS	EPA 8260B/C	1,3-Dichloropropane
GC/MS	EPA 8260B/C	1,4-Dichlorobenzene (p-Dichlorobenzene)
GC/MS	EPA 8260B/C	1-Chlorohexane
GC/MS	EPA 8260B/C	2,2-Dichloropropane
GC/MS	EPA 8260B/C	2-Butanone (Methyl ethyl ketone MEK)
GC/MS	EPA 8260B/C	2-Chloroethyl vinyl ether
GC/MS	EPA 8260B/C	2-Chlorotoluene
GC/MS	EPA 8260B/C	2-Hexanone
GC/MS	EPA 8260B/C	2-Nitropropane
GC/MS	EPA 8260B/C	4-Chlorotoluene
GC/MS	EPA 8260B/C	4-Methyl-2-pentanone (MBK)
GC/MS	EPA 8260B/C	Acetone
GC/MS	EPA 8260B/C	Acetonitrile
GC/MS	EPA 8260B/C	Acrolein (Propenal)
GC/MS	EPA 8260B/C	Acrylonitrile
GC/MS	EPA 8260B/C	Allyl chloride (3-Chloropropene)
GC/MS	EPA 8260B/C	Benzene
GC/MS	EPA 8260B/C	Benzyl Chloride
GC/MS	EPA 8260B/C	Bromobenzene
GC/MS	EPA 8260B/C	Bromochloromethane
GC/MS	EPA 8260B/C	Bromodichloromethane
GC/MS	EPA 8260B/C	Bromoform
GC/MS	EPA 8260B/C	n-Butylbenzene
GC/MS	EPA 8260B/C	sec-Butylbenzene
GC/MS	EPA 8260B/C	tert-Butylbenzene
GC/MS	EPA 8260B/C	Carbon disulfide

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/MS	EPA 8260B/C	Carbon tetrachloride
GC/MS	EPA 8260B/C	Chlorobenzene
GC/MS	EPA 8260B/C	Chloroethane
GC/MS	EPA 8260B/C	Chloroform
GC/MS	EPA 8260B/C	Chloroprene
GC/MS	EPA 8260B/C	Cyclohexane
GC/MS	EPA 8260B/C	Cyclohexanone
GC/MS	EPA 8260B/C	cis-1,2-Dichloroethylene
GC/MS	EPA 8260B/C	trans-1,2-Dichloroethylene
GC/MS	EPA 8260B/C	cis-1,3-Dichloropropene
GC/MS	EPA 8260B/C	trans-1,3-Dichloropropylene
GC/MS	EPA 8260B/C	cis-1,4-Dichloro-2-butene
GC/MS	EPA 8260B/C	trans-1,4-Dichloro-2-butene
GC/MS	EPA 8260B/C	Di-isopropylether (DIPE)
GC/MS	EPA 8260B/C	Dibromochloromethane
GC/MS	EPA 8260B/C	Dibromomethane (Methylene Bromide)
GC/MS	EPA 8260B/C	Dichlorodifluoromethane
GC/MS	EPA 8260B/C	Diethyl ether
GC/MS	EPA 8260B/C; EPA 8260B/C SIM	p-Dioxane (1,4-Dioxane)
GC/MS	EPA 8260B/C	Ethanol (Ethyl Alcohol)
GC/MS	EPA 8260B/C	Ethyl acetate
GC/MS	EPA 8260B/C	Ethyl methacrylate
GC/MS	EPA 8260B/C	Ethyl tert-butyl alcohol (ETBA)
GC/MS	EPA 8260B/C	Ethyl tert-butyl ether (ETBE)
GC/MS	EPA 8260B/C	Ethylbenzene
GC/MS	EPA 8260B/C	Ethylene Oxide
GC/MS	EPA 8260B/C	Hexachlorobutadiene
GC/MS	EPA 8260B/C	Hexane
GC/MS	EPA 8260B/C	Iodomethane (Methyl iodide)
GC/MS	EPA 8260B/C	Isobutyl alcohol (2-Methyl-1-propanol)
GC/MS	EPA 8260B/C	p-Isopropyltoluene
GC/MS	EPA 8260B/C	Isopropylbenzene
GC/MS	EPA 8260B/C	Methacrylonitrile
GC/MS	EPA 8260B/C	Methyl Acetate
GC/MS	EPA 8260B/C	Methyl bromide (Bromomethane)
GC/MS	EPA 8260B/C	Methyl chloride (Chloromethane)
GC/MS	EPA 8260B/C	Methylcyclohexane

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/MS	EPA 8260B/C	Methyl methacrylate
GC/MS	EPA 8260B/C	Methyl tert-butyl ether (MTBE)
GC/MS	EPA 8260B/C	Methylene chloride
GC/MS	EPA 8260B/C	Naphthalene
GC/MS	EPA 8260B/C	Pentachloroethane
GC/MS	EPA 8260B/C	Propionitrile (Ethyl cyanide)
GC/MS	EPA 8260B/C	n-Propylbenzene
GC/MS	EPA 8260B/C	Styrene
GC/MS	EPA 8260B/C	tert-Amyl alcohol (TAA)
GC/MS	EPA 8260B/C	tert-Amyl methyl ether (TAME)
GC/MS	EPA 8260B/C	tert-Butyl alcohol (TBA)
GC/MS	EPA 8260B/C	tert-Butyl formate (TBF)
GC/MS	EPA 8260B/C	Tetrachloroethylene (Perchloroethylene)
GC/MS	EPA 8260B/C	Tetrahydrofuran
GC/MS	EPA 8260B/C	Toluene
GC/MS	EPA 8260B/C	Trichloroethene (Trichloroethylene)
GC/MS	EPA 8260B/C	Trichlorofluoromethane
GC/MS	EPA 8260B/C	Vinyl acetate
GC/MS	EPA 8260B/C	Vinyl chloride
GC/MS	EPA 8260B/C	Xylene (total)
GC/MS	EPA 8260B/C	m,p-Xylene
GC/MS	EPA 8260B/C	o-Xylene
GC/MS	EPA 8260B/C	1-Bromopropane
GC/MS	EPA 8260B/C	Isopropyl Alcohol
GC/MS	EPA 8260B/C	n-Butyl Alcohol
GC/MS	EPA 8270D	1,2,4,5-Tetrachlorobenzene
GC/MS	EPA 8270D	1,2,4-Trichlorobenzene
GC/MS	EPA 8270D	1,2-Dichlorobenzene (o-Dichlorobenzene)
GC/MS	EPA 8270D	1,2-Diphenylhydrazine
GC/MS	EPA 8270D	1,3,5-Trinitrobenzene (1,3,5-TNB)
GC/MS	EPA 8270D	1,3-Dichlorobenzene (m-Dichlorobenzene)
GC/MS	EPA 8270D	1,3-Dinitrobenzene (1,3-DNB)
GC/MS	EPA 8270D	1,4-Dichlorobenzene (p-Dichlorobenzene)
GC/MS	EPA 8270D	1,4-Dithiane
GC/MS	EPA 8270D	1,4-Oxathiane
GC/MS	EPA 8270D	1,4-Naphthoquinone
GC/MS	EPA 8270D	1,4-Phenylenediamine

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/MS	EPA 8270D	1-Chloronaphthalene
GC/MS	EPA 8270D; EPA 8270D SIM	1-Methylnaphthalene
GC/MS	EPA 8270D	1-Naphthylamine
GC/MS	EPA 8270D	2,3,4,6-Tetrachlorophenol
GC/MS	EPA 8270D	2,4,5-Trichlorophenol
GC/MS	EPA 8270D	2,4,6-Trichlorophenol
GC/MS	EPA 8270D	2,4-Dichlorophenol
GC/MS	EPA 8270D	2,4-Dimethylphenol
GC/MS	EPA 8270D	2,4-Dinitrophenol
GC/MS	EPA 8270D	2,4-Dinitrotoluene (2,4-DNT)
GC/MS	EPA 8270D	2,6-Dichlorophenol
GC/MS	EPA 8270D	2,6-Dinitrotoluene (2,6-DNT)
GC/MS	EPA 8270D	2-Acetylaminofluorene
GC/MS	EPA 8270D	2-Chloronaphthalene
GC/MS	EPA 8270D	2-Chlorophenol
GC/MS	EPA 8270D	2-Methyl-4,6-dinitrophenol (4,6-Dinitro-o-cresol)
GC/MS	EPA 8270D; EPA 8270D SIM	2-Methylnaphthalene
GC/MS	EPA 8270D	2-Methylphenol (o-Cresol)
GC/MS	EPA 8270D	2-Naphthylamine
GC/MS	EPA 8270D	2-Nitroaniline
GC/MS	EPA 8270D	2-Nitrophenol
GC/MS	EPA 8270D	2-Picoline (2-Methylpyridine)
GC/MS	EPA 8270D	3,3`-Dichlorobenzidine
GC/MS	EPA 8270D	3,3`-Dimethylbenzidine
GC/MS	EPA 8270D	3-Methylcholanthrene
GC/MS	EPA 8270D	3&4-Methylphenol (m,p-Cresol)
GC/MS	EPA 8270D	3-Nitroaniline
GC/MS	EPA 8270D	4-Aminobiphenyl
GC/MS	EPA 8270D	4-Bromophenyl phenyl ether
GC/MS	EPA 8270D	4-Chloro-3-methylphenol
GC/MS	EPA 8270D	4-Chloroaniline
GC/MS	EPA 8270D	4-Chlorophenyl phenylether
GC/MS	EPA 8270D	4-Dimethyl aminoazobenzene
GC/MS	EPA 8270D	4-Nitroaniline
GC/MS	EPA 8270D	4-Nitrophenol
GC/MS	EPA 8270D	4,4'-methylene-bis(2-chloroaniline)

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/MS	EPA 8270D	5-Nitro-o-toluidine
GC/MS	EPA 8270D	7,12-Dimethylbenz(a) anthracene
GC/MS	EPA 8270D; EPA 8270D SIM	Acenaphthene
GC/MS	EPA 8270D; EPA 8270D SIM	Acenaphthylene
GC/MS	EPA 8270D	Acetophenone
GC/MS	EPA 8270D	Aniline
GC/MS	EPA 8270D	Anilazine
GC/MS	EPA 8270D; EPA 8270D SIM	Anthracene
GC/MS	EPA 8270D	Aramite
GC/MS	EPA 8270D	Atrazine
GC/MS	EPA 8270D	Benzaldehyde
GC/MS	EPA 8270D	Benzidine
GC/MS	EPA 8270D; EPA 8270D SIM	Benzo(a)anthracene
GC/MS	EPA 8270D; EPA 8270D SIM	Benzo(a)pyrene
GC/MS	EPA 8270D; EPA 8270D SIM	Benzo(b)fluoranthene
GC/MS	EPA 8270D; EPA 8270D SIM	Benzo(g,h,i)perylene
GC/MS	EPA 8270D; EPA 8270D SIM	Benzo(k)fluoranthene
GC/MS	EPA 8270D	Benzoic acid
GC/MS	EPA 8270D	Benzyl alcohol
GC/MS	EPA 8270D	Biphenyl (1,1'-Biphenyl)
GC/MS	EPA 8270D	bis(2-Chloroethoxy)methane
GC/MS	EPA 8270D	bis(2-Chloroethyl) ether
GC/MS	EPA 8270D	bis(2-Chloroisopropyl) ether (2,2`-Oxybis(1-chloropropane))
GC/MS	EPA 8270D	bis(2-Ethylhexyl) phthalate (DEHP)
GC/MS	EPA 8270D	Butyl benzyl phthalate
GC/MS	EPA 8270D	Carbazole
GC/MS	EPA 8270D	Caprolactam
GC/MS	EPA 8270D	Chlorobenzilate
GC/MS	EPA 8270D; EPA 8270D SIM	Chrysene
GC/MS	EPA 8270D	Diallate
GC/MS	EPA 8270D	Dinoseb
GC/MS	EPA 8270D	Di-n-butyl phthalate
GC/MS	EPA 8270D	Di-n-octyl phthalate
GC/MS	EPA 8270D; EPA 8270D SIM	Dibenz(a,h)anthracene
GC/MS	EPA 8270D	Dibenz(a,j)acridine
GC/MS	EPA 8270D	Dibenzofuran

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/MS	EPA 8270D	Diethyl phthalate
GC/MS	EPA 8270D	Dimethyl phthalate
GC/MS	EPA 8270D	a,a-Dimethylphenethylamine
GC/MS	EPA 8270D	Diphenyl Ether
GC/MS	EPA 8270D	p-Dioxane (1,4-Dioxane)
GC/MS	EPA 8270D	Ethyl methanesulfonate
GC/MS	EPA 8270D; EPA 8270D SIM	Fluoranthene
GC/MS	EPA 8270D; EPA 8270D SIM	Fluorene
GC/MS	EPA 8270D	Hexachlorobenzene
GC/MS	EPA 8270D	Hexachlorobutadiene
GC/MS	EPA 8270D	Hexachlorocyclopentadiene
GC/MS	EPA 8270D	Hexachloroethane
GC/MS	EPA 8270D	Hexachlorophene
GC/MS	EPA 8270D	Hexachloropropene
GC/MS	EPA 8270D; EPA 8270D SIM	Indeno(1,2,3-cd)pyrene
GC/MS	EPA 8270D	Isodrin
GC/MS	EPA 8270D	Isophorone
GC/MS	EPA 8270D	Isosafrole
GC/MS	EPA 8270D	Kepone
GC/MS	EPA 8270D	Methapyrilene
GC/MS	EPA 8270D	Methyl methanesulfonate
GC/MS	EPA 8270D; EPA 8270D SIM	Naphthalene
GC/MS	EPA 8270D	Nicotine
GC/MS	EPA 8270D	Nitrobenzene
GC/MS	EPA 8270D	Nitroquinoline-1-oxide
GC/MS	EPA 8270D	n-Nitroso-di-n-butylamine
GC/MS	EPA 8270D	n-Nitrosodi-n-propylamine
GC/MS	EPA 8270D	n-Nitrosodiethylamine
GC/MS	EPA 8270D	n-Nitrosodimethylamine
GC/MS	EPA 8270D	n-Nitrosodiphenylamine
GC/MS	EPA 8270D	n-Nitrosodiphenylamine/Diphenylamine (analyte pair)
GC/MS	EPA 8270D	n-Nitrosomethylethylamine
GC/MS	EPA 8270D	n-Nitrosomorpholine
GC/MS	EPA 8270D	n-Nitrosopiperidine
GC/MS	EPA 8270D	n-Nitrosopyrrolidine
GC/MS	EPA 8270D	Pentachlorobenzene

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/MS	EPA 8270D	Pentachloroethane
GC/MS	EPA 8270D	Pentachloronitrobenzene
GC/MS	EPA 8270D; EPA 8270D SIM	Pentachlorophenol
GC/MS	EPA 8270D	Phenacetin
GC/MS	EPA 8270D; EPA 8270D SIM	Phenanthrene
GC/MS	EPA 8270D	Phenol
GC/MS	EPA 8270D	Pronamide (Kerb)
GC/MS	EPA 8270D	Propazine
GC/MS	EPA 8270D; EPA 8270D SIM	Pyrene
GC/MS	EPA 8270D	Pyridine
GC/MS	EPA 8270D	Resorcinol
GC/MS	EPA 8270D	Safrole
GC/MS	EPA 8270D	Simazine
GC/MS	EPA 8270D	o-Toluidine
GC/MS	EPA 8270D	Dimethoate
GC/MS	EPA 8270D	Disulfoton
GC/MS	EPA 8270D	Famphur
GC/MS	EPA 8270D	Methyl parathion (Parathion methyl)
GC/MS	EPA 8270D	Parathion ethyl
GC/MS	EPA 8270D	Phorate
GC/MS	EPA 8270D	Sulfotepp
GC/MS	EPA 8270D	Thionazin (Zinophos)
GC/MS	EPA 8270D	O,O,O-Triethyl phosphorothioate
HPLC	EPA 8310	1-Methylnaphthalene
HPLC	EPA 8310	2-Methylnaphthalene
HPLC	EPA 8310	Acenaphthene
HPLC	EPA 8310	Acenaphthylene
HPLC	EPA 8310	Anthracene
HPLC	EPA 8310	Benzo(a)anthracene
HPLC	EPA 8310	Benzo(a)pyrene
HPLC	EPA 8310	Benzo(b)fluoranthene
HPLC	EPA 8310	Benzo(g h i)perylene
HPLC	EPA 8310	Benzo(k)fluoranthene
HPLC	EPA 8310	Chrysene
HPLC	EPA 8310	Dibenz(a h)anthracene
HPLC	EPA 8310	Fluoranthene
HPLC	EPA 8310	Fluorene

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
HPLC	EPA 8310	Indeno(1,2,3-cd)pyrene
HPLC	EPA 8310	Naphthalene
HPLC	EPA 8310	Phenanthrene
HPLC	EPA 8310	Pyrene
HPLC	EPA 8330A/B	1,3,5-Trinitrobenzene (1,3,5-TNB)
HPLC	EPA 8330A/B	1,3-Dinitrobenzene (1,3-DNB)
HPLC	EPA 8330A/B	2,4,6-Trinitrotoluene (2,4,6-TNT)
HPLC	EPA 8330A/B	2,4-Dinitrotoluene (2,4-DNT)
HPLC	EPA 8330A/B	2,6-Dinitrotoluene (2,6-DNT)
HPLC	EPA 8330A/B	2-Amino-4,6-dinitrotoluene (2-am-dnt)
HPLC	EPA 8330A/B	2-Nitrotoluene
HPLC	EPA 8330A/B	3,5-Dinitroaniline
HPLC	EPA 8330A/B	3-Nitrotoluene
HPLC	EPA 8330A/B	4-Amino-2,6-dinitrotoluene (4-am-dnt)
HPLC	EPA 8330A/B	4-Nitrotoluene
HPLC	EPA 8330A/B	Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)
HPLC	EPA 8330A/B	Nitrobenzene
HPLC	EPA 8330A/B; EPA 8332	Nitroglycerin
HPLC	EPA 8330A/B	Methyl-2,4,6-trinitrophenylnitramine (Tetryl)
HPLC	EPA 8330A/B	Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)
HPLC	EPA 8330A/B; EPA 8332	Pentaerythritoltetranitrate (PETN)
HPLC	EPA 8330A	2,2’,6,6’-Tetranitro-4,4’-azoxytoluene
HPLC	EPA 8330A/B	2-amino-6-Nitrotoluene
HPLC	EPA 8330A/B	4-amino-2-Nitrotoluene
HPLC	EPA 8330A/B	2-amino-4-Nitrotoluene
HPLC	EPA 8330A/B	2,4-diamino-6-Nitrotoluene
HPLC	EPA 8330A/B	2,6-diamino-4-Nitrotoluene
HPLC	EPA 8330A/B	DNX
HPLC	EPA 8330A/B	MNX
HPLC	EPA 8330A/B	TNX
HPLC	EPA 8330A	Nitroguanidine
HPLC	EPA 8330A	Guanidine Nitrate
LC/MS/MS	EPA 6850	Perchlorate
LC/MS/MS	EPA 537 MOD[2]	Perfluorobutanoic Acid
LC/MS/MS	EPA 537 MOD[2]	Perfluoropentanoic Acid

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
LC/MS/MS	EPA 537 MOD²	Perfluorohexanoic Acid
LC/MS/MS	EPA 537 MOD²	Perfluoroheptanoic Acid
LC/MS/MS	EPA 537 MOD²	Perfluorooctanoic Acid
LC/MS/MS	EPA 537 MOD²	Perfluorononanoic Acid
LC/MS/MS	EPA 537 MOD²	Perfluorodecanoic Acid
LC/MS/MS	EPA 537 MOD²	Perfluoroundecanoic Acid
LC/MS/MS	EPA 537 MOD²	Perfluorododecanoic Acid
LC/MS/MS	EPA 537 MOD²	Perfluorotridecanoic Acid
LC/MS/MS	EPA 537 MOD²	Perfluorotetradecanoic Acid
LC/MS/MS	EPA 537 MOD²	Perfluorononanesulfonic Acid
LC/MS/MS	EPA 537 MOD²	Perfluorobutanesulfonic Acid
LC/MS/MS	EPA 537 MOD²	Perfluorohexanesulfonic Acid
LC/MS/MS	EPA 537 MOD²	Perfluorooctanesulfonic Acid
LC/MS/MS	EPA 537 MOD²	Perfluorodecanesulfonic Acid
LC/MS/MS	EPA 537 MOD²	Perfluoropentanesulfonic Acid
LC/MS/MS	EPA 537 MOD²	Perfluoroheptanesulfonic acid
LC/MS/MS	EPA 537 MOD²	Perfluorooctane sulfonamide
LC/MS/MS	EPA 537 MOD²	N-Methyl perfluorooctane sulfonamide
LC/MS/MS	EPA 537 MOD²	N-Ethyl perfluorooctane sulfonamide
LC/MS/MS	EPA 537 MOD²	Perfluoro-1-octanesulfonamidoacetic acid
LC/MS/MS	EPA 537 MOD²	N-Methyl perfluorooctanesulfonamidoacetic acid
LC/MS/MS	EPA 537 MOD²	N-Ethyl perfluorooctanesulfonamidoacetic acid
LC/MS/MS	EPA 537 MOD²	N-Methyl perfluorooctane sulfonamidoethanol
LC/MS/MS	EPA 537 MOD²	4:2 Fluorotelomer Sulfonate
LC/MS/MS	EPA 537 MOD²	N-Ethyl perfluorooctane sulfonamidoethanol
LC/MS/MS	EPA 537 MOD²	6:2 Fluorotelomer Sulfonate
LC/MS/MS	EPA 537 MOD²	8:2 Fluorotelomer Sulfonate
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluorobutanoic Acid (PFBA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluoropentanoic Acid (PFPeA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-1515	Perfluorohexanoic Acid (PFHxA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluoroheptanoic Acid (PFHpA)

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluorooctanoic Acid (PFOA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluorononanoic Acid (PFNA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluorodecanoic Acid (PFDA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluoroundecanoic Acid (PFUnA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluorododecanoic Acid(PFDoA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluorotridecanoic Acid (PFTrDA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluorotetradecanoic Acid (PFTA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluorobutanesulfonic Acid (PFBS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluorohexanesulfonic Acid(PFHxS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluorooctanesulfonic Acid(PFOS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluorononanesulfonic Acid(PFNS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluorodecanesulfonic Acid(PFDS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluoroheptanesulfonic acid(PFHpS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluoropentanesulfonic Acid(PFPeS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluorooctane sulfonamide (PFOSA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	N-Methyl perfluorooctanesulfonamidoacetic acid (MeFOSAA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	N-Ethyl perfluorooctanesulfonamidoacetic acid (EtFOSAA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	4:2 Fluorotelomer Sulfonate (FTS 4:2)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	6:2 Fluorotelomer Sulfonate(FTS 6:2)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	8:2 Fluorotelomer Sulfonate (FTS 8:2)
ICP	EPA 6010C/D	Aluminum

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
ICP	EPA 6010C/D	Antimony
ICP	EPA 6010C/D	Arsenic
ICP	EPA 6010C/D	Barium
ICP	EPA 6010C/D	Beryllium
ICP	EPA 6010C/D	Cadmium
ICP	EPA 6010C/D	Calcium
ICP	EPA 6010C/D	Chromium
ICP	EPA 6010C/D	Cobalt
ICP	EPA 6010C/D	Copper
ICP	EPA 6010C/D	Iron
ICP	EPA 6010C/D	Lead
ICP	EPA 6010C/D	Magnesium
ICP	EPA 6010C/D	Manganese
ICP	EPA 6010C/D	Molybdenum
ICP	EPA 6010C/D	Nickel
ICP	EPA 6010C/D	Potassium
ICP	EPA 6010C/D	Selenium
ICP	EPA 6010C/D	Silver
ICP	EPA 6010C/D	Sodium
ICP	EPA 6010C/D	Strontium
ICP	EPA 6010C/D	Thallium
ICP	EPA 6010C/D	Tin
ICP	EPA 6010C/D	Titanium
ICP	EPA 6010C/D	Vanadium
ICP	EPA 6010C/D	Zinc
ICP/MS	EPA 6020A/B	Aluminum
ICP/MS	EPA 6020A/B	Antimony
ICP/MS	EPA 6020A/B	Arsenic
ICP/MS	EPA 6020A/B	Barium
ICP/MS	EPA 6020A/B	Beryllium
ICP/MS	EPA 6020A/B	Cadmium
ICP/MS	EPA 6020A/B	Calcium
ICP/MS	EPA 6020A/B	Chromium
ICP/MS	EPA 6020A/B	Cobalt
ICP/MS	EPA 6020A/B	Copper
ICP/MS	EPA 6020A/B	Iron
ICP/MS	EPA 6020A/B	Lead

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
ICP/MS	EPA 6020A/B	Magnesium
ICP/MS	EPA 6020A/B	Manganese
ICP/MS	EPA 6020A/B	Molybdenum
ICP/MS	EPA 6020A/B	Nickel
ICP/MS	EPA 6020A/B	Potassium
ICP/MS	EPA 6020A/B	Selenium
ICP/MS	EPA 6020A/B	Silver
ICP/MS	EPA 6020A/B	Sodium
ICP/MS	EPA 6020A/B	Strontium
ICP/MS	EPA 6020A/B	Thallium
ICP/MS	EPA 6020A/B	Tin
ICP/MS	EPA 6020A/B	Titanium
ICP/MS	EPA 6020A/B	Vanadium
ICP/MS	EPA 6020A/B	Zinc
CVAA	EPA 7471B	Mercury
UV/VIS	EPA 7196A	Hexavalent Chromium (Cr6+)
UV/VIS	EPA 9012B	Cyanide (Total)
IC	EPA 9056A	Bromide
IC	EPA 9056A	Chloride
IC	EPA 9056A	Fluoride
IC	EPA 9056A	Nitrate
IC	EPA 9056A	Nitrite
IC	EPA 9056A	Sulfate
IC	EPA 9056A	Total nitrate-nitrite
Gravimetric Methods	SM 2540G	% solids
Gravimetric Methods	EPA 9071B	Oil and Grease
Electrometric Methods	EPA 9045D	Hydrogen Ion (pH)
Combustion	EPA 9060A	Total Organic Carbon
Ignitability	EPA 1010A MOD	Flash Point
Waste Characterization	EPA Ch.7	Reactive Cyanide and Reactive Sulfide
Waste Characterization	EPA Section 7.3	Reactive Cyanide
Waste Characterization	EPA Section 7.3	Reactive Sulfide
Preparation	**Method**	**Type**
Organics Preparation	EPA 3510C	Separatory Funnel Liquid-Liquid Extraction; Leachates

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
TCLP Preparation	EPA 1311	Toxicity Characteristic Leaching Procedure
SPLP Preparation	EPA 1312	Synthetic Precipitation Leaching Procedure
Organics Preparation	EPA 8011	Microextraction
Organics Preparation	EPA 3546	Microwave Extraction
Organics Preparation	EPA 3550C	Ultrasonic Extraction
Organics Preparation	EPA 3580A	Waste Dilution for Extractable Organics
Organics Preparation	EPA 8330A; EPA 8332	Ultrasonic Extraction
Organics Preparation	EPA 8330B	Shaker Table Extraction
Volatile Organics Preparation	EPA 3585	Waste Dilution for Volatile Organics
Volatile Organics Preparation	EPA 5030A	Closed System Purge and Trap; Bulk Soils
Volatile Organics Preparation	EPA 5030B	Closed System Purge and Trap; Leachates and Methanol Extracts
Volatile Organics Preparation	EPA 5035; EPA 5035A	Closed System Purge and Trap
Organics Cleanup	EPA 3660B	Sulfur Cleanup
Organics Cleanup	EPA 3665A	Sulfuric Acid Cleanup
Lachat MicroDistillation	EPA 9012B	Cyanide MicroDistillation; proprietary method
Inorganic Preparation	EPA 3010A	Metals Acid Digestion by Hotblock; Leachates
Inorganic Preparation	EPA 3050B	Metals Acid Digestion by Hotblock
Inorganic Preparation	EPA 3060A	Alkaline Digestion, Cr6+
Inorganic Preparation	EPA 7470A	CVAA Digestion by Hotblock; Leachates
Inorganic Preparation	EPA 7471B	CVAA Digestion by Hotblock

Note:

1. This scope is formatted as part of a single document including Certificate of Accreditation No. L2229
2. Not compliant with QSM V5.1 Table B-15

Vice President

APPENDIX C

SGS SOP #MS019.2: Analysis of Per- and Polyfluoroalkyl Substances by LC/MS/MS and Isotope Dilution, Standard Operating Procedure

ANALYSIS OF PER- and POLYFLUORINATED ALKYL SUBSTANCES BY LC/MS/MS AND ISOTOPE DILUTION

Prepared by: Norm Farmer Date: 04/05/18

Approved by: Mike Eger Date: 04/06/18

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TITLE: ANALYSIS OF PER- and POLYFLUORINATED ALKYL SUBSTANCES BY LC/MS/MS AND ISOTOPE DILUTION

REFERENCES: LC/MS/MS and QSM 5.1 Table B-15

REVISED SECTIONS: 7.3.2, 7.4.3.1, 7.4.4.1, 9.0, 12.0 and Table 2

1.0 SCOPE AND APPLICATION, SUMMARY

1.1 Scope and Application

1.1.1 This method is used to determine the concentrations of select Per- and Polyfluorinated Alkyl Substances (PFAS) in water and solid matrices utilizing an HPLC equipped with a tandem mass spectrometer (MS/MS).

1.1.2 Analytes that may be reported under this method are listed in TABLE 1.

1.1.3 The Lower Limit of Quantitation (LLOQ) or Reporting limits (RL) are based on the extraction procedure and the lowest calibration standard. LLOQs may vary depending on matrix complications and volumes. LLOQs for this method are 1-4 ug/l for direct inject aqueous samples, 0.010-0.040 ug/l for SPE extracted aqueous samples and 1.0-4.0 ug/kg for solid samples. Solid matrices are reported on a dry weight basis.

1.1.4 **PFBA** and **PFOSA** tend to recover erratically by SPE cartridge. These analytes may also be lost during the evaporative step. Data for these analytes should be reviewed carefully. Alternate cartridges may be used depending on the specific analytes of interest.

1.1.5 The Method Detection Limit (MDL) for each analyte is evaluated on an annual basis for each matrix and instrument. MDLs are pooled for each matrix, and the final pooled MDLs are verified. The verified MDLs are stored in the LIMS and should be at least 2 to 3 times lower than the LLOQ. Exceptions may be made on a case by case basis; however, at no point shall the MDL be higher than the reported LLOQ.

1.1.6 The LLOQ for each analyte is evaluated on an annual basis for each matrix and instrument. The LLOQ verifications are prepared by spiking a clean matrix at 0.5 to 2 times the current LLOQ level. This LLOQ verification is carried through the same preparation and analytical procedures as the samples. Recovery of the analytes should be within the established limits. The DOD QSM requirements for Limit of Detection (LOD) and Limit of Quantitation (LOQ) verifications are different. See SOP QA020 for complete requirements for MDL, LOD, LOQ, and LLOQ.

1.1.7 Compounds detected at concentrations between the LLOQ and MDL are quantitated and qualified as estimated values and reported with either a “J” or “I”

qualifier. Some program or project specifications may require that no values below the LLOQ be reported.

1.1.8 For DOD projects refer to QSM 5.1, Table B-15 for additional method requirements and data qualifying guidance.

1.2 Summary

1.2.1 This method is adapted from EPA 537 and modified for the analysis of environmental water and soil samples per DoD QSM 5.1 Table B-15. For the purpose of the AFCEC (Air Force Civil and Engineering Center) ERPIMS (Environmental Resources Program Info Management System) EDD, this method is referred to as MS019.0.

This SOP is not designed to be used to analyze drinking water by EPA 537. Drinking water samples should be analyzed by SOP MS017.

1.2.2 Samples are received, stored, and extracted within the appropriate holding times.

1.2.3 Sample preparation is performed in accordance with SGS – Orlando SOP OP069 and OP070.

1.2.4 Samples known to be high in PFCs (such as AFFF) may be screened by serially diluting and analyzing by direct injection onto the LC/MS/MS. For definitive analysis these samples must be subcontracted to a laboratory certified for AFFF analysis by QSM 5.1.

1.2.5 Perfluorinated compounds are separated, detected and quantitated using an LC/MS/MS. After HPLC separation and ionization, the specific Perfluorinated compound is isolated in the first mass spectrometer and transferred to a collision cell for fragmentation. The resulting fragments are introduced into the second mass spectrometer where they are detected and quantified.

1.2.6 Perfluorinated analytes may exist in branched and/or linear form. Fluorotelomer production results in linear isomers only but electrochemical fluorination results in branched and linear isomers. The branched isomers may account for up to 30% of the total analyte. The branched isomer will elute just before the linear isomer.

1.2.7 Manual integrations are performed in accordance with SOP QA029.

2.0 PRESERVATION AND HOLDING TIME

2.1 Preservation

2.1.1 Samples shall be collected in 125mL polyethylene bottles. A 125mL polyethylene wide mouth bottle is recommended for solid samples. Caps must not have Teflon liners.

2.1.2 Chlorinated finish waters or samples expected to have extreme pH's may be treated with 5.0 g/L of Trizma®.

2.1.3 The samples must be chilled to ≤10°C from the time of collection until arrival at the laboratory. Samples must not exceed 10°C during the first 48 hours after collection. The samples must be refrigerated at ≤ 6°C from the time of receipt until extraction.

2.1.4 The extracts must be stored at ≤6°C to minimize the potential for methanol evaporation but must be allowed to come to room temperature prior to analysis.

2.2 Holding Time

2.2.1 Aqueous samples must be extracted within 28 days of collection.

2.2.2 Solid and waste samples must be extracted within 28 days of collection.

2.2.3 Extracts must be analyzed within 40 days of extraction.

3.0 INTERFERENCES

3.1 Data from all blanks, samples, and spikes must be evaluated for interferences. Method interferences may be caused by contaminants in solvents, reagents, or glassware. The analytes in this method can also be found in many common laboratory supplies and equipment, such as PTFE (polytetrafluoroethylene) or Teflon products, HPLC solvent lines, methanol, aluminum foil, SPE transfer lines, bottle caps, etc. All of these materials must be demonstrated to be free from interferences.

3.2 Contact with glass containers, pipettes, or syringes should be minimized since the Perfluorinated compounds can potentially adsorb to glass surfaces.

3.3 Matrix interferences may be caused by contaminants that are co-extracted from the sample. The extent of matrix interferences will vary considerably from source to source, depending upon the nature of the water. Humic and/or fulvic material can be co-extracted during SPE and high levels can cause enhancement and/or suppression in the electrospray ionization source or low recoveries on the SPE sorbent. Total organic carbon (TOC) is a good indicator of the humic content of the sample.

3.4 SPE cartridges can be a source of interferences. The analysis of field and method blanks can provide important information regarding the presence or absence of such interferences. Brands and lots of SPE devices should be tested to ensure that contamination does not preclude analyte identification and quantitation.

3.5 Water and containers used for equipment blanks or field blanks should be tested prior to use. For smaller sampling events DI water will be provided in the same type of bottle used for sample collection. For larger sampling events four-liter collapsible LDPE containers should be used. Containers should be filled with DI water and allowed to sit for several hours before testing. If the bottles are from the same lot and filled with DI on the

same day, then one analysis per 10 containers should suffice. The DI water and container blanks must be free of any analytes of interest or interferences at ½ the required LLOQ to be acceptable.

3.6 A field blank should be collected with each set of samples. Each field blank consists of 4 bottles. Two bottles are filled with DI water at the lab and the other two bottles are empty. If Trizma® is being used for the samples then the two bottles with DI water should also contain Trizma®. At the sampling site the sampler should open then two empty bottles and transfer the DI water from the full bottles into them. Cap the bottles, label as field blanks, and return them to the laboratory along with the samples for analysis.

4.0 DEFINITIONS

4.1 Batch: A group of samples which are similar with respect to matrix and the testing procedures being employed and which are processed as a unit. A sample batch is limited to a maximum of 20 samples.

4.2 Blank Spike (BS): An analyte-free matrix spiked with a known amount of analyte(s), processed simultaneously with the samples through all the steps of the analytical procedure. Blank Spike Recoveries are used to document laboratory performance for a given method. This may also be called a Laboratory Control Sample (LCS).

4.3 Continuing Calibration Verification (CCV): A check standard used to verify instrument calibration throughout an analytical run. For all GC and HPLC methods, a CCV must be analyzed at the beginning of the analytical run, after every 10 samples, and at the end of the run.

4.4 Field Blank (FB): An aliquot of reagent water that is placed in a sample container in the laboratory and treated as a sample in all respects, including shipment to the sampling site, exposure to sampling site conditions, storage, preservation, and all analytical procedures. The purpose of the FB is to determine if method analytes or other interferences are present in the field environment.

4.5 Holding Time: The maximum times that samples may be held prior to preparation and/or analysis and still considered valid.

4.6 Isotope Dilution Standards (Extracted Internal Standards): A standard containing isotopically labelled versions of the native target analytes. These isotopes are usually labelled with C13 or d2 atoms. Isotope Dilution Standards are used to measure the extraction efficiency and to correct the concentrations of the native analytes based on the recovery of their isotopically labelled analogs. The terms isotope dilution standards and extracted internal standard are used interchangeably throughout this SOP. Technically if a direct mass labelled analog is used to quantitate the native analyte it is an isotope dilution technique; however, if a direct mass labelled analog is not available for quantitation and a similar mass labelled analog is used, it is an extracted internal standard technique.

4.7 Initial Calibration (ICAL): A series of standards used to establish the working range of a particular instrument and detector. The low point must be at a level equal to or below the LLOQ.

4.8 Initial Calibration Verification (ICV): A standard from a source different than that used for the initial calibration. A different vendor should be used whenever possible. The ICV is used to verify the validity of an Initial Calibration. This may also be called a QC check standard.

4.9 Matrix Spike (MS): A sample spiked with a known amount of analyte(s), processed simultaneously with the samples through all the steps of the analytical procedure. The matrix spike recoveries are used to document the bias of a method in a given sample matrix.

4.10 Matrix Spike Duplicate (MSD): A replicate sample spiked with a known amount of analyte(s), processed simultaneously with the samples through all the steps of the analytical procedure. The matrix spike duplicate recoveries are used to document the precision and bias of a method in a given sample matrix.

4.11 Method Blank (MB): An analyte-free matrix to which all reagents are added in the same volumes or proportions as used in sample processing. The method blank is processed simultaneously with the samples through all the steps of the analytical procedure. The method blank is used to document contamination resulting from the analytical process.

4.12 Sample Duplicate (DUP): A replicate sample which is used to document the precision of a method in a given sample matrix.

4.13 Preservation: Refrigeration and/or reagents added at the time of sample collection (or later) to maintain the chemical integrity of the sample.

5.0 REAGENTS

5.1 Water – HPLC grade or equivalent

5.2 Methanol – HPLC grade or equivalent

5.3 Acetic Acid – HPLC grade or equivalent

5.4 Perfluorinated Alkyl Substances stock standards – Traceable to Certificate of Analysis.

5.5 Mass labeled – Injection Standards

Perfluoro-n-[3,4,5-13C3]pentanoic acid (13C3-PFPeA)
Perfluoro-n-[1,2-13C2]hexanoic acid (13C2-PFHxA)
Perfluoro-[1,2-13C2]octanoic acid (13C2-PFOA)
Perfluoro-1-[1,2,3,4-13C4]octanesulfonic acid (13C4-PFOS)
Perfluoro-n-[1,2-13C2]decanoic acid (13C2-PFDA)

5.6 Mass labeled – Isotope Dilution Standards – Extracted Internal Standards

13C4-PFBA	13C6-PFDA	13C8-PFOS
13C5-PFPeA	13C7-PFUnDA	13C8-FOSA
13C5-PFHxA	13C2-PFDoDA	13C2-4:2FTS
13C4-PFHpA	13C2-PFTeDA	13C2-6:2FTS
13C8-PFOA	13C3-PFBS	13C2-8:2FTS
13C9-PFNA	13C3-PFHxS	d3-MeFOSAA
		d5-EtFOSAA*

If interferences (increasing area counts) are noted with d5-EtFOSAA during the initial calibration it should be omitted and the reference for EtFOSAA changed to d3-MeFOSAA.

6.0 APPARATUS

6.1 HPLC – Agilent Technologies 1260

Suitable HPLC equipped with an autosampler, pump, and column compartment. System may have a membrane degasser.

6.2 MS/MS – Agilent Technologies 6460A or 6470

LC/MS/MS must be capable of negative ion electrospray ionization near the required flow rate of the HPLC Column. The system must be capable of performing MS/MS to produce unique precursor and product ions for the PFAS method analytes within the specified retention time segments. A minimum of 10 scans across each peak is required to ensure adequate precision.

6.3 Data System – Agilent Technologies MassHunter B.07.0x and B.08.0x.

6.3.1 A computer system interfaced to the HPLC/MS/MS that allows for the continuous acquisition and storage of all data obtained throughout the duration of the chromatographic program.

6.3.2 The software should allow for the viewing of the specific MS/MS Spectra acquired over the analytical run. Comparisons can then be made between spectra from standards and samples.

6.3.3 Data is archived to a backup server for long term storage.

6.4 Columns: Agilent Poroshell 120 EC C18 2.7um, 100 x 4.6 mm ID or equivalent

6.5 Disposable polyethylene transfer pipettes

6.6 15ml Centrifuge tubes

6.7 Polyethylene screw cap and autosampler vials

6.8 Volumetric Pipettors and volumetric “plasticware” for dilutions of standards and extracts.

6.9 125ml and 250ml HDPE bottles – shown to be PFC free

7.0 PROCEDURE

7.1 Standards Preparation

Standards are prepared from commercially available certified neat or reference standards. All standards must be logged in the HPLC Standards Logbook. All standards shall be traceable to their original source. The standards should be stored at ≤ 6°C, or as recommended by the manufacturer. Calibration levels, spike and isotope dilution standard concentrations, preparation information, and vendor part numbers can be found in the MS STD Summary in the Active SOP directory. A summary of the calibration concentrations can be found in Table 4.

7.1.1 Stock Standard Solutions

Stock standards are available from some commercial vendors. All vendors must supply a “Certificate of Analysis” with the standard. The certificate will be retained by the lab. Hold time for unopened stock standards is until the vendor’s expiration date. Once opened, the hold time is reduced to one year or the vendor’s expiration date (whichever is shorter).

7.1.2 Intermediate Standard Solutions

Intermediate standards are prepared by quantitative dilution of the stock standard with methanol. The hold time for intermediate standards is six months or the vendor’s expiration date (whichever is shorter). Intermediate standards may need to be remade if comparisons to other standards indicate analyte degradation or concentration changes. Intermediate standards should be stored in polyethylene vials.

7.1.3 Calibration Standards

Calibration standards for Perfluorinated analytes are prepared at a minimum of five concentration levels through quantitative dilutions of the intermediate standard. Calibration standards are prepared in methanol. The low standard is at a concentration at or below the RL and the remaining standards defines the working range of the detector. Calibration standards should be stored in polyethylene vials. See Table 4 for levels.

Perfluorinated analytes may exist in branched and/or linear form. If a branched form is commercially available, then the calibration standards

must contain the branched and linear form. PFHxS and PFOS are currently available in mixes of branched and linear isomers. PFOA is available as a technical mix.

Calibration standard concentrations are verified by the analysis of an initial calibration verification (ICV) standard.

7.2 HPLC/MS/MS Conditions

7.2.1 HPLC Conditions

5-10ul autosampler injection

Column temperature – 50.0 °C Flow – 1.0 ml/min

Gradient Program

Time (min)	Water (0.1% acetic acid)	MeOH (0.1% acetic acid)
0-0.0	65%	35%
0-7.0	0%	100%
7.0-18.0	0%	100%
18.0-22.0	65%	35%

7.2.2 MS/MS Conditions

Parameter	Value	Parameter	Value
Gas Temp C	350	Sheath Gas Flow (l/min)	10
Gas Flow (l/min)	10	Capillary (V)	4500
Nebulizer (psi)	55	V Charging	600
Sheath Gas Heater	320	Ionization Mode	Neg ESI

Fragmentation voltages and collisions energies are optimized for each analyte and are stored in the instrument method. Precursor ions and transition masses are listed in Table 2.

LC/MS/MS conditions are optimized for each instrument. Actual conditions may vary slightly from those listed above.

7.3 Sample Preparation

7.3.1 Low Level Aqueous Samples

A 125ml aliquot of sample (entire bottle) is extracted utilizing a solid phase extraction cartridge. The cartridge is eluted with methanol. The extract is carbon cleaned, concentrated and the final volume is adjusted to 1.0ml, and then transferred to a vial for storage. Refer to SOP OP069.

7.3.2 Solid Samples

A 2-gram aliquot of sample is extracted with methanol or a basic methanol and water mix utilizing an ultrasonic bath. The extract is carbon cleaned, concentrated and the final volume is adjusted to 1.0ml, and then transferred to a vial for storage. Refer to SOP OP070.

7.3.3 High Level Aqueous and Non-Aqueous Samples

A 1.0ml aliquot of sample is serially diluted into DI water or methanol. Sample is screened to determine the final dilutions. Results may be reported as **Screening Data** only, if definitive data is needed, the samples must be subcontracted to a laboratory certified for the analysis of AFFF by QSM 5.1.

7.4 HPLC/MS/MS Analysis

Instrument calibration consists of four major sections:

Mass Tuning and Calibration
Transition Window Selection
Initial Calibration Procedures
Continuing Calibration Verification

7.4.1 Mass Tuning & Calibration and Transition Window Selection

Before samples can be run, the LC/MS/MS system must be mass calibrated and tune checked.

The instrument must be hardware tuned per manufacturer's instructions after any maintenance is performed and prior to analyzing a new calibration curve. The Agilent mass calibration ranges from 112.986 to 2833.873 amu.

The instrument must have a valid mass calibration prior to any sample analysis. The mass calibration must be updated as needed. (i.e. QC failures, ion masses showing large deviations from known masses, or major instrument maintenance is performed).

Verify the instrument tune and mass calibration by analyzing a mid-point Perfluorinated compound standard. This may be done using the daily CCV. The ions must be within ± 0.5 amu of the expected mass.

The mid-point standard is also used to check the analyte retention times. These retention times are used to update the transition windows. The windows must be wide enough to ensure that the branched and linear isomer for PFHxS and PFOS are completely within the transition window. The branched isomer will elute just prior to the linear isomer. If they are partially cut off, adjust the retention time of the linear isomer or the width of the transition window. Use a similar size window for the other analytes that do not have a branched standard. Later eluting peaks are broader and require a slightly wider transition window.

7.4.2 Initial Calibration Procedures

Before samples can be run, the LC/MS/MS system must be calibrated.

7.4.2.1 Isotope Dilution Standard (Extracted Internal Standard) Calibration

A minimum 5-point calibration curve is created for the native PFAS compounds using an Isotope Dilution or Extracted Internal Standard technique. SGS - Orlando routinely performs a 8-point calibration to maximize the calibration range and to allow for quadratic fits. See Table 4.

The calibration standards for PFHxS and PFOS must consist of both branched and linear isomers. The branched isomer elutes just prior to the linear isomer. PFCs are currently being reported as the sum of the branched and linear isomers so both peaks must be integrated.

Response factors (RF) for each analyte at each calibration level are determined as follows:

$$RF = (A_{analyte} \mathbf{X} C_{ids})/(A_{ids} \mathbf{X} C_{analyte})$$

$A_{analyte}$ = area of the analyte
A_{ids} = area of the isotope dilution standard
$C_{analyte}$ = concentration of the analyte
C_{ids} = concentration of the isotope dilution standard.

The mean RF and standard deviation of the RF are determined for each analyte. The percent relative standard deviation (%RSD) of the response factors is calculated for each analyte as follows:

%RSD = (Standard Deviation of RF X 100) / Mean RF

If the %RSD $\leq$ 20%, linearity through the origin can be assumed and the mean RF can be used to quantitate target analytes in the samples.

Alternatively, a calibration curve of response vs. amount can be plotted. This method allows for the use of average response factors, linear regressions, and non-linear regressions and forced origins. Linear regressions may be unweighted or weighted as 1/x or $1/x^2$. If the correlation coefficient (r) is $\geq$0.995 ($r^2 \geq$0.990) then the curve can be used to quantitate target analytes in the samples. Regardless of which calibration model is chosen, the laboratory should visually inspect the curve plots to see how the individual calibration points compare to the plot.

Linear Curve Fit $y = ax + b$

y = response ratio x = concentration ratio

a = linear term b = constant term

Quadratic Curve Fit $y = ax^2 + bx + c$

y = response ratio x = concentration ratio

a = quadratic term b = linear term c = constant term

Each point must be refitted against the initial calibration. Use % Error to evaluate the difference between the measured and the true amounts or concentrations used to create the model. The MassHunter software will do this automatically.

Calculation of the % Error

% ERR = (xi-x'i) / xi * 100

x'i = Measured amount of analyte at calibration level i, in mass or concentration units.

xi = True amount of analyte at calibration level i, in mass or concentration units.

Percent error between the calculated and expected amounts of an analyte must be ≤ ±30% for all standards (70-130% of True Value).

7.4.2.2 Initial Calibration Verification (ICV)

The validity of the initial calibration curve must be verified through the analysis of an initial calibration verification (ICV) standard. The ICV must be prepared from a second source at a mid-range concentration.

NOTE: Second source standards may consist of linear isomers only.

NOTE: Analyze the PFOA Technical Mix to identify the branched isomers. This is a qualitative standard only.

The %D for the compound of interest must be ≤ ±30% (70-130% of True Value). If the ICV does not meet these criteria, a second standard should be prepared. If the ICV still does not meet criteria, analyze an ICV prepared from a third source (if available). If this ICV meets criteria, proceed with sample analysis. If the ICV still does not meet criteria, determine which two standards agree. Make fresh calibration

standards and an ICV from the two sources that agree. Recalibrate the instrument.

NOTE: Second source standards may not be available for all of the Perfluorinated analytes.

7.4.2.3 Highest Standard and Instrument Blank

Analyze an instrument blank immediately following the highest standard analyzed. The highest standard analyzed may be analyzed as part of the calibration curve or following the calibration curve. The highest standard may be at or above the concentration of highest level of the calibration. It cannot be used to extend the calibration range.

The instrument blank must be analyzed immediately following the highest standard. The instrument blank must be free of any analytes of interest or interferences at ½ the required LOQ to be acceptable.

If the acceptance criteria is not met, the concentration of the standard should be lowered and another blank analyzed.

The highest standard and instrument blank pair are used only to document a highest concentration at which carryover does not occur. If sample concentrations exceed this range and the sample(s) following exceed this acceptance criteria (>1/2 LOQ), they must be reanalyzed.

7.4.2.4 Retention Time Windows

Retention time windows must be established whenever a new column is installed in an instrument or whenever a major change has been made to an instrument.

Retention time windows are crucial to the identification and quantitation of target compounds. They are also helpful in setting transition windows. Absolute retention times are used for compound identification in all GC and HPLC methods that do not employ internal standard calibration. Generally internal calibration methods utilize relative retentions times. Retention time windows are established to compensate for minor shifts in absolute retention times that result from normal chromatographic variability. The width of the retention time window should be carefully established to minimize the occurrence of both false positive and false negative results.

Retention time windows are established by injecting all standard mixes three times over the course of 72 hours. The width of the retention time window for each analyte, surrogate, and major constituent in multi-component analytes is defined as ± 3 times the standard deviation of the mean absolute retention time or 0.1 minutes, whichever is greater.

Establish the center of the retention time window for each analyte and surrogate by using the absolute retention time for each analyte and surrogate from the calibration verification standard at the beginning of the analytical shift. For samples run during the same shift as an initial calibration, use the retention time of the mid-point standard of the initial calibration.

Initial peak identification is based on the retention time of a peak falling within the retention time window for a given analyte. Time reference peaks extracted internal standards and injection standard are used to correct for run-to-run variations in retention times due to temperature, flow, or injector fluctuations. HPLC retention times tend to shift more than GC retention times.

7.4.2.5 Ion Ratios

A minimum of two transition ions are monitored for each target analyte except for PFBA and PFPeA (which only have a single transition ion). Transition ions are listed in Table 2 and structures for each transition are listed in Table 3.

The ratio of the primary and secondary transition masses should be updated from the initial calibration. They may be updated from the midpoint standard or from an average of all levels. Additionally, the ion ratio may be updated from the opening daily CCV.

The MassHunter software is set to flag the analyte if the ratio of these ions is not within ± 30% of the expected, (e.g., if the ion ratio is expected to be 50% in the standard, the ion ratio in the corresponding sample must be between 20 and 80%).

The signal to noise ratio for the primary transition mass must be at least 10 times that of the background and the secondary transition mass must be at least 3 times that of the background.

7.4.3 Daily Calibration and Carryover Verifications

7.4.3.1 Continuing Calibration Verification (CCV)

Continuing calibration verification standards for the Perfluorinated compounds are prepared at low and mid-range concentration. CCV standards are prepared from the same stock as the initial calibration standards.

A low level CCV must be analyzed prior to sample analysis and at least once every 12 hours to ensure accuracy at the LOQ.

The CCV must be analyzed at the beginning and end of each run to verify that the initial calibration is still valid. Additionally, the mid-point CCV must be analyzed after every 10 samples.

The percent difference (%D) for each analyte of interest will be monitored. The |%D| must be $\leq \pm 30\%$ for the analytes in each CCV.

If the first continuing calibration verification does not meet criteria, a second standard may be injected. If the second standard does not meet criteria, the system must be recalibrated. If the second standard meets criteria, then a third standard must be analyzed. If the third standard also meets criteria, then the system is considered in control and results may be reported.

If the |%D| is outside the control limits, then documented corrective action is necessary. This may include recalibrating the instrument and reanalyzing the samples, performing instrument maintenance to correct the problem and reanalyzing the samples, or qualifying the data. Qualifying the data should only be done if the sample cannot be reanalyzed. Under certain circumstances, the data may be reported, i.e. The CCV failed high, the associated QC passed, and the samples were ND.

NOTE: Any target analytes that are detected in the samples must be bracketed by an acceptable initial calibration curve and acceptable CCV standards; otherwise, the samples must be reanalyzed, or the data must be qualified.

7.4.3.2 Carryover Verification

A high standard and an instrument blank must be analyzed each day prior to the analysis of samples. The high standard may be at or above the concentration of highest level of the calibration.

The instrument blank must be analyzed immediately following the high standard. The instrument blank must be free of any analytes of interest or interferences at ½ the required LOQ to be acceptable.

If the acceptance criteria is not met, the concentration of the standard should be lowered and another blank analyzed.

The highest standard and instrument blank pair are used only to document a highest concentration at which carryover does not occur. If sample concentrations exceed this range and the sample(s) following exceed this acceptance criteria (>1/2 LOQ), they must be reanalyzed.

7.4.4 Sample Extract Analysis

7.4.4.1 Samples are analyzed in a set referred to as an analysis sequence or batch. A batch consists of the following:

Initial Calibration Standards (or Initial CCV and low level CCV)
Carryover Check Standard
Instrument Blank
CCV Standards
    Low-Level (LOQ)
    Mid-Level
QC Extracts
Sample Extracts
Bracketing CCV Standards

7.4.4.2 Two microliters of injection standard solution is added to every 100ul of extract in the autosampler vial. Generally, 500ul of extract are transferred to the autosampler vial with a gas tight syringe.

7.4.4.3 Five to ten microliters (same amount as standards) of extract is injected into the HPLC by the autosampler. The data system then records the resultant peak responses and retention times.

7.4.4.4 Tentative identification of an analyte occurs when the peak from the sample extract falls within the retention time window of the target compound.

7.4.4.5 Positive identification is confirmed by comparing the ion ratio in the sample to the ion ratio of the standards. For the linear isomer, the primary and secondary transition masses must both be present. For the branched isomer the primary and secondary transition masses should both be present. In rare circumstances a particular branched peak may only exhibit a single transition ion.

The MassHunter software is set to flag the analyte if the ratio of these ions is not within ± 30% of the expected, (e.g., if the ion ratio is expected to be 50% in the standard, the ion ratio in the corresponding sample must be between 20 and 80%).

The signal to noise ratio for the primary transition mass must be at least 10 times that of the background and the secondary transition mass must be at least 3 times that of the background.

7.4.4.6 Some of the PFASs may have multiple chromatographic peaks due to the presence of linear and branched isomers. This is prevalent in PFHxS and PFOS. The areas of all the linear and branched isomers peaks must be included and the concentrations reported as a total for each of these analytes.

NOTE: The branched isomers must be included in the quantitation even if the calibration is based on just the linear isomer.

7.4.4.7 If the compound identification does not confirm, then the result should be reported as ND or "U".

7.4.4.8 If the analyte response exceeds the linear range of the system, the extract must be diluted and reanalyzed. It is recommended that extracts be diluted so that the response falls into the middle of the calibration curve.

Dilutions for this method are performed differently depending on the concentration of the target analytes in the extract. For dilutions in the 2-10 fold range, the extract is diluted with a methanol:water mix. No additional isotope dilution standards are added. For dilutions greater than 10-fold, additional isotope dilution standards are added. The theoretical concentration of the isotope dilution standards in the extract will need to be entered into MassHunter so that the software can correctly calculate the native analyte concentration.

7.4.4.9 If peak identification is prevented by the presence of interferences, further cleanup may be required, or the extract must be diluted so that the interference does not mask any analytes.

7.5 Maintenance and Trouble Shooting

7.5.1 Refer to SOP GC001 for routine instrument maintenance and trouble shooting.

7.5.2 All instrument maintenance must be documented in the appropriate "Instrument Repair and Maintenance" log. The log will include such items as problem, action taken, correction verification, date, and analyst.

7.5.3 Repairs performed by outside vendors must also be documented in the log. The analyst or Department Supervisor responsible for the instrument must complete the log if the repair technician does not.

7.5.4 PC and software changes must be documented in the "Instrument Repair and Maintenance" log. Software changes may require additional validation.

8.0 METHOD PERFORMANCE

Method performance is monitored through the routine analysis of negative and positive control samples. These control samples include method blanks (MB), blank spikes (BS), matrix spikes (MS), and matrix spike duplicates (MSD). The MB and BS are used to monitor overall method performance, while the MS and MSD are used to evaluate the method performance in a specific sample matrix.

Blank spike, matrix spike, and matrix spike duplicate samples are compared to statistically generated control limits. These control limits are reviewed and updated annually. Control limits are stored in the LIMS. Additionally, blank spike accuracy is regularly evaluated for statistical trends that may be indicative of systematic analytical errors.

9.0 QUALITY ASSURANCE / QUALITY CONTROL

Accuracy and matrix bias are monitored by the use of isotope dilution standards and by the analysis of a QC set that is prepared with each batch (maximum of 20 samples) of samples. The QC set consists of a method blank (MB), blank spike (BS), matrix spike (MS), and matrix spike duplicate (MSD). All control limits are updated annually and are listed in the LIMS.

9.1 Injection Standards

Perfluoro-[1,2-13C2]octanoic acid (13C2-PFOA) and Perfluoro-1-[1,2,3,4-13C4]octanesulfonic acid (13C4-PFOS) are used as injection standards for this method. Additional analytes listed in Section 5.5 may be used as additional injection standards.

The response of the injection standards in all subsequent runs must be ±50% of the response from the initial calibration midpoint standard.

9.1.1 If the injection standard responses are not within limits, the following are required.

9.1.1.1 Check to be sure that there are no errors in calculations, integrations, or injection standard solutions. If errors are found, recalculate the data accordingly.

9.1.1.2 Check instrument performance. If an instrument performance problem is identified, correct the problem and reanalyze the sample.

9.1.1.3 If no problem is found, prepare a second aliquot of extract and reanalyze the sample.

9.1.1.4 If upon reanalysis, the responses are still not within limits, reanalyze the sample at a dilution.

9.1.1.5 If upon analysis of the dilution the responses are within limits, then the sample or select analytes may need to be reported from the dilution or qualified.

9.1.1.6 The responses of the isotope dilution standards can be used to help assess the data too.

9.2 Isotope Dilution Standards

9.2.1 The analytes listed in section 5.6 are used as the isotope dilution standards for this method.

A known amount of isotope dilution standard is added to each sample including the QC set prior to extraction. The recovery (corrected for dilution) for each isotope dilution standard must be 50% to 150%.

The % recovery may be calculated by direct comparison of the isotope dilutions standard responses to the response from the initial calibration midpoint standard or they may be calculated from the calculated concentrations.

% Recovery = (Sample Amount / Amount Spiked) X 100

Only those isotope dilution standards that directly link to the native analytes being reported need to pass. For example, 13C4-PFBA only needs to pass if PFBA is being reported.

9.2.2 If any isotope dilution standard response/recovery is not within the established control limits, the following are required.

9.2.2.1 Check to be sure that there are no errors in calculations, dilutions, integrations, isotope dilution standard solutions. If errors are found, recalculate the data accordingly. If errors are suspected, re-vial and re-inject the extract to verify.

9.2.2.2 Check instrument performance. It may be necessary to re-vial and re-inject the extract in order to verify performance. If an instrument performance problem is identified, correct the problem and reanalyze the sample.

9.2.2.3 Check for instrument suppression or enhancement by reanalyzing the sample at a dilution.

9.2.2.4 If no problem is found, re-extract and reanalyze the sample. **NOTE:** If the recoveries are high and the sample is non-detect, then re-extraction may not be necessary. If there is insufficient sample for re-extraction, reanalyze the sample and footnote this on the report.

9.2.2.5 If upon reanalysis, the recovery is still not within control limits, the problem is considered matrix interference. Isotope dilution standards from both sets of analysis should be reported on the final report.

9.3 Method Blank

9.3.1 The method blank is either HPLC water or cleaned sand (depending upon sample matrix). The method blank is then taken through all procedures along with the other samples to determine any contamination from reagents, glassware, or high-

level samples. The method blank must be free of any analytes of interest or interferences at ½ the required LOQ to be acceptable. Common laboratory contaminants must be below the LLOQ if present. If the method blank is not acceptable, corrective action must be taken to determine the source of the contamination. Samples associated with a contaminated method blank shall be evaluated as to the best corrective action for each particular sample. This may include reanalyzing the samples, re-extracting and reanalyzing the samples or qualifying the results with a "B" or "V" qualifier.

9.3.2 If the MB is contaminated but the samples are non-detect, then the source of contamination must be investigated and documented. At a minimum the samples must be re-extracted and reanalyzed for confirmation. If the re-extracted sample result confirms the original ND result, then the original result can be reported without qualification. If there is insufficient sample to re-extract, or if the sample is re-extracted beyond hold time, the appropriate footnote and qualifiers should be added to the results. This must be approved by the department supervisor.

9.3.3 If the MB is contaminated but the samples results are > 10 times the contamination level, the source of the contamination must be investigated and documented. The samples results may be reported with the appropriate "B" or "V" qualifier. This must be approved by the department supervisor.

9.3.4 If the MB is contaminated but the samples results are < 10 times the contamination level, the source of the contamination must be investigated and documented. The samples must be re-extracted and reanalyzed for confirmation. If there is insufficient sample to re-extract, or if the sample is re-extracted beyond hold time, the appropriate footnote and qualifiers should be added to the results. This must be approved by the department supervisor.

9.4 Blank Spike

9.4.1 The blank spike is either HPLC water or cleaned sand (depending upon sample matrix) to which the spike standard has been added. The blank spike is then taken through all procedures along with the other samples to monitor the efficiency of the extraction procedure. The percent recovery for each analyte is calculated as follows:

% Recovery = (Blank Spike Amount / Amount Spiked) X 100

The percent recovery for each analyte of interest must fall within the established control limits for the results to be acceptable. As additional analytes are added to this method, the recoveries will need to be carefully evaluated. Alternate SPE cartridges may improve the recovery of select analytes such as PFBA and PFOSA.

9.4.2 If the blank spike recoveries are not within the established control limits, the following are required.

9.4.2.1 Check to be sure that there are no errors in calculations, dilutions, integrations, or spike solutions. If errors are found, recalculate the data accordingly. If errors are suspected, re-vial and re-inject the extract to verify.

9.4.2.2 Check instrument performance. It may be necessary to re-vial and re-inject the extract in order to verify performance. If an instrument performance problem is identified, correct the problem and reanalyze the sample.

9.4.2.3 If the recovery of an analyte in the BS is high and the associated sample is non-detect, the data may be reportable. For any DoD QSM projects the resulting data must be qualified accordingly.

9.4.2.4 If no problem is found, the department supervisor shall review the data and determine what further corrective action is best for each particular sample. That may include reanalyzing the samples, re-extracting and reanalyzing the samples, or qualifying the results as estimated.

9.4.2.5 If there is insufficient sample to re-extract, or if the sample is re-extracted beyond hold time, the appropriate footnote and qualifiers should be added to the results. This must be approved by the department supervisor.

9.5 Matrix Spike and Matrix Spike Duplicate

9.5.1 Matrix spike and spike duplicates are replicate sample aliquots to which the spike standard has been added. The matrix spike and spike duplicate are then taken through all procedures along with the other samples to monitor the precision and accuracy of the procedure. The percent recovery for each analyte is calculated as follows:

% Recovery = [(Spike Amount – Sample Amount) / Amount Spiked] X 100

The percent recovery for each analyte of interest must fall within the established control limits for the results to be acceptable.

9.5.2 If the matrix spike recoveries are not within the established control limits, the following are required.

9.5.2.1 Check to be sure that there are no errors in calculations, dilutions, integrations, or spike solutions. If errors are found, recalculate the data accordingly. If errors are suspected, re-vial and re-inject the extract to verify.

9.5.2.2 Check instrument performance. It may be necessary to re-vial and re-inject the extract in order to verify performance. If an instrument performance problem is identified, correct the problem and reanalyze the sample.

9.5.2.3 If no problem is found, compare the recoveries to those of the blank spike. If the blank spike recoveries indicate that the problem is sample related, document this on the run narrative. Matrix spike recovery failures are not grounds for re-extract but are indications of the sample matrix effects.

9.5.3 Precision

Matrix spike and spike duplicate recoveries for each analyte are used to calculate the relative percent difference (RPD) for each compound.

RPD = [| MS Result – MSD Result | / Average Result] X 100

The RPD for each Perfluorinated compound must be less than 30%. If the RPDs fall outside of the established control limits, the MS and MSD must be reanalyzed to ensure that there was no injection problem. If upon reanalysis the RPDs are still outside of the control limits, the department supervisor shall review the data and determine if any further action is necessary. RPD failures are generally not grounds for re-extraction.

10.0 CALCULATIONS

The concentration of each Perfluorinated compound in the original sample is calculated as follows:

Water (ug/l) = $(CONC_{inst})$ X (V_F / V_I) X DF

Soil (ug/kg) = $[(CONC_{inst})$ X (V_F / W_I) X DF] / %solids

$CONC_{inst}$	=	Instrument concentration calculated from the initial calibration using mean CF or curve fit
DF	=	Dilution Factor
V_F	=	Volume of final extract (ml)
V_I	=	Volume of sample extracted (ml)
W_I	=	Weight of sample extracted (g)
%solids	=	Dry weight determination in decimal form

11.0 SAFETY AND POLLUTION PREVENTION

11.1 Safety

The analyst must follow normal safety procedures as outlined in the SGS Health and Safety Program, which includes the use of safety glasses, gloves, and lab coats.

The toxicity of each reagent and target analyte has not been precisely defined; however, each reagent and sample should be treated as a potential health hazard. Material Safety Data Sheets (MSDS) or Safety Data Sheets (SDS) are available for all reagents and many of the target analytes. Exposure must be reduced to the lowest possible level. Personal protective equipment must be used by all analysts.

11.2 Pollution Prevention

Wastewater and methanol from the instrument are collected in waste storage bottles and are eventually transferred to the non-chlorinated waste drum.

Sample Extracts are archived and stored for 30 days after analysis. Old extracts and standards are disposed of in the waste vial drum.

12.0 REFERENCES

SW846 Method 8000D Revision 4, July 2014

EPA Method 537 Revision 1.1, September 2009

DOD QSM 5.0, July 2013

DOD QSM 5.1, January 2017

Standard Operating Procedure for the Extraction and Quantitation of Perfluorinated Compounds from Surface Soils, Methods Development and Application Branch, US EPA, Mark Strynar, October 2008

Standard Test Method for Determination of Perfluorinated Compounds by LC/MS/MS, ASTM D7968-14

Draft Procedure for Analysis of Perfluorinated Carboxylic Acids and Sulfonic Acids in Sewage Sludge and Biosolids by HPLC/MS/MS, December 2011

EPA Technical Advisory: Laboratory Analysis of Drinking Water Samples for PFOA Using EPA Method 537 Rev. 1.1, EPA 815-B-16-021, September 2016

TABLE 1: Target Analytes

Perfluorobutanoic acid	PFBA	375-22-4
Perfluoropentanoic acid	PFPeA	2706-90-3
Perfluorohexanoic acid	PFHxA	307-24-4
Perfluoroheptanoic acid	PFHpA	375-85-9
Perfluorooctanoic acid	PFOA	335-67-1
Perfluorononanoic acid	PFNA	375-95-1
Perfluorodecanoic acid	PFDA	335-76-2
Perfluoroundecanoic acid	PFUnDA	2058-94-8
Perfluorododecanoic acid	PFDoDA	307-55-1
Perfluorotridecanoic acid	PFTrDA	72629-94-8
Perfluorotetradecanoic acid	PFTeDA	376-06-7
Perfluorohexadecanoic acid	PFHxDA	67905-19-5
Perfluorooctadecanoic acid	PFOcDA	16517-11-6
Perfluorobutanesulfonic acid	PFBS	375-73-5
Perfluoropentanesulfonic acid	PFPeS	2706-91-4
Perfluorohexanesulfonic acid	PFHxS	355-46-4
Perfluoroheptanesulfonic acid	PFHpS	375-92-8
Perfluorooctanesulfonic acid	PFOS	1763-23-1
Perfluorononanesulfonic acid	PFNS	474511-07-4
Perfluorodecanesulfonic acid	PFDS	335-77-3
4:2 Fluorotelomer sulfonate	4:2FTS	757124-72-4
6:2 Fluorotelomer sulfonate	6:2FTS	27619-97-2
8:2 Fluorotelomer sulfonate	8:2FTS	39108-34-4
Perfluorooctane sulfonamide	PFOSA	754-91-6
N-Methyl perfluorooctanesulfonamidoacetic acid	MeFOSAA	2355-31-9
N-Ethyl perfluorooctanesulfonamidoacetic acid	EtFOSAA	2991-50-6

TABLE 2: Precursor and Primary Transition Masses

Analyte	Type	Precursor Ion	Prod Ion Primary	Prod Ion Secondary
13C4-PFBA	IDS	217	172	
PFBA	Native	213	169	
13C5-PFPeA	IDS	268	223	
PFPeA	Native	263	219	
13C5-PFHxA	IDS	318	273	
PFHxA	Native	313	269	119
13C4-PFHpA	IDS	367	322	
PFHpA	Native	363	319	169
13C2-PFOA	INJ	415	370	
13C8-PFOA	IDS	421	376	
PFOA	Native	413	369	169
13C9-PFNA	IDS	472	427	
PFNA	Native	463	419	219
13C6-PFDA	IDS	519	474	
PFDA	Native	513	469	219
13C7-PFUnDA	IDS	570	525	
PFUnDA	Native	563	519	269
13C2-PFDoDA	IDS	615	570	
PFDoDA	Native	613	569	319
PFTrDA	Native	663	619	369
13C2-PFTeDA	IDS	715	670	
PFTeDA	Native	713	669	219

TABLE 2: Precursor and Primary Transition Masses

Analyte	Type	Precursor Ion	Prod Ion Primary	Prod Ion Secondary
13C3-PFBS	IDS	302	99	
PFBS	Native	299	80	99
13C3-PFHxS	IDS	402	99	
PFPeS	Native	349	80	99
PFHxS	Native	399	80	99
PFHpS	Native	449	80	99
13C4-PFOS	INJ	503	80	
13C8-PFOS	IDS	507	99	
PFOS	Native	499	80	99
PFNS	Native	549	80	99
PFDS	Native	599	80	99
13C8-FOSA	IDS	506	78	
FOSA	Native	498	78	478
d3-MeFOSAA	IDS	573	419	
MeFOSAA	Native	570	419	512
d5-EtFOSAA	IDS	589	419	
EtFOSAA	Native	584	419	483
13C2-4:2FTS	IDS	329	309	
4:2FTS	Native	327	307	81
13C2-6:2FTS	IDS	429	409	
6:2FTS	Native	427	407	81
13C2-8:2FTS	IDS	529	509	
8:2FTS	Native	527	507	81

TABLE 3: Precursor and Transition Ion Structure

Analyte	MW	Precursor Ion Mass	Prod Ion Primary	Prod Ion Secondary	Prod Ion Tertiary
	Parent Structure	Precrusor Ion Structure	Prim Ion Structure	Sec Ion Structure	Tert Ion Structure
PFBA	214	213	169		
	$CF_3(CF_2)_2COOH$	$CF_3(CF_2)_2COO$	$CF_3(CF_2)_2$		
PFPeA	264	263	219		
	$CF_3(CF_2)_3COOH$	$CF_3(CF_2)_3COO$	$CF_3(CF_2)_3$		
PFHxA	314	313	269	119	
	$CF_3(CF_2)_4COOH$	$CF_3(CF_2)_4COO$	$CF_3(CF_2)_4$	CF_3CF_2	
PFHpA	364	363	319	169	119
	$CF_3(CF_2)_5COOH$	$CF_3(CF_2)_5COO$	$CF_3(CF_2)_5$	$CF_3(CF_2)_2$	CF_3CF_2
PFOA	414	413	369	169	219
	$CF_3(CF_2)_6COOH$	$CF_3(CF_2)_6COO$	$CF_3(CF_2)_6$	$CF_3(CF_2)_2$	$CF_3(CF_2)_3$
PFNA	464	463	419	219	169
	$CF_3(CF_2)_7COOH$	$CF_3(CF_2)_7COO$	$CF_3(CF_2)_7$	$CF_3(CF_2)_3$	$CF_3(CF_2)_2$
PFDA	514	513	469	219	
	$CF_3(CF_2)_8COOH$	$CF_3(CF_2)_8COO$	$CF_3(CF_2)_8$	$CF_3(CF_2)_3$	
PFUnDA	564	563	519	269	
	$CF_3(CF_2)_9COOH$	$CF_3(CF_2)_9COO$	$CF_3(CF_2)_9$	$CF_3(CF_2)_4$	
PFDoDA	614	613	569	319	169
	$CF_3(CF_2)_{10}COOH$	$CF_3(CF_2)_{10}COO$	$CF_3(CF_2)_{10}$	$CF_3(CF_2)_5$	$CF_3(CF_2)_2$
PFTrDA	664	663	619	369	169
	$CF_3(CF_2)_{11}COOH$	$CF_3(CF_2)_{11}COO$	$CF_3(CF_2)_{11}$	$CF_3(CF_2)_6$	$CF_3(CF_2)_2$
PFTeDA	714	713	669	219	169
	$CF_3(CF_2)_{12}COOH$	$CF_3(CF_2)_{12}COO$	$CF_3(CF_2)_{12}$	$CF_3(CF_2)_3$	$CF_3(CF_2)_2$
PFBS	338	299	80	99	
	$CF_3(CF_2)_3SO_3K$	$CF_3(CF_2)_3SO$	SO_3	FSO_3	
PFPeS	372	349	80	99	
	$CF_3(CF_2)_4SO_3Na$	$CF_3(CF_2)_4SO_3$	SO_3	FSO_3	
PFHxS	422	399	80	99	119
	$CF_3(CF_2)_5SO_3Na$	$CF_3(CF_2)_5SO_3$	SO_3	FSO_3	CF_3CF_2
PFHpS	472	449	80	99	
	$CF_3(CF_2)_6SO_3Na$	$CF_3(CF_2)_6SO_3$	SO_3	FSO_3	
PFOS	522	499	80	99	230
	$CF_3(CF_2)_7SO_3Na$	$CF_3(CF_2)_7SO_3$	SO_3	FSO_3	$(CF_2)_3SO_3$
PFNS	572	549	80	99	
	$CF_3(CF_2)_8SO_3Na$	$CF_3(CF_2)_8SO_3$	SO_3	FSO_3	
PFDS	622	599	80	99	
	$CF_3(CF_2)_9SO_3Na$	$CF_3(CF_2)_9SO_3$	SO_3	FSO_3	
FOSA	499	498	78	478	
	$CF_3(CF_2)_7SO_2NH_2$	$CF_3(CF_2)_7SO_2NH$	SO_2N	$(CF_2)_8SO_2N$	
MeFOSAA	571	570	419	512	
	$CF_3(CF_2)_7SO_2N(CH_3)CH_2COOH$	$CF_3(CF_2)_7SO_2N(CH_3)CH_2COO$	$CF_3(CF_2)_7$	$CF_3(CF_2)_7SO_2NCH_3$	
EtFOSAA	585	584	419	483	
	$CF_3(CF_2)_7SO_2N(C_2H_5)CH_2COOH$	$CF_3(CF_2)_7SO_2N(C_2H_5)CH_2COO$	$CF_3(CF_2)_7$	$CF_3(CF_2)_7SO_2$	
4:2FTS	350	327	307	81	
	$CF_3(CF_2)_3(CH_2)_2SO_3Na$	$CF_3(CF_2)_3(CH_2)_2SO_3$	$CF_3(CF_2)_3(C)_2SO_2$	HSO_3	
6:2FTS	450	427	407	81	
	$CF_3(CF_2)_5(CH_2)_2SO_3Na$	$CF_3(CF_2)_5(CH_2)_2SO_3$	$CF_3(CF_2)_5(C)_2SO_2$	HSO_3	
8:2FTS	550	527	507	81	
	$CF_3(CF_2)_7(CH_2)_2SO_3Na$	$CF_3(CF_2)_7(CH_2)_2SO_3$	$CF_3(CF_2)_7(C)_2SO_2$	HSO_3	

TABLE 4: Standard Levels

	LC/MS/MS for PFAAs *LEVELS IN PPB											
COMPOUND	ICAL								ICV1	ICV2	SPIKE	ID STD
Perfluorobutanoic acid	1.0	2.0	5.0	10.0	20.0	40.0	50.0	100.0	20.0		20.0	
Perfluoropentanoic acid	1.0	2.0	5.0	10.0	20.0	40.0	50.0	100.0	20.0		20.0	
Perfluorohexanoic acid	1.0	2.0	5.0	10.0	20.0	40.0	50.0	100.0	20.0		20.0	
Perfluoroheptanoic acid	1.0	2.0	5.0	10.0	20.0	40.0	50.0	100.0	20.0		20.0	
Perfluorooctanoic acid	1.0	2.0	5.0	10.0	20.0	40.0	50.0	100.0	20.0	20.0	20.0	
Perfluorononanoic acid	1.0	2.0	5.0	10.0	20.0	40.0	50.0	100.0	20.0		20.0	
Perfluorodecanoic acid	1.0	2.0	5.0	10.0	20.0	40.0	50.0	100.0	20.0		20.0	
Perfluoroundecanoic acid	1.0	2.0	5.0	10.0	20.0	40.0	50.0	100.0	20.0		20.0	
Perfluorododecanoic acid	1.0	2.0	5.0	10.0	20.0	40.0	50.0	100.0	20.0		20.0	
Perfluorotridecanoic acid	1.0	2.0	5.0	10.0	20.0	40.0	50.0	100.0	20.0		20.0	
Perfluorotetradecanoic acid	1.0	2.0	5.0	10.0	20.0	40.0	50.0	100.0	20.0		20.0	
Perfluorobutanesulfonic acid	1.0	2.0	5.0	10.0	20.0	40.0	50.0	100.0	20.0		20.0	
Perfluoropentanesulfonic acid	1.0	2.0	5.0	10.0	20.0	40.0	50.0	100.0	20.0		20.0	
Perfluorohexanesulfonic acid	1.0	2.0	5.0	10.0	20.0	40.0	50.0	100.0	20.0		20.0	
Perfluoroheptanesulfonic acid	1.0	2.0	5.0	10.0	20.0	40.0	50.0	100.0	20.0		20.0	
Perfluorooctanesulfonic acid	1.0	2.0	5.0	10.0	20.0	40.0	50.0	100.0	20.0		20.0	
Perfluorononanesulfonic acid	1.0	2.0	5.0	10.0	20.0	40.0	50.0	100.0	20.0		20.0	
Perfluorodecanesulfonic acid	1.0	2.0	5.0	10.0	20.0	40.0	50.0	100.0	20.0		20.0	
Perfluorooctane sulfonamide	1.0	2.0	5.0	10.0	20.0	40.0	50.0	100.0	20.0		20.0	
N-MeFOSAA	1.0	2.0	5.0	10.0	20.0	40.0	50.0	100.0	20.0		20.0	
N-EtFOSAA	1.0	2.0	5.0	10.0	20.0	40.0	50.0	100.0	20.0		20.0	
4:2 Fluorotelomer sulfonate	1.0	2.0	5.0	10.0	20.0	40.0	50.0	100.0	20.0		20.0	
6:2 Fluorotelomer sulfonate	1.0	2.0	5.0	10.0	20.0	40.0	50.0	100.0	20.0		20.0	
8:2 Fluorotelomer sulfonate	1.0	2.0	5.0	10.0	20.0	40.0	50.0	100.0	20.0		20.0	
MPFAC-24ES Isotope Dilutions STD	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0		20.0
Perfluoro-[1,2-13C2]octanoic acid ISTD	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0		
Perfluoro-1-[1,2,3,4-13C4]octanesulfonic acid ISTD	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0		

$$Mass_{acid} = Mass_{salt} \mathbf{X} MW_{acid}/MW_{salt}$$

MW_{acid} = Molecular weight of PFAA
MW_{salt} = Molecular weight of the salt

APPENDIX D

SOP #1: Sampling for Per- and Polyfluoroalkyl Substances
Standard Operating Procedure

SOP #1: Sampling for Per- and Polyfluoroalkyl Substances Standard Operating Procedure

Table of Contents

1.0 Purpose

The purpose of this Standard Operating Procedure (SOP) is to provide guidance for collecting samples for per- and polyfluoroalkyl substances (PFAS) analysis.

2.0 Scope

This procedure applies to Ahtna Environmental, Inc. (Ahtna) personnel and subcontractors who collect or otherwise handle samples of groundwater for analysis of PFAS. This SOP should be reviewed by all onsite personnel prior to implementation of field activities. This SOP outlines general practices for collecting PFAS samples and provides a summary of unacceptable field and sampling materials (likely to contain PFAS) and acceptable alternatives.

3.0 General Guidance

Because of the potential presence of PFAS in common consumer products and in equipment typically used to collect groundwater samples and the low detection limits associated with laboratory PFAS analysis, special handling and care must be taken when collecting samples for PFAS analysis.

3.1 Field Equipment and Materials

Table 1 provides a summary of items that are likely to contain PFAS (i.e., prohibited items) and that are not to be used by the sampling team at the site, along with acceptable alternatives.

Table 1. Summary of Prohibited and Acceptable Items for PFAS Sampling

Prohibited Items	Acceptable Items
Field Sampling Equipment (pumps, tubing, bailers, etc.)	
Teflon® and other fluoropolymer-containing materials (e.g., Teflon® tubing, bailers, tape; Teflon-containing plumbing paste, or other Teflon® materials). Low-density polyethylene (LDPE)-containing materials. **Note:** The Grundfos Redi-Flo™ submersible pump has a Teflon® impeller and is not recommended for collecting PFAS samples.	High-density polyethylene (HDPE) is preferred; otherwise silicone tubing. HDPE or stainless steel bailers. Peristaltic pumps. Stainless steel submersible pumps (e.g., ProActive stainless steel pumps with PVC [polyvinyl chloride] leads and Geotech Stainless Steel Geosub pumps). Bladder pumps with polyethylene bladders and tubing need to be evaluated on a case-by-case basis because the gaskets and O-rings may contain PFAS. Equipment with Viton components needs to be evaluated on a case-by-case basis. Viton contains polytetrafluoroethylene (PTFE) but may be acceptable if used in gaskets or O-rings that are sealed and will not come into contact with sample or sampling equipment.

Prohibited Items	Acceptable Items
Field Documentation	
Waterproof/treated paper or field books, plastic clipboards, markers (including Sharpies®), Post-It® and other adhesive paper products.	Plain loose paper, metal clipboard, ballpoint pens.
Field Clothing and Laundering	
New clothing. Clothing or boots made of or with Gore-Tex™ or other synthetic waterproof/water resistant and/or stain resistant materials Coated Tyvek® material that may contain PFAS. Clothing laundered using fabric softener.	Synthetic or cotton material, previously laundered more than six times without the use of fabric softeners. Polyurethane and wax-coated materials. Boots made with polyurethane and PVC, well-worn or untreated leather boots. Tyvek® material that is PFAS-free (e.g., uncoated).
Sample Storage and Preservation	
LDPE or glass containers. PTFE or Teflon®-lined caps. Chemical (blue) ice packs.	Laboratory-provided sample containers *preferred*; or HDPE or polypropylene bottles with an unlined plastic screw cap, as specified by the laboratory doing the analysis, regular ice (double-bagged with HDPE or polypropylene bags).
Personal Hygiene (the day of sample collection)	
Cosmetics, moisturizers, hand cream, or other related products.	**Sunscreens –** Alba Organics Natural, Yes To Cucumbers, Aubrey Organics, Jason Natural Sun Block, Kiss My Face, Baby-safe sunscreens that are "free" or "natural." **Insect Repellents –** Jason Natural Quit Bugging Me, Repel Lemon Eucalyptus, Herbal Armor, California Baby Natural Bug Spray, BabyGanics. **Sunscreen and insect repellant –** Avon Skin So Soft Bug Guard – SPF 30.
Rain Events	
Waterproof or resistant rain gear.	Pop-up canopy that is only touched or moved prior to and following sampling activities.
Decontamination	
Decon 90. Water from an onsite well.	Alconox® and/or Liquinox®. PFAS-free laboratory supplied water.
Food and Beverage	
Food and beverages, except as noted under Acceptable Items.	Bottled water and/or hydration drinks (i.e., Gatorade® and Powerade®), only for consumption in the staging area.

For items that are not described in Table 1, the project team must perform a tiered review process for each item as described in Table 2 before such items are brought on site.

Table 2. Tiered Approach to Assist with Field Decisions

Tier and Description	Action
Tier 1: Products that *will come into direct contact* with field samples include, but are not limited to, sampling equipment, sample containers, and well construction materials.	Highest level of scrutiny requiring the Project Chemist's input to evaluate the items as a possible source of PFAS contamination.[1]
Tier 2: Products that will not come into direct contact with samples, but could be reasonably expected to contain PFAS, such as waterproof or nonstick products.	Project team/affected person reviews the Safety Data Sheet (SDS). If it shows PFAS, the product should not be used.[2] If product SDS does not indicate PFAS, confirm with Project Chemist before use.
Tier 3: Products that will not come into direct contact with samples and are not expected to contain PFAS, such as ballpoint pens, zipper bags, and body braces.	Project team/affected person reviews the SDS and if no PFAS, then appropriate to use.

3.2 Personal Protective Equipment

Disposable nitrile gloves must be worn at all times. Further, a new pair of nitrile gloves shall be donned prior to the following activities at each sample location:

1. Decontamination of re-usable sampling equipment.
2. Contact with sample bottles or water containers.
3. Insertion of anything into the well (e.g., tubing, pump, bailer, water level meter).
4. Insertion of silicon tubing into the peristaltic pump.
5. Sample collection upon completion of monitoring well purging.
6. Handling of any quality assurance/quality control samples including field blanks and equipment blanks.

New gloves shall also be donned after the handling of any non-dedicated sampling equipment, contact with non-decontaminated surfaces, or when judged necessary by field personnel. The use of a different colored glove (e.g., bright orange) for the collection of PFAS samples can help provide a visual reminder to prevent cross-contamination.

3.3 Sample Collection Method/Sequence

1. After donning a new pair of nitrile gloves, collect the sample for PFAS ***first***, prior to collecting

[1] It may be necessary to have Tier 1 products analyzed to confirm a specific batch or lot number does not contain PFAS. Alternate products will need to be evaluated/used if PFAS are identified in the product.
[2] To evaluate product SDS and/or manufacturing specs, check if the product contains anything with "fluoro" in the name or the acronyms TPE, FEP, ETFE, and/or PFA. If fluorinated compounds are not listed in the manufacturing specs and/or on the SDS, product can be used.

samples for any other parameters into any other containers. This order of sampling avoids contact with any other type of sample container, bottles, or packaging materials that may have PFAS-related content.

2. Do not place the sample bottle cap on any surface when collecting the sample and avoid all contact with the inside of the sample bottle or its cap.
3. Once the sample is collected, capped, and labeled, place the sample bottle(s) in two re-sealable plastic HDPE or polypropylene bags (e.g., Ziploc®) and place in an appropriate cooler packed only with ice (also double bagged with HDPE or polypropylene bags).

3.4 Samples Collected from Monitoring Wells

The preferred method for collecting samples from monitoring wells is with HDPE HydraSleeve™ samplers (see Field Sampling SOPs, HydraSleeve Field Manual) to limit the potential for cross-contamination. If low flow sampling methods are used, the procedures listed below must be followed:

1. If measuring field parameters using a multi-meter, samples for laboratory analyses must be collected before the flow-through cell and the three-way stopcock. This will be accomplished by disconnecting the three-way stopcock from the pump discharge tubing so that the samples are collected directly from the pump tubing.
2. When feasible, use dedicated single-use or disposable polyethylene or silicone materials (tubing, bailers, etc.) for monitoring well purging and sampling equipment.
3. When reuse of materials or sampling equipment across multiple sampling locations is necessary, follow project decontamination protocols with allowed materials identified in Table 1 and incorporate equipment blanks into the sampling program, as appropriate.
4. When using positive displacement/submersible pump or bladder pump sampling equipment, familiarize yourself with the sampling pump/accessory equipment specifications to confirm that device components are not made of nor contain polytetrafluoroethylene (PTFE, a.k.a. Teflon®) or other PFAS-containing components.

3.5 Samples Collected from Extraction Wells

1. If feasible, avoid contact with any tape or pipe thread paste containing Teflon® on pipe fittings or sampling tap threads that may be present on the water supply discharge pipe.
2. The sample for PFAS will be collected while the extraction well pump is operating and after the pump has been operating for at least one hour.
3. Discharge water will be purged through the sampling tap on the discharge pipe for a minimum of 20 minutes prior to collection of samples.

3.6 Samples Collected from the Groundwater Treatment Plant

1. If feasible, avoid contact with any tape or pipe thread paste containing Teflon® on pipe fittings or sampling tap threads that may be present on sample port.
2. The sample for PFAS will be collected while the groundwater treatment plant is operating and after the groundwater treatment plant has been operating for at least one hour.
3. Discharge water will be purged through the sampling port for a minimum of 20 minutes prior to

collection of samples.

3.7 Decontamination

Decontamination fluids have been viewed as a possible source of equipment cross-contamination. Therefore, more frequent changes of decontamination liquids may be warranted. Refer to Table 1 for prohibited and acceptable decontamination liquids. A final rinse with "PFAS-free" deionized (DI) water is required.

3.8 Wet Weather

1. Field sampling occurring during wet weather (e.g., rainfall and snowfall) should be conducted while wearing appropriate clothing that will not pose a risk for cross-contamination. Sampling teams will avoid synthetic gear that has been treated with water-repellant finishes containing PFAS and use rain gear made from polyurethane and wax-coated materials.
2. Sampling teams should consider the use of a pop-up canopy that can be erected over the sample location and provide shelter from the rain. The canopy material is likely a treated surface and should be treated as such; therefore, nitrile gloves should be worn when moving the canopy, changed immediately afterwards, and further contact with the canopy should be avoided until all sampling activities have been finished and the team is ready to move on to the next sample location.

3.9 Personal Hygiene

1. Field personnel will not use cosmetics, moisturizers, hand cream, or other related products as part of their hygiene routine on the morning of a sampling event, as these products may contain surfactants and are a potential source of PFAS.
2. Many manufactured sunscreen and insect repellants contain PFAS and should not be brought or used on site. Sunscreen and insect repellants that are used on site should consist of 100% natural ingredients. Acceptable sunscreens and insect repellents are listed in Table 1.
3. For washroom breaks, field personnel will leave the exclusion zone and then remove gloves and overalls. Field personnel should wash as normal with extra time for rinsing with water after soap use. When finished washing, the use of a mechanical dryer is preferred, and the use of paper towel for drying is to be avoided (if possible).

3.10 Visitors

An exclusion zone shall be set up around the sample location to keep unauthorized personnel from entering the area and potentially contaminating sampling materials. Visitors to the site shall be instructed to remain outside of the exclusion zone and downwind during sampling activities.

APPENDIX E

SOPs #2 and #3: QAPP Revision 6
Field Sampling Standard Operating Procedures

- SOP #2: *HydraSleeves™ Field Manual*: Geoinsight, 2006 (SOP #3 from QAPP Revision 6; Ahtna, 2018)
- SOP #3: *OU2 and Sites 2/12 GWTSs and OUCTP EISB Extraction Well Sample Handling and Custody Requirements*: Ahtna, 2016 (SOP #5 from QAPP Revision 6; Ahtna, 2018)

HYDRASleeve

Simple by Design

US Patents No. 6,481,300; No. 6,837,120; others pending

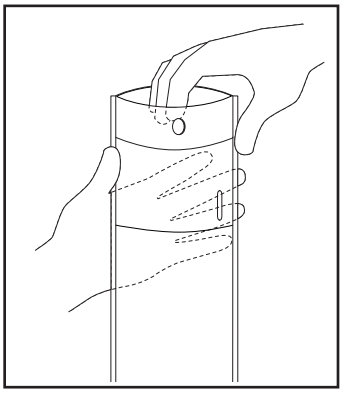
Field Manual

Introduction

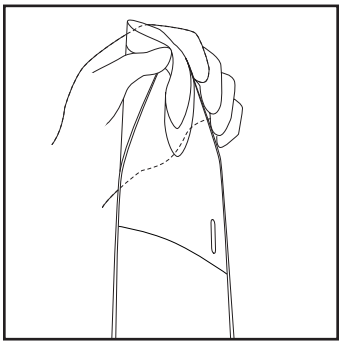
The HydraSleeve groundwater sampler can be used to collect a representative sample for most physical and chemical parameters without purging the well. It collects a whole water sample from a user-defined interval (typically within the well screen), without mixing fluid from other intervals. One or more HydraSleeves are placed within the screened interval of the monitoring well, and a period of time is allocated for the well to re-equilibrate. Hours to months later, the sealed HydraSleeve can be activated for sample collection. When activated, HydraSleeve collects a sample with no drawdown and minimal agitation or displacement of the water column. Once the sampler is full, the one-way reed valve collapses, preventing mixing of extraneous, non-representative fluid during recovery.

Assembly

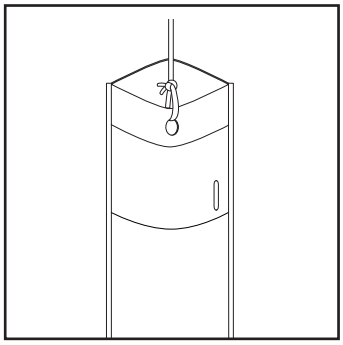
Assembling the HydraSleeve is simple, and can be done by one person in the field, taking only a minute or two.



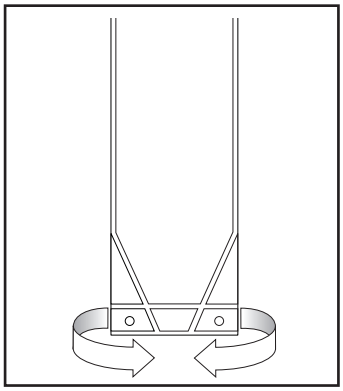
1 Remove HydraSleeve from package and grasp top to "pop" open.



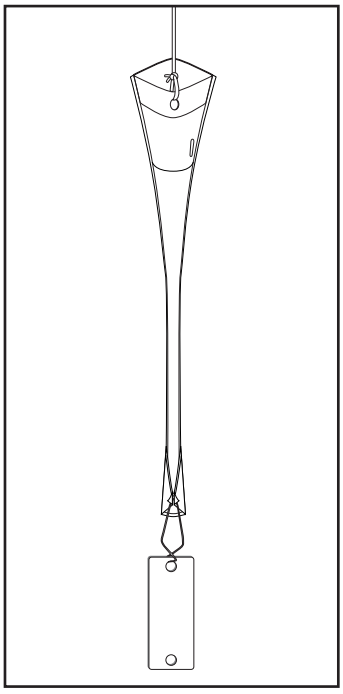
2 Squeeze side fins together at top to bend reinforcing strips outward.



3 Attach line to hole at top of HydraSleeve.



4 Fold the two holes at bottom of HydraSleeve together and attach weight



5 Sampler is ready to insert into the well.

Placing the HydraSleeve(s)

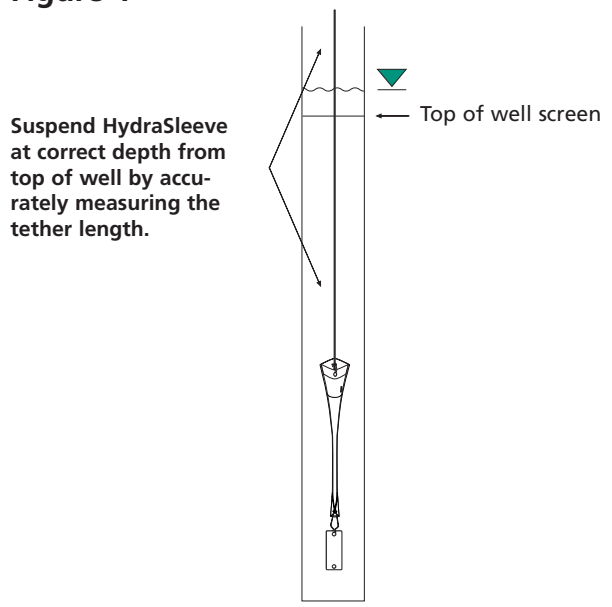
To collect a representative groundwater sample without purging, the well must be allowed time to re-equilibrate after placement of the sampler. When any device is lowered into a well, some mixing of the water column occurs. The diameter of the device and its shape greatly affect the degree of mixing. The flat cross-section of the empty HydraSleeve minimizes the disturbance to the water column as the sampler is lowered into position, reducing the time needed for the well to return to equilibrium.

There are three basic methods for holding a HydraSleeve in position as the well equilibrates.

TOP DOWN DEPLOYMENT (Figure 1)
Measure the correct amount of suspension line needed to "hang" the top of the HydraSleeve(s) at the desired sampling depth (in most cases, this will be at the bottom of the sampling zone). The upper end of the tether can be connected to the well cap to suspend the HydraSleeve at the correct depth until activated for sampling.

Note: For deep settings, it may be difficult to accurately measure long segments of suspension line in the field. Factory prepared, custom suspension line and attachment points can be provided.

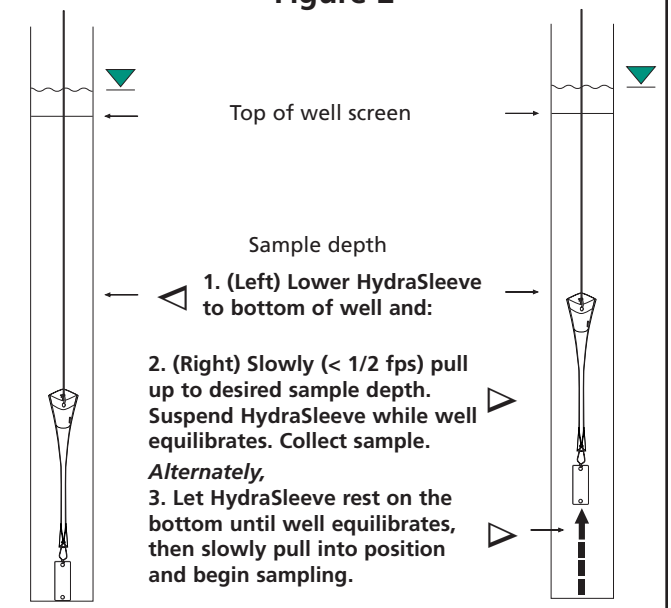
Figure 1



BOTTOM DEPLOYMENT (Figure 2)
Sound the well to determine the exact depth. Lower the weighted HydraSleeve into the well and let it touch the bottom. Very slowly (less than 1/2 foot per second) raise the sampler to the point where the check valve is at the depth the sample is to be collected. Attach the suspension line to the top of the well to suspend it at this depth. (It is often easier to measure a few feet from the bottom of the well up to the sample point, than it is to measure many feet from the top of the well down.)

Alternately, the sampler can be left on the bottom until the well re-equilibrates. For sampling, it can be very slowly pulled (< 1/2 fps) to sampling depth, then activated (see "Sample Collection," p. 6) to collect the sample, and retrieved to the surface.

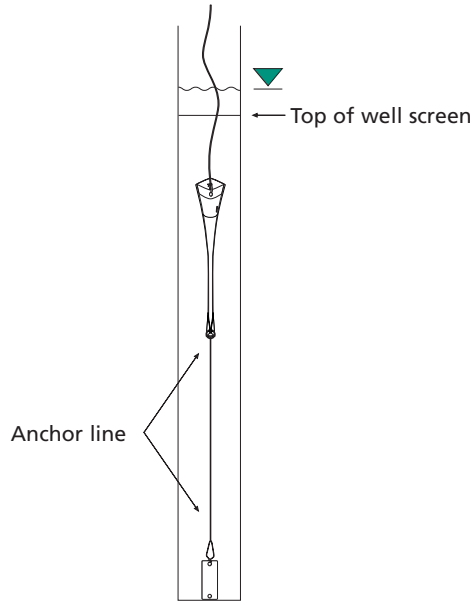
Figure 2



BOTTOM ANCHOR (Figure 3)

Determine the exact depth of the well. Calculate the distance from the bottom of the well to the desired sampling depth. Attach an appropriate length anchor line between the weight and the bottom of the sampler and lower the assembly until the weight rests on the bottom of the well, allowing the top of the sampler to float at the correct sampling depth.

Figure 3



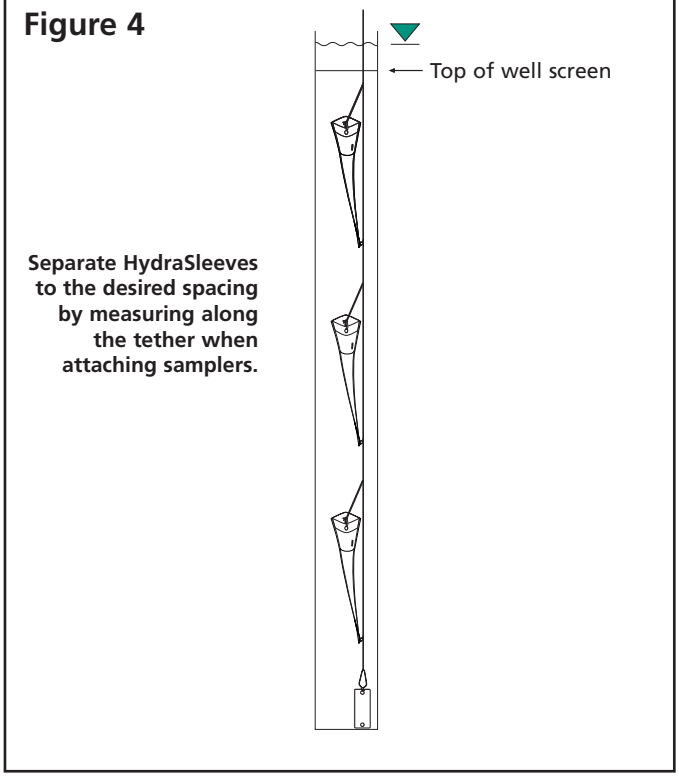
Multiple Interval Deployment

There are two basic methods for placing multiple HydraSleeves in a well to collect samples from different levels simultaneously.

ATTACHED TO A SINGLE TETHER (Figure 4)

To use 3 or more samplers simultaneously, we recommend attaching them all to a tether for support to prevent the sampling string from pulling apart. The weight is attached to a single length of suspension line and allowed to rest on the bottom of the well. The top and bottom of each HydraSleeve are attached to the tether at the desired sample intervals. Cable tie or stainless steel clips (supplied) work well for attaching the HydraSleeves to the line. Simply push one end of the clip between strands of the rope at the desired point before attaching the clip to the HydraSleeve.

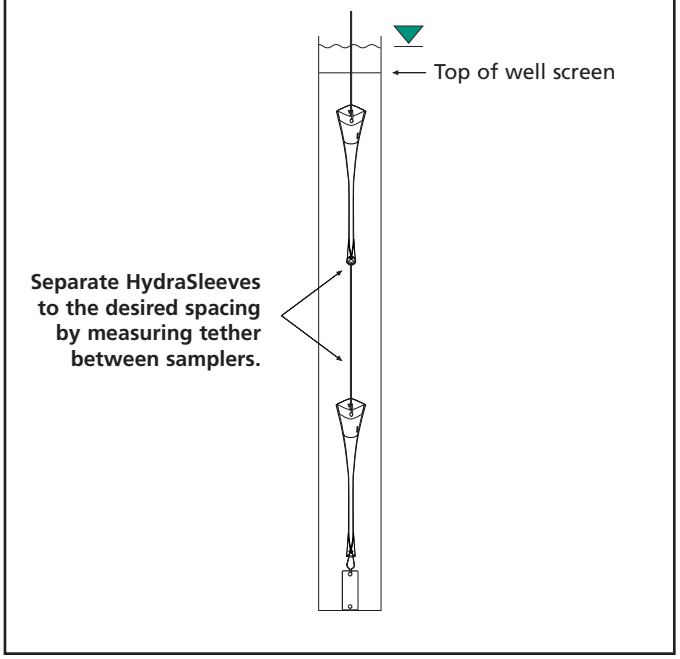
Figure 4



ATTACHED END TO END (Figure 5)

To place 2 or 3 stacked HydraSleeves for vertical profiling, use one of the methods described above to locate the bottom sampler. Attach the bottom of the top sampler to the top of the following HydraSleeve(s) with a carefully measured length of suspension cable. Connect the weight to the bottom sampler. Note: if many HydraSleeves are attached to a tether, more weight may be required than with a single sampler.

Figure 5



Sample Collection

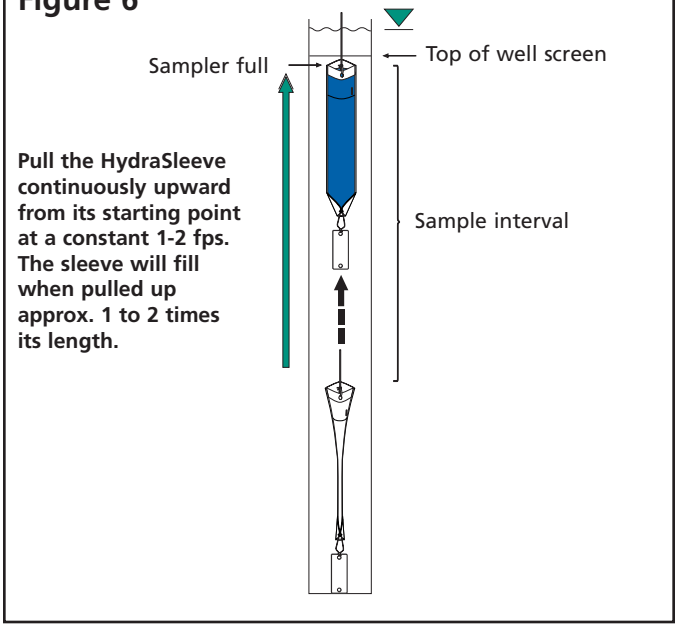
The HydraSleeve must move upward at a rate of one foot per second or faster (about the speed a bailer is usually pulled upward) for water to pass through the check valve into the sample sleeve. The total upward distance the check valve must travel to fill the sample sleeve is about 1 to 2 times the length of the sampler. For example, a 24-inch HydraSleeve needs a total upward movement of 24 to no more than 48 inches to fill. The upward motion can be accomplished using one long continuous pull, several short strokes, or any combination that moves the check valve the required distance in the open position. A special technique is used for sampling low-yield wells.

CONTINUOUS PULL (Figure 6)

Pull the HydraSleeve continuously upward from its starting point at a constant 1 to 2 feet per second until full. This method usually provides the least turbid samples and is analogous to coring the water column from the bottom up.

Note: When using this method, the screen interval should be long enough so the sampler fills before exiting the top of the screen.

Figure 6

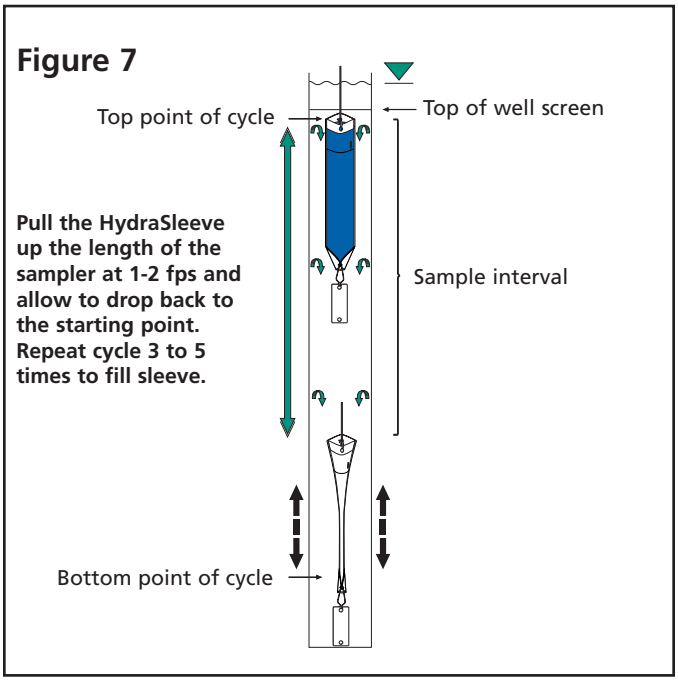


SHORT STROKES (Figure 7)

Pull the sampler upward at about 1 to 2 feet per second for the length of the sampler and let it drop back to the starting point. Repeat the cycle 3 to 5 times.

This method provides a shorter sampling interval than the continuous pull method (above), and usually reduces the turbidity levels of the sample below that of numerous rapid, short cycles (below). The sample comes from between the top of the cycle and the bottom of the sampler at its lowest point.

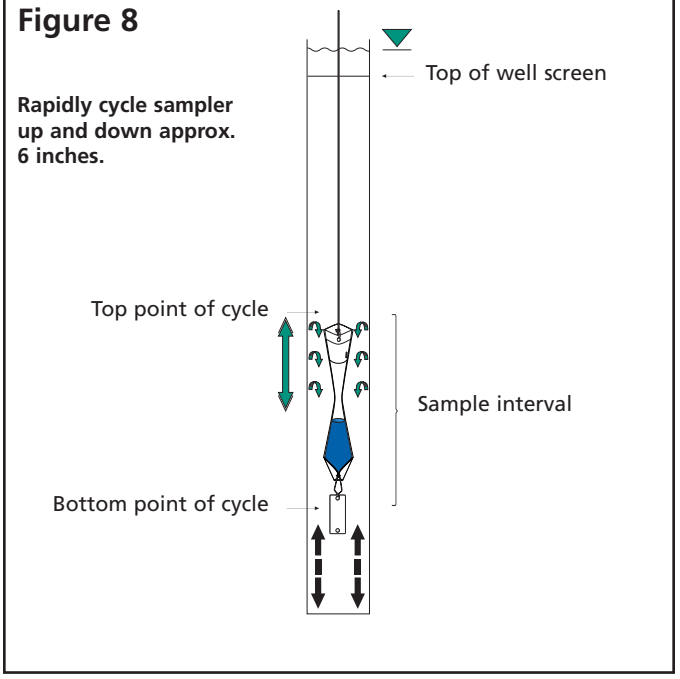
Figure 7



RAPID, SHORT CYCLES (Figure 8)

Cycle the HydraSleeve up and down using rapid, short strokes (6-inch cycle at a minimum of 1 cycle per second) 5 to 8 times. This method provides the shortest sampling interval. Dye studies have shown that when using this method the sample flows into the check valve from along the length of the sampler and immediately above the check valve. The sample interval is from the bottom the sampler at its lowest point in the cycle to the top of the check valve at the peak of the cycle.

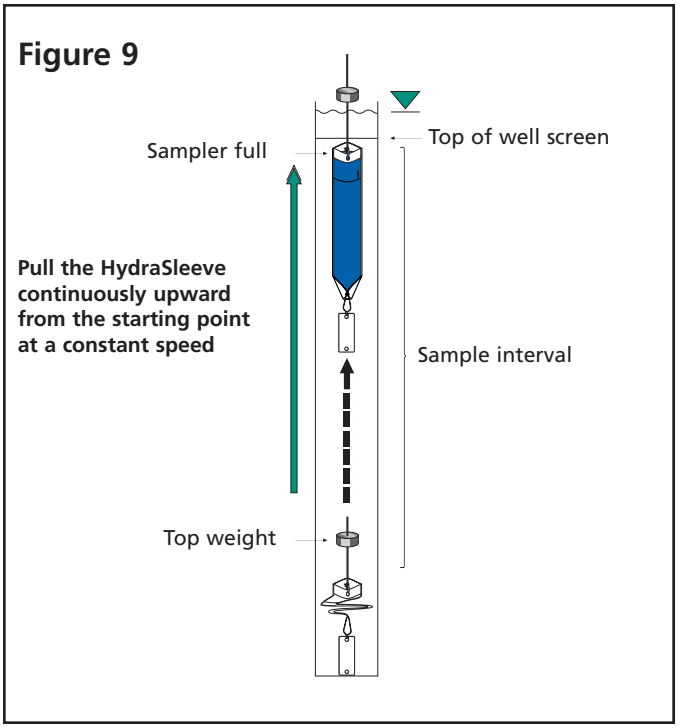
Figure 8



SAMPLING LOW-YIELD WELLS (Figure 9)

HydraSleeve provides the best available technology for sampling low yield wells. When pulled upward after the well re-equilibrates, the HydraSleeve will collect a water core from the top of the sampler to about its own length above that point. The sample is collected with no drawdown in the well and minimal sample agitation. An optional top weight can be attached to compress the sampler in the bottom of the well if needed for an extremely short water column. With a top weight, the check valve is pushed down to within a foot of the bottom of the well.

Figure 9



Sample Discharge

The best way to remove a sample from the HydraSleeve with the least amount of aeration and agitation is with the short plastic discharge tube (included).

First, squeeze the full sampler just below the top to expel water resting above the flexible check valve. (Photo 1, top left)

Then, push the pointed discharge tube through the outer polyethylene sleeve about 3-4 inches below the white reinforcing strips. (Photo 2, middle left)

Discharge the sample into the desired container. (Photo 3, bottom left)

Raising and lowering the bottom of the sampler or pinching the sample sleeve just below the discharge tube will control the flow of the sample. The sample sleeve can also be squeezed, forcing fluid up through the discharge tube, similar to squeezing a tube of toothpaste. With a little practice, and using a flat surface to set the sample containers on, HydraSleeve sampling becomes a one-person operation.

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Attachment A: Standard Operating Procedure (SOP) #5

OU2 and Sites 2/12 GWTSs and OUCTP EISB Extraction Well Sample Handling and Custody Requirements

Table of Contents

1.0 Sample Types

Project samples may be extraction well groundwater samples, Groundwater Treatment Plant (GWTP) process water samples, or quality control/quality assurance samples. Standard operating procedures for the collection of these water samples are described in this document.

1.1 Extraction Well Samples

Extraction well samples (standard field samples) will be generated to evaluate the effectiveness of the remedial action in containing the groundwater contamination plume, removing contaminant mass from the groundwater, and achieving remedial action objectives. Data generated will be applied to decision rules identified in the QAPP to determine operational status and sampling frequency for individual extraction wells.

1.2 GWTP Process Samples

GWTP process samples (standard field samples) will be generated to evaluate the effectiveness and efficiency of GWTP components in removing chemicals of concern (COCs) from extracted groundwater, determining the timing for replacing granular activated carbon (GAC) in the GAC vessels, and maintaining discharge limits for COCs in treated water.

1.3 Quality Control (QC)

Field QC samples will be generated to evaluate the precision, accuracy, and integrity of field sampling and laboratory analytical procedures. Quality control samples are introduced into the sample analysis stream along with environmental samples. The frequency of field QC sample generation is based on project Data Quality Objectives (DQOs), as well as the total number of samples submitted and the nature and intensity of the investigative process that is being monitored or evaluated. The following QC samples will be employed during the field program.

1.3.1 Trip Blanks

Trip blanks are prepared by the laboratory using contaminant-free water (e.g., nitrogen purged deionized water) which is poured into Volatile Organic Analysis (VOA) vials and shipped to Ahtna Environmental Inc. (Ahtna) by the laboratory. The laboratory also provides pre-cleaned and hydrochloric acid (HCl) acid-preserved sample containers for collecting water samples for Volatile Organic Compound (VOC) analysis. Trip blanks will accompany sample containers into the field and will be shipped back to the laboratory with every cooler that contains samples for VOC analyses. Trip blanks will be analyzed for all VOC analytes specified for environmental samples in the corresponding cooler.

1.3.2 Field Duplicate Samples

Duplicate samples are submitted to the contract laboratory for the purpose of assessing the effect of the sample matrix on analytical measurement precision.

The laboratory will not be informed as to the identity of duplicate samples and no special sample handling protocol will be employed during collection, shipment, or analysis of these samples. These “blind” duplicate samples will be submitted and analyzed on a frequency of one in ten of the total

environmental sampling effort for each matrix sampled. Areas of known contamination or critical sampling points may be preferentially selected for submittal as blind duplicates. Duplicate samples will be analyzed for the same parameters as the corresponding primary sample.

2.0 Field Documentation

Field activities and sample collection will be documented using the following forms and information as appropriate: sample label, chain of custody form, groundwater sampling form, well completion details, well development form, cooler receipt form, waste management label, and hazardous waste label. The purpose of standardized field documentation and sampling procedures is to maintain integrity of field documentation and field samples throughout the remediation process. Each field sample will be labeled and sealed immediately after collection. Sample identification documents will be carefully prepared to maintain control of sample disposition. Field sample custody procedures are described in Section 4.1. Standard procedures for documentation of field activities are presented below.

2.1 Field Logbooks

Field procedures relevant to sample collection and field activities will be recorded daily in permanently bound notebooks. Each individual in the field will maintain a bound field logbook with serially numbered pages. The logbook is signed and dated prior to daily initiation of field work. If logbook duties are transferred, the individuals relinquishing and receiving will both sign and date the logbook and record the transfer time. Logbook corrections are made by a single line strikeout of the incorrect entry and entering the correct information that is initialed by the person making the entry. If the correction is made at a later time or date, the correction date is also entered. Unused partial or whole logbook pages are crossed out and unused pages signed and dated at the end of each workday. All entries must be legible, in ink, and primarily factual in content. Hypothetical information can be entered but should be noted accordingly. Logbook entries may include the following information as necessary:

- Project name and number.
- Site name and location.
- Arrival and departure date/time.
- Name and affiliation of personnel onsite (including site visitors), and personnel contacted.
- Author name and date.
- Field instrument calibration methods and identification number.
- Chronology and location of activities.
- Sampling locations.
- Sample identification numbers, amount collected, sampling method and container (size/type) for each sample collected, including QC samples. Sample processing techniques such as filtration, compositing, and preservation techniques should be noted. Alternatively, this information may be contained on the COC form, groundwater sampling form, or other field form. The logbook will then contain a unique identifier linking the field log book entry to the field form.
- Date and time of sample collection, name of sampler.
- Field observations including weather conditions and applicable comments.

- Number of shipping coolers packaged and sent.
- Name and address of all receiving laboratories.
- Any modifications or deviations from quality assurance project plan.

Written reports of all significant non-routine events for field and laboratory work will be sent to the USACE Contracting Officer within 48 hours of occurrence. These reports will identify the problem, corrective action, and verbal written instructions from the USACE Project Manager (PM) to Ahtna regarding corrective action. Significant non-routine events are occurrences that impact cost of work, work schedule, work quality, and analytical data quality.

2.2 Sample Identification and Labels

2.2.1 Sample Identification

Two sample identifiers, the sample number and the station number, will be used to designate samples and sampling locations. Sample numbers will be used for coding, tracking, and reporting chemical data. Station numbers will encode sample type, site identification, and boring number or monitoring well sequence. Conventions for generating sample and station numbers are presented below.

The sample number is a coded identification designed to satisfy project and database criteria. Each sample number:

- Will contain up to 12 characters.
- Will be unique.
- Will be traceable to a specific sampling event.
- Will be traceable to a specific sampler.
- Will incorporate a specific site designation.
- Will not obviously indicate to the laboratory the sample depth, station number, or type of sample (i.e., original sample and duplicate).

All chemical data produced by the contract laboratory will be reported using the sample number. Samples will be numbered as follows (no spaces in actual sample numbers):

YR WK X SSS 000 Z

Where:

YR = Calendar year

WK = Week of the year

X = One-letter ID code assigned to each field sampler

SSS = Three-character site identification code: “OU2” or “212”

000 = Three-digit sequence number for each sample

Z = Assigned QC sample code

Assigned sample QC codes are as follows:

- A = Trip blank

- B = Not used for groundwater treatment system (GWTS) sampling
- C = Not used for GWTS sampling
- D = Field duplicate
- E = Not used for GWTS sampling
- F = Standard field sample

For example, sample number 1704M212015A represents the fifteenth sample collected by sampler "M" and is a trip blank (QC code A) collected at Sites 2/12 during Week 4 of 2017. Each sample collector will start with sequence number 001 and continue consecutively through 999. Field personnel are responsible for keeping track of their own sequence in the field logbook. Field audits will include checks of this sample numbering system to ensure that correct procedures are being followed.

Week numbers are assigned to week-long periods ending on Friday. For example, Week 4 of 2017 is the week ending January 27, 2017. Week numbers below 9 must contain a zero (i.e., 01 through 08). For aqueous samples, multiple sample containers for each discrete sample may be required to fulfill analytical requirements. In these instances, the same sample number will be used on all sample containers.

The station description is a sequence of characters designed to identify site-specific samples. Station descriptions will not be included on the laboratory copy of the chain of custody form. The station description field on the chain of custody form will be used to record the site, sample type, sequence number, and other relevant sample characteristics.

The convention for station description naming is as follows:

ST-SSS-000-XXX

Where:

ST = Sample type

SSS = Three-character site identification code (same as for sample numbering scheme)

000 = Station number unique to each station

XXX = Sample depth or aquifer

Station description names will not include spaces. Example sample type codes are as follows:

- EW = Extraction well
- MP = Multi-port well
- MW = Monitoring well
- SG = Soil gas
- SL = Sludge
- PZ = Piezometer
- TS = Treatment system
- WW = Wastewater
- VE = Vapor extraction

Sample depth may indicate the actual depth the sample was collected relative to ground surface or top of well casing (e.g. the pump intake depth), the port the sample was collected from in a multi-port well, or the aquifer the sample was collected from. Example sample depth codes for aquifers at the former Fort Ord are as follows:

- A = A-Aquifer
- 180 = Upper or Lower 180-Foot Aquifer

For example, station name EW-OU2-13-A represents an extraction well station 13 at the OU2 site with a sample depth in the A-Aquifer.

2.2.2 Sample Label

All samples will be properly labeled to prevent misidentification of samples. Preprinted sample labels will be provided. The label will be affixed to the sample container prior to transportation to the laboratory and will contain the following information:

- Project name, number, and location
- Site name
- Name of collector
- Date and time of collection
- Sample identification number
- Preservative, if any
- Requested test methods or analyses

2.3 Chain of Custody Record

A chain of custody (COC) record will be filled out for and will accompany every sample to the analytical laboratory for documentation of sample possession from the time of collection to sample receipt. A carbonless copy of the chain of custody form will be retained in the investigation files according to project number. The primary laboratory will upload copies of the cooler receipt forms and associated chain of custody forms to its LabLink website for review by the Project Chemist within 24 hours of sample receipt. The forms will contain the following information:

- Sample number or identification
- Name and signature of collector, sampler, or recorder
- Name, number, and location of project
- Project manager's name
- Date of collection
- Place of collection (station description)
- Sample type
- Analyses requested
- Dates and times of possession changes

- Signature of persons relinquishing and receiving sample
- Laboratory sample number, where applicable
- Date and time of laboratory sample receipt

2.4 Transfer and Review of Field Documentation

During site-specific field operations, copies of each field logbook page will be telefaxed or hand delivered to the Task Manager on a daily basis. In the absence of a facsimile, field staff will be in contact with the Task Manager, via mobile telephones.

At the end of each week of field operations, all field documentation will be copied, and originals sent to the Task Manager or Project Manager for review and verification. Original field documents will be kept in the project files. Verification and review of field documentation will include at a minimum, the following checks:

- Consistency of dates and times of activities; among the various field records and forms
- Consistency of sample location and identification documentation among the various field records and forms
- Accuracy and correctness of well completion details
- Correctness of sample preservation techniques

Errors or inconsistencies identified during the review process will trigger a nonconformance investigation to be conducted by the Project Chemist or Quality Control System Manager (QCSM). Appropriate corrective action will be implemented and documented if systemic errors are identified.

3.0 Groundwater Sampling

This section describes groundwater sampling procedures to be followed prior to, during, and after groundwater sample collection from monitoring wells. Procedures for collecting grab groundwater samples are described at the end of this section.

3.1 Sampling Preparation

Prior to sampling, the well vault or GWTS process sampling port will be examined for signs of tampering or deterioration and observations noted. After a well vault is opened, the Activity Hazard Analysis (AHA) may call for the air in the wellhead vicinity to be tested for organic vapors with the Photo Ionization Detector (PID) or Flame Ionization Detector (FID) and/or for explosive atmospheres with an oxygen/combustible gas indicator (see Appendix E of the Site Safety and Health Plan). Results will be recorded in the field notebook. (Note: well vault air testing is not required for routine groundwater sampling as long as previous results indicate that organic vapors or explosive atmosphere are not present). All measuring and sampling equipment will be decontaminated prior to use in any well (see Section 3.5).

Extraction wells that are not normally operated will be run to purge a minimum of three well volumes prior to sample collection. Pumped purge volumes will be estimated using the flow meter in the well vault. The volume of water purged and the withdrawal rates will be recorded. Purge rates will be sustainable and executed at a rate that minimizes drawdown to prevent water from cascading into the

well. Prior to sample collection, ports for extraction well and process sampling will be purged with the port valve completely open for a minimum of 1 minute to ensure stagnant water and any foreign matter or debris are discharged so a representative sample may be collected.

If a well is purged dry before three casing volumes have been removed, VOC samples will be collected immediately. Other samples will be taken after the well has recovered to within 80 percent of the static water level prior to purging, or after 4 hours, or when sufficient water volume is available to meet analytical requirements, whichever occurs first.

Pre-cleaned sample containers will be provided by the laboratory. The containers for each sample will be labeled in advance of the sampling event with the date, sample number, project name, sampler's name or initials, parameters for analysis (method numbers where possible), and preservation.

3.2 Sampling Procedures

After purging, samples will be collected using designated sampling ports in extraction well vaults or designated GWTS process sampling ports. Water samples will be collected carefully by discharging directly from the sample port to the appropriate sample containers.

Water samples for VOC analysis will be collected in VOA vials, which will be filled by inserting the sample port spout to the bottom of the VOA vial and keeping the spout beneath the surface of the liquid as it fills the vial until there is a convex meniscus over the neck of the bottle. The Teflon side of the septum (in the cap) will be positioned against the meniscus, and the cap screwed on tightly; the sample will be inverted, and the vial tapped lightly. The absence of an air bubble indicates a successful seal; if a bubble is evident, the sample will be discarded and the process repeated.

All sample bottles and equipment will be kept away from fuels and solvents. Gasoline (used in generators) will be transported in a different vehicle from the vehicle containing sampling equipment, sample bottles, etc. If possible, one person should be designated to handle samples and another person should operate the generators and refuel equipment, if required. Disposable gloves will be worn for each separate activity and then properly disposed. Care will be taken to avoid fuel spillage.

All samples will be packaged and transported appropriately, as described in Section 4.3.

3.3 Water-Level Measurement

The methods presented below are intended to produce water-level measurements that are consistent over multiple measurement events. Calibration and precision requirements for water-level measurements are summarized in Section 3.4.

Groundwater levels may be measured using an electrical sounder, a steel tape, or a pressure transducer. All water-level measurements will be taken from an obvious survey mark at the top edge of the well casing. Water levels will be measured using the following procedures.

Electrical Sounder

The standard equipment for making individual water-level measurements will be a battery-powered sounder. The sounder must have firmly affixed or permanent marks on the sounder line at regular intervals (minimum interval of 0.01 foot).

Calibration checks on the electrical sounder will be made periodically. The sounder markings will first be checked for the proper spacing by physically comparing the spacing with a graduated steel tape. Accuracy rechecks will be made after any incident that might alter the measuring capability of the instrument, such as cable stretching, entanglement, or sensor tip replacement.

Portions of the cable that are inserted in wells will be decontaminated after use according to the procedure described in Section 3.5. Sounders will be maintained in a clean and functional condition.

Steel Tape

A graduated steel tape (with 0.01-foot graduations) can be used for water-level measurements in conjunction with other methods and, when required, for a quality control check of other methods. The steel tape will be periodically checked for kinks, and if kinked tapes are found, the tape will be labeled as unusable and taken out of service. Portions of the tape that are inserted in wells will be cleaned after use according to the procedure described in Section 3.5. Tapes will be maintained in a clean and functional condition.

3.4 Sampling Equipment Calibration Procedures

Included is a description of the procedure or a reference to an applicable standard operating procedure, the calibration frequency, and the calibration standards used. All instruments and manufacturers' instructions and specifications are maintained in the project files. All instruments are calibrated prior to being sent to the field. Field calibration procedures will be documented in the Field Logbook.

Water-Level Measurement Instruments

Electrical sounder: Checked against steel surveyor's tape prior to initial use. Battery and sensitivity checked daily.

Graduated steel tape: Referred to new steel tape; manufacturer-supplied temperature correction is applied if appropriate for field conditions.

Pressure transducer: Factory calibrated once, in-house calibration checked with water columns prior to aquifer tests, and weekly field checks made against steel tape or electrical sounder.

3.5 Decontamination Procedures

All reusable equipment that may come in contact with potentially contaminated soil, sediment, or water will be decontaminated prior to use to reduce the potential for cross-contamination during field activities. Decontamination will consist of steam cleaning (high pressure, hot water washing); non-phosphate detergent wash; solvent rinse; distilled, deionized (DI), or clean water rinse; pesticide-grade methanol rinse; and final rinse with DI water, as appropriate.

The procedures for decontaminating sampling equipment are described below:

- Wash steel tapes, well sounders, transducers, and water quality probes in a non-phosphate detergent solution, and rinse in distilled or DI water, or wipe clean after each use, depending upon site conditions. Clean the portion of these devices inserted into wells with a mild non-phosphate detergent solution.

4.0 Sample Handling Procedures

Appropriate sample handling techniques are necessary to protect the samples and maintain sample custody protocol requirements following collection. Sample handling includes custody, container/preservative type, transfer, storage, and disposal.

4.1 Field Sample Custody

Standardized sample custody procedures will be followed through sample collection, transfer, storage, analysis, and ultimate disposal. Sample custody begins with shipment of the empty sample container sent to the office or site. All sample containers are shipped from the laboratory in sealed containers or cartons with appropriate seals and custody information. Sample quantities, types, and locations will be specified before the actual field work commences.

A sample is considered under custody if one or more of the following criteria are met:

- The sample is in the sampler's possession
- The sample is in the sampler's view
- The sample is in a designated secure area after being in the sampler's possession

4.2 Sample Containers and Preservation

Samples should be collected and containerized in order of the analyte volatilization sensitivity. A preferred collection order is listed below:

- Volatile organic compounds
- Sulfate and chloride

Methods of sample preservation are intended to retard biological action, retard hydrolysis, and reduce sorption effects. Preservation methods are generally limited to pH control, chemical addition, refrigeration, and protection from light.

All sample containers will be properly labeled (see Section 2.2) and monitored for temperature control in the field and during laboratory transport and storage. Temperature blanks will be used in all coolers containing samples requiring preservation at reduced temperature (4°C).

4.3 Sample Transfer and Shipment

Samples will always be accompanied by a chain of custody record. When transferring samples, both the individuals relinquishing and receiving the samples will sign, date, and note the transference time on the chain of custody record. Samples will be packaged properly for shipment, including isolation of samples suspected of high chemical concentrations, and dispatched to the appropriate laboratory for analysis. Custody seals will be used when samples are shipped via courier service, and must be placed on the container so that the seals have to be broken before the container can be opened. The seal must be signed and dated by the field personnel. Custody seals are not deemed necessary when the samples will be in the continuous possession of project, field, or laboratory personnel. The chain of custody record(s) will accompany each sample shipment. Samples will be packaged for shipment as follows:

- Print the following information clearly in waterproof ink on the label; the test methods requested, the

preservative(s) used (if any), the sample number, the project number, the initials of the sample collector, and the date and time the sample was collected.

- Fill out field sample log and chain of custody record as described in Sections 1.2.1 and 1.2.3, respectively.
- Place each sample bottle or set of VOA vials in a separate plastic bag and seal the bag. Squeeze air from the bag before sealing.
- If using a plastic cooler as a shipping container, tape shut the drain plug from the inside and outside, and line the cooler with a large plastic bag. If sample containers are glass, place approximately 3 inches of inert packing material, such as asbestos-free vermiculite, perlite, or Styrofoam beads in the bottom of the container or wrap the sample containers in other appropriate protective packing material (e.g., bubble wrap. Other commercial shipping containers (cardboard or fiber boxes complete with separators and preservatives) may be used but should be preapproved by the USACE.
- Place the bottles upright in the lined plastic cooler and position to avoid contact during shipment. Cardboard separators may be placed between the bottles at the discretion of the shipper.
- Transport all samples to the laboratory on ice chilled to 4°C ± 2°C.
- Place additional inert packing material in the cooler to partially cover the sample bottles (more than halfway). If samples are required to be shipped to the laboratory with ice, place ice in double bags around, among, and on top of the sample bottles, fill the cooler with inert packing material, and tape the liner shut.
- Place paperwork going to the lab inside a plastic bag. Seal the bag and tape to the inside of the cooler lid. Include the original of the COC form in the paperwork sent to the laboratory. The last block on the COC form should indicate the over-night carrier and air bill number, if applicable. Fill out the air bill before the samples are handed over to the carrier. Notify the laboratory if the shipper suspects that the sample contains any other substance that would require laboratory personnel to take additional safety precautions.
- Close the cooler and tape it securely shut.
- Place at least two signed custody seals on the cooler, one on the front and one on the side. Additional seals may be used if the sampler or shipper deems necessary. Affix "fragile" and "this end up" labels on coolers, as appropriate.
- Samples may be hand delivered to the laboratory, transported by commercial or laboratory couriers, or shipped to the laboratory using an overnight shipper.

4.4 Laboratory Custody

A designated laboratory sample custodian will accept custody of the samples and verify that the information on the sample label matches that on the chain of custody form(s). Pertinent information as to sample condition, shipment, pickup, and courier will also be checked on the chain of custody form(s). In addition, a Cooler Receipt Form (e.g., cooler receipt form) will also be completed by the custodian and copies will be sent to the project chemist within 24 hours of sample receipt. On receiving samples at the laboratory, the temperature inside the cooler and of the temperature blank will be measured immediately after opening the cooler and the results recorded on the cooler receipt form. Information on

the date and time of receipt, method of shipment, and sample condition also will be recorded on this form. The custodian will then enter the appropriate data into the laboratory sample tracking system. The laboratory custodian will use the sample number on the sample label as well as assign a unique laboratory number to each sample. The custodian will then transfer the sample(s) to the proper analyst(s) or store the sample(s) in the appropriate secure area.

Laboratory personnel are responsible for the care and custody of samples from the time they are received through sample disposal. Data sheets and laboratory records will be retained by the laboratory as part of the permanent documentation for a period of at least 3 years.

APPENDIX F

Responses to Comments on the Draft QAPP

Responses to Comments submitted by the U.S. Environmental Protection Agency (USEPA)[1]

GENERAL COMMENT 1: On July 13, 2018, California issued drinking water notification levels of 14 parts per trillion (ppt) for Perfluorooctanoic Acid (PFOA) and 13 ppt for Perfluorooctane Sulfonate (PFOS) (https://www.waterboards.ca.gov/press_room/press_releases/2018/pr071318_pfoa_nl.pdf); however, the Draft Quality Assurance Project Plan, Former Fort Ord, California, Volume 1, Appendix A, Addendum No. 1, Perfluorooctanoic Acid and Perfluorooctane Sulfonate Sampling and Analysis, Operable Unit 2, Former Fort Ord, California, dated September 28, 2018 (Addendum No. 1) does not reference the notification guideline. It should be noted that the notification guideline requires that if testing is conducted and the levels are exceeded, then water agencies are required to report the results to their governing boards and to the California State Water Board. Please revise Addendum No. 1 to reference the notification guideline and the reporting requirements.

RESPONSE TO GENERAL COMMENT 1: *Addendum No. 1 was not revised per the comment. Per the California guidelines, the notification requirement only applies to "local water agencies." The U.S. Department of the Army (Army) does not own or operate any water supply system at the former Fort Ord. As stated in Worksheet #11, the purpose of this groundwater sampling effort is only to screen for the presence of PFOA and PFOS in groundwater associated with Operable Unit 2 (OU2) at the former Fort Ord to determine the need for further action.*

GENERAL COMMENT 2: The Addendum No. 1 text includes several references to United States Environmental Protection Agency (USEPA) Method 537; however, Section 1.2.1 of Appendix C (Analysis of Per- and Polyfluoroalkyl Substances by LC/MS/MS and Isotope Dilution, Standard Operating Procedure) indicates that the method utilized is adapted from USEPA Method 537 and modified for the analysis of environmental water and soil samples per Department of Defense (DoD) Quantity Systems Manual (QSM) 5.1 Table B-15. Please revise Addendum No. 1 text to clarify that modified USEPA Method 537 is being utilized rather than USEPA Method 537.

RESPONSE TO GENERAL COMMENT 2: *Addendum No. 1 was revised per the comment.*

GENERAL COMMENT 3: The sampling rationale presented in Section 4.1.2 does not provide sufficient information to ensure that potential PFOA and PFOS releases from the Fort Ord Landfills will be properly characterized. While the rationale states that monitoring wells were selected for sampling "based on the distribution of [Operable Unit] OU2 [contaminants of concern] COCs in groundwater at concentrations above their respective aquifer cleanup levels," the rationale does not address groundwater flow direction and the monitoring wells' locations downgradient of the Fort Ord Landfills (source areas). In addition, the groundwater flow direction and the locations of the Fort Ord Landfills are not included on Figures 2 (OU2 A-Aquifer Well Sampling Locations) or 3 (OU2 Upper 180-Foot Aquifer Well Sampling Locations). Please revise Section 4.1.2 to describe the locations of the monitoring wells with respect to the Fort Ord Landfills and groundwater flow direction to demonstrate that the monitoring wells will provide a proper characterization of potential PFOA and PFOS releases from the landfills. In addition, revise Figures 2 and 3 to include the groundwater flow direction.

[1] In a letter dated October 29, 2018 (see Administrative Record No. OU2-715.2).

RESPONSE TO GENERAL COMMENT 3: *Note that this QAPP is an addendum to Appendix A of the* Quality Assurance Project Plan, Superfund Response Actions, Former Fort Ord, California, Volume I*. Please refer to Appendix A (also referred to as "QAPP Revision 6" in Addendum No. 1) Worksheets #10, #11 and #13 for the information requested in the comment.*[2]

GENERAL COMMENT 4: The Standard Operating Procedure (SOP) numbers listed in Worksheet #s 17a, 17b and 21 for field sampling are not consistently numbered/referenced in the attachments. For example, SOP #3 is listed as the PFOA/PFOS sampling SOP in Worksheet #21, yet this SOP is not labeled as a number in Appendix D. Also, the SOPs for "OU2 and Sites 2/12 [Groundwater Treatment Systems] GWTSs and OUCTP EISB Extraction Well Sample Handling and Custody Requirements" are listed in Appendix E as SOP #5, yet SOP #5 is not included in Worksheet #s 17a, 17b and 21. Please revise the SOP numbers so that they are consistent between the worksheets and the associated attachments.

RESPONSE TO GENERAL COMMENT 4: *Addendum No. 1 was revised per the comment.*

SPECIFIC COMMENT 1: Section 3.2.2, Step 2: Identify the Goals of the Study, Page 12: Section 3.2.2 states, "Does the OU2 groundwater treatment plant (GWTP) effectively remove PFOA/PFOS from groundwater;" however, Section 3.2.2 does not define "effectively." As such, it is unclear what will constitute effective removal of PFOA/PFOS from groundwater by the OU2 GWTP. Please revise Section 3.2.2 to clarify what will constitute effective removal of PFOA/PFOS from groundwater by the OU2 GWTP.

RESPONSE TO SPECIFIC COMMENT 1: *Addendum No. 1 was revised to "Does the OU2 groundwater treatment plant (GWTP) effectively remove PFOA/PFOS from groundwater (i.e., are concentrations of PFOA/PFOS at the GWTP effluent less than concentrations at the GWTP influent [if detected] and by how much?)?"*

SPECIFIC COMMENT 2: Section 3.2.4, Step 4: Define the Boundaries of the Study, Page 13: Section 3.2.4 defines the study boundaries (e.g., overall geographic boundary, lateral boundary); however, these study boundaries are not identified on Figures 2 (OU2 A-Aquifer Well Sampling Locations) and 3 (OU2 Upper 180-Foot Aquifer Well Sampling Locations). Please revise Figures 2 and 3 to locate the study boundaries.

RESPONSE TO SPECIFIC COMMENT 2: *The study boundaries are sufficiently identified for the purposes of Addendum No. 1 in Figure 1. Addendum No. 1 was not revised per the comment.*

SPECIFIC COMMENT 3: Section 3.2.7, Step 7: Develop the Plan for Obtaining Data, Pages 13-14: Section 3.2.7 discusses the collection of samples from monitoring wells but does not discuss the collection of samples from the GWTP. Please revise Section 3.2.7 to clarify how samples will be collected from the GWTP.

RESPONSE TO SPECIFIC COMMENT 3: *Addendum No. 1 was revised to add "GWTP samples will be collected using designated GWTP process sampling ports to discharge water directly from the sample port to the appropriate sample containers."*

[2] See Administrative Record No. BW-2785F.

SPECIFIC COMMENT 4: Section 3.3, Worksheet #12: Measurement Performance Criteria, Page 16: The Accuracy/Precision section in Worksheet #12 table lists analyte recoveries from SOP #MS019.2. SOP #MS019.2 states in Section 9.5.2 that recoveries must fall within established control limits. Please clarify if the values in Worksheet# 12 are the established in-house laboratory-derived limits.

RESPONSE TO SPECIFIC COMMENT 4: *Addendum No. 1 was revised to include a footnote in Worksheet #12 in the Accuracy/Precision section stating the recoveries are established in-house laboratory-derived limits.*

SPECIFIC COMMENT 5: Section 3.5.7, Data Types, Page 20: Section 3.5.7 indicates that data will be validated by Ahtna; however, Section 3.5.14 (Data Review Tasks) indicates that data will be validated by Ahtna or Wood. Please revise Addendum No. 1 to clarify the company that will validate the data.

RESPONSE TO SPECIFIC COMMENT 5: *Section 3.5.7 was revised to be consistent with Section 3.5.14.*

SPECIFIC COMMENT 6: Section 3.6, Worksheet #15: Laboratory-Specific Detection/Quantitation Limits, Page 23: The limit of quantitation (LOQ) listed for PFOA in Worksheet #15 is not consistent with the information provided in the laboratory SOP. Section 1.1.3 of SOP FN: MS019.2 Rev. Date: 04/2018 (Appendix C) states "The Lower Limit of Quantitation (LLOQ) or Reporting limits (RL) are based on the extraction procedure and the lowest calibration standard. LLOQs may vary depending on matrix complications and volumes. LLOQs for this method are 1-4 µg/L for direct inject aqueous samples, 0.010-0.040 µg/L for SPE extracted aqueous samples and 1.0-4.0 µg/Kg for solid samples. Solid matrices are reported on a dry weight basis." According to Worksheet #15, the achievable Laboratory Limit in µg/L for the LOQ is 0.008 µg/L for PFOA, which is below method range of 0.010-0.040 µg/L, per the SOP. Please provide clarification for this inconsistency.

RESPONSE TO SPECIFIC COMMENT 6: *The laboratory SOP MS019.2 range of LLOQ limits are a holdover from an earlier version of the SOP. The SOP is expected to be updated next year; therefore, Addendum No. 1 was revised to note the discrepancy between Worksheet #15 and the laboratory SOP and to clarify the LOQ listed for PFOA in Worksheet #15 is the correct one.*

SPECIFIC COMMENT 7: Section 4.1.1, Worksheet #17a: OU2 GWTP PFOA/PFOS Screening, Page 24: Section 4.1.1 states, "Sample will be collected from the effluents of whichever GAC [granular activated carbon] vessels are in the lead positions for GAC Train #1 and GAC Train #2 at the time of the sampling event;" however, information regarding when the last GAC change-out occurred along with the quantity of water that the units have processed at the time of sampling should be documented. These factors influence the effectiveness of the GACs in treating PFOA and PFOS. Please ensure that information regarding when the last GAC change-out occurred along with the quantity of water that the units have processed at the time of sampling are documented.

RESPONSE TO SPECIFIC COMMENT 7: *Note this is a new GWTP that has not processed any extracted groundwater. GAC is scheduled to be placed in the GAC vessels the week of November 5, 2018 and groundwater extraction and treatment operations are scheduled to begin November 26, 2018. As noted in Section 3.5.16, a technical memorandum reporting sampling and analytical results will be issued in February 2019. Per the comment, the technical memorandum will note the volume of groundwater processed at the time of sampling.*

SPECIFIC COMMENT 8: Section 5.0, Worksheets #19 & #30: Sample Container, Preservation, and Hold Times, Page 27: Worksheets #19 & #30 show a holding time of 14 days for extraction and 28 days until analysis, which is the same as USEPA Method 537. Worksheets #12 and #23 both state that samples are to be analyzed by SOP MS019.2, which indicates a 28 day holding time for extraction and a 40 day holding time for the analysis. Please clarify which holding times are to be used and make them consistent between the SOP and worksheets.

RESPONSE TO SPECIFIC COMMENT 8: *Worksheets #19 & #30 were revised to be consistent with the SOP MS019.2 holding times.*

Responses to Comments submitted by the California Department of Toxic Substances Control (DTSC) Geological Services Unit (GSU)[3]

COMMENT 1: The groundwater wells proposed for sampling of PFOA and PFOS in both the A-Aquifer and the Upper 180-Foot Aquifer are appropriately located. However, it would be helpful if these wells were more clearly designated on Figures 2 and 3, beyond the red well location symbols currently displayed. For example, Figure legends should indicate that wells with red symbols are specifically included in the PFOA and PFOS sampling plan.

RESPONSE TO COMMENT 1: *The legends in Figures 2 and 3 were revised per the comment.*

COMMENT 2: Identify the Goals of the Study. Worksheet #11, Step 2. GSU recommends considering the inclusion of the recently issued California drinking water notification levels (NLs) of 14 parts per trillion (ppt) for PFOA and 13 ppt for PFOS. These NLs could be included for informational purposes, as they are nonregulatory, health-based, advisory levels only.

RESPONSE TO COMMENT 2: *Worksheet #11 was not revised per the comment. Per the California NL guidelines, there is a notification requirement that applies to water systems that serve customers drinking water. The Army does not own or operate any water supply system at the former Fort Ord. As stated in Worksheet #11, the purpose of this groundwater sampling effort is only to screen for the presence of PFOA and PFOS in groundwater associated with OU2 at the former Fort Ord to determine the need for further action.*

COMMENT 3: GSU recommends sampling for all Per- and Polyfluoroalkyl Substances (PFAS) in future sampling events, as per Army guidance issued on September 4, 2018, in the memorandum, "Army Guidance for Addressing Releases of Per- and Polyfluoroalkyl Substances." While the intent of the December 2018 sampling event is to determine if PFOA and PFOS are present in groundwater at OU-2, as per the aforementioned Army guidance (Section 8, Analytical Methods), there are currently 14 PFAS analytes which can be tested using EPA Method 537, Rev. 1.1 and all PFAS analyzed using this method should be reported.

RESPONSE TO COMMENT 3: *Future sampling, if warranted by the results of the December 2018 sampling event and subsequent basewide review of historical activities associated with PFOA/PFOS, may include additional PFAS analytes per Army guidance.*

[3] In a letter dated October 26, 2018 (see Administrative Record No. OU2-715.3).

Responses to Comments submitted by the California Department of Toxic Substances Control (DTSC) Human and Ecological Risk Office (HERO)[4]

COMMENT 1: Worksheet #11 - Step 2: Identify the Goals of the Study. HERO recommends including a question to address the recently released California interim notification levels (NLs) for PFOA and PFOS and to whether the detected concentrations in groundwater exceed these levels. This information would be provided for informational purposes, as HERO acknowledges that these levels are not promulgated values.

RESPONSE TO COMMENT 1: *Worksheet #11 was not revised per the comment. Per the California NL guidelines, there is a notification requirement that applies to water systems that serve customers drinking water. The Army does not own or operate any water supply system at the former Fort Ord. As stated in Worksheet #11, the purpose of this groundwater sampling effort is only to screen for the presence of PFOA and PFOS in groundwater associated with OU2 at the former Fort Ord to determine the need for further action.*

COMMENT 2: Analyte List. HERO recommends sampling for the 12 other PFASs at a later sampling event. HERO acknowledges that the main focus of the December 2018 sampling event is to sample and determine if PFOA and PFOS are present in the groundwater at OU2, at the request of DTSC. Please note that on September 4, 2018 the Army released guidance for investigating PFASs at current and former Army installations, "Army Guidance for Addressing Releases of Per- and Polyfluoroalkyl Substances." The guidance recommends on page 7 that "all PFAS analytes that are available through this method [EPA Method 537, Rev. 1.1] should be reported." There are currently 14 analytes associated with EPA Method 537, Rev. 1.1.

RESPONSE TO COMMENT 2: *Future sampling, if warranted by the results of the December 2018 sampling event and subsequent basewide review of historical activities associated with PFOA/PFOS, may include additional PFAS analytes per Army guidance.*

COMMENT 3: Figures 2 and 3. Please identify on Figures 2 and 3 the groundwater monitoring wells that will be sampled for PFOA and PFOS. Currently, both figures show all of the wells and only a subset of the wells listed on the figures will be sampled.

RESPONSE TO COMMENT 3: *The legends in Figures 2 and 3 were revised to indicate the wells that will be sampled for PFOA and PFOS.*

[4] In a letter dated October 26, 2018 (see Administrative Record No. OU2-715.3).