June 2024

ADDENDUM 2
UNIFORM FEDERAL POLICY QUALITY ASSURANCE PROJECT PLAN
PER- AND POLYFLUOROALKYL SUBSTANCES
PHASE I REMEDIAL INVESTIGATION

Fairchild Air Force Base

Spokane County, Washington

U.S. Army Corps of Engineers
Seattle District

U.S. Air Force
Civil Engineer Center



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Addendum 2
Uniform Federal Policy Quality Assurance Project Plan
Per- and Polyfluoroalkyl Substances
Phase I Remedial Investigation

Fairchild Air Force Base
Spokane County, Washington

Prepared for:

U.S. Army Corps of Engineers, Seattle District
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Fairchild Air Force Base – Air Force Civil Engineer Center
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6/10/2024

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Date

6/12/2024

James Costello, P.G.
Program Manager

Date

June 2024
Version: Final
EA Project No. 63296.05

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LIST OF ACRONYMS AND ABBREVIATIONS

°C	degrees Celsius
AEC	Anderson Environmental Contractors
AFCEC	Air Force Civil Engineer Center
APP	Accident Prevention Plan
APPL	Agriculture & Priority Pollutants Laboratories, Inc.
B.A.	Bachelor of Arts
B.S.	Bachelor of Science
ft bgs	Feet below ground surface
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CHMM	Certified Hazardous Materials Manager
CIH	Certified Industrial Hygienist
CLIN	Contract line item number
CPR	Cardiopulmonary resuscitation
CSP	Certified Safety Professional
DL	Detection limit
DoD	Department of Defense
DOE	Department of Energy
DPT	Direct-push technology
EA	EA Engineering, Science, and Technology, Inc., PBC
Ecology	Washington State Department of Ecology
EPA	U.S. Environmental Protection Agency
ERPIMS	Environmental Resources Program Information Management System
FAFB	Fairchild Air Force Base
FTS	Fluorotelomer sulfonic acid
HDPE	High-density polyethylene
IDW	Investigation-derived waste
LC/MS/MS	liquid chromatography and tandem mass spectrometry
LG	Licensed Geologist
LHG	Licensed Hydrogeologist
LOD	Limit of detection
LOQ	Limit of quantitation
mg/kg	Milligram(s) per kilogram
mL	Milliliter(s)

LIST OF ACRONYMS AND ABBREVIATIONS (CONTINUED)

M.S.	Master of Science
NND	No Name Ditch
ng/L	Nanogram(s) per liter
OSHA	Occupational Safety and Health Administration
oz	ounce(s)
P.E.	Professional Engineer
P.G.	Professional Geologist
Ph.D.	Doctor of Philosophy
PFAS	Per- and polyfluoroalkyl substances
PFBA	Perfluorobutanoic acid
PFBS	Perfluorobutanesulfonic acid
PFHxA	Perfluorohexanoic acid
PFHxS	Perfluorohexanesulfonic acid
PFNA	Perfluorononanoic acid
PFOA	Perfluorooctanoic acid
PFOS	Perfluorooctanesulfonic acid
PSL	Project screening level
QA	Quality assurance
QAPP	Quality Assurance Project Plan
QC	Quality control
QSM	Quality Systems Manual
RI	Remedial Investigation
RPM	Remedial Project Manager
RSL	Regional Screening Level
SOP	Standard operating procedure
SSHP	Site Safety and Health Plan
THQ	Target hazard quotient
UFP	Uniform Federal Policy
USACE	U.S. Army Corps of Engineers

1. INTRODUCTION

In June 2021, a Uniform Federal Policy (UFP) Quality Assurance Project Plan (QAPP) was issued to define and document the roles, responsibilities, policies, and procedures governing data collection, evaluation, and reporting associated with the per- and polyfluoroalkyl substances (PFAS) Phase I Remedial Investigation (RI) at Fairchild Air Force Base (FAFB), Spokane County, Washington (Figure 1-1). This UFP-QAPP was prepared by EA Engineering, Science, and Technology, Inc., PBC (EA) under Contract Number W912DQ-17-D-3015 and Delivery Order Number W912DW20F2055 (EA 2021). UFP-QAPP Addendum 1 was submitted in 2022 to support the No Name Ditch Investigation conducted in October 2022 (EA 2022).

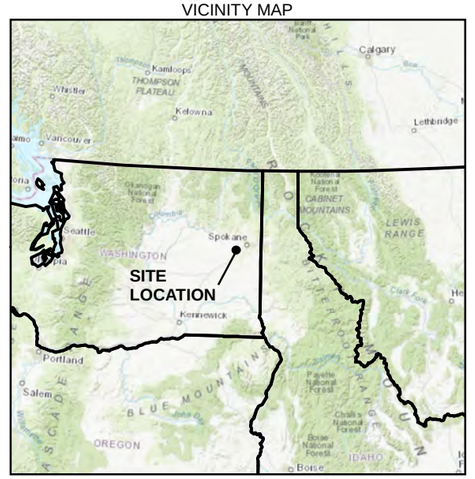
In February 2024, Modification P00002 was awarded to EA. The modification includes changes to the scope for existing contract line item numbers (CLINs), the addition of CLIN 0029 (Fairchild Additional Soil, Groundwater, Sediment, and Surface Water Sampling), and incorporates November 2023 U.S. Environmental Protection Agency (EPA) Regional Screening Levels (RSLs), which are consistent with those presented in the Assistant Secretary of Defense memorandum regarding *Investigating Per- and Polyfluoroalkyl Substances within the Department of Defense Cleanup Program* (DoD 2023) using a target hazard quotient (THQ) equal to 0.1. This UFP-QAPP Addendum 2 has been prepared to support work occurring following Modification P00002 and incorporates changes to the analytical laboratory, data validator, RSLs, and project team. This UFP-QAPP Addendum 2 will be used in conjunction with the UFP-QAPP (EA 2021). Only worksheets and appendices updated for the UFP-QAPP Addendum 2 are included in Section 2.

This document is organized as follows:

- **Section 1, Introduction**—Describes the purpose of the UFP-QAPP Addendum 2.
- **Section 2, Worksheets**—Includes the optimized worksheets specified by the Intergovernmental Data Quality Task Force UFP for QAPPs.
- **Section 3, References**—Provides reference information for the sources cited in this UFP-QAPP Addendum 2.
- **Appendix A, Standard Operating Procedure Addition and Updates**—Appendix A of the UFP-QAPP (EA 2021) provides the standard operating procedures (SOPs) to be used in support of field sampling activities. One additional SOP pertinent to the No Name Ditch Investigation, SOP 021, is included in this UFP-QAPP Addendum 2. Several SOP versions have been updated from those included in Appendix A of the UFP-QAPP (EA 2021) and have been added here; these updates supersede the original SOPs.
- **Appendix B, Laboratory Accreditation and SOPs**—Appendix C of the UFP-QAPP (EA 2021) provides laboratory accreditation certificates and scopes, and SOPs for the laboratories currently approved to support this project. Appendix C in this UFP-QAPP Addendum 2 presents accreditation certificates and scopes and SOPs for the laboratories supporting the work described in this addendum.

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VICINITY MAP



Legend

Fairchild AFB Boundary

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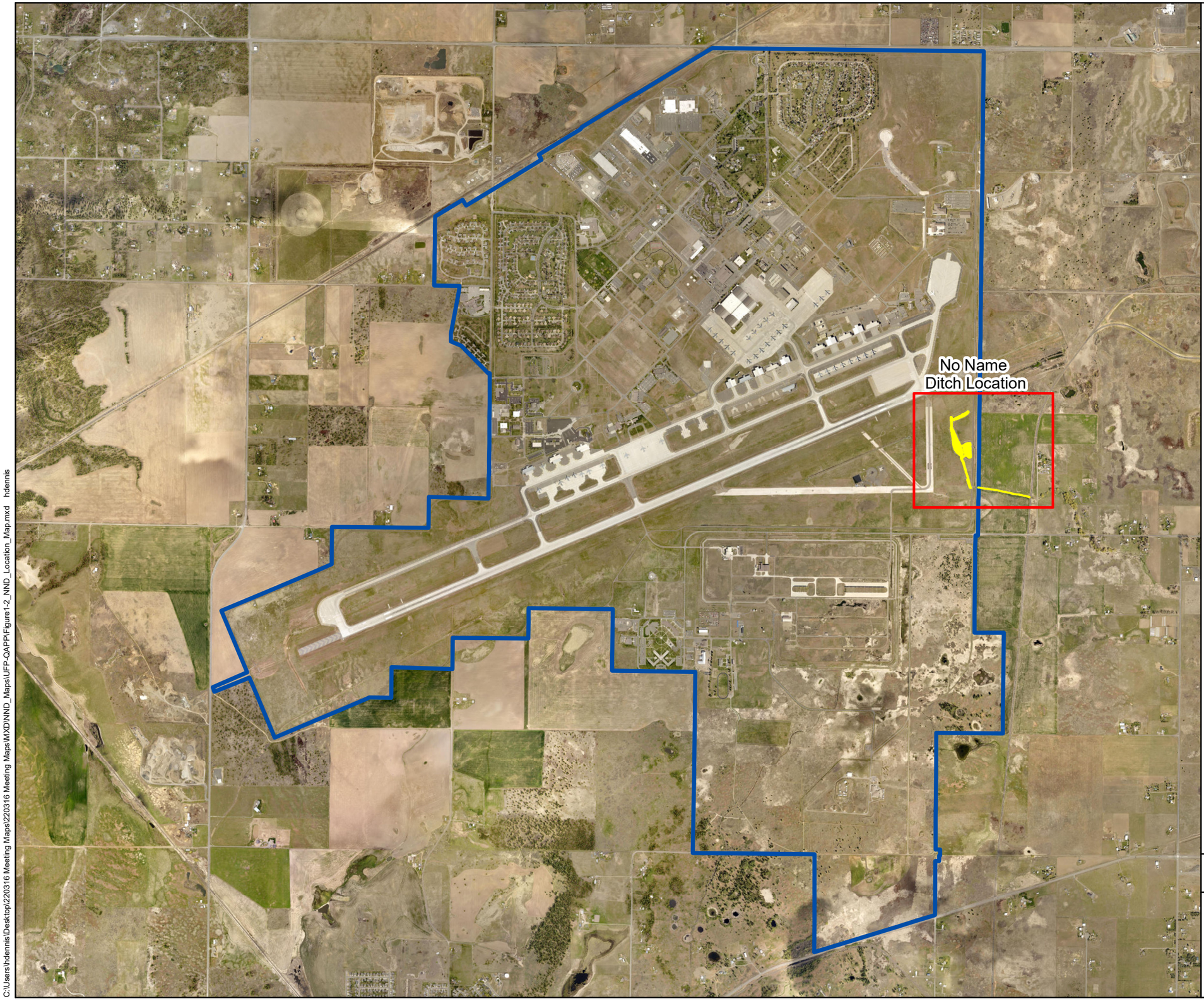
United States Air Force
Fairchild AFB, Washington

Figure 1-1: Fairchild AFB Site Map

Fairchild AFB
Phase I PFAS Remedial Investigation

\\weafp\Departments\FederalKansas City_2017 (Mega) ERA_R2Projects\2020_FAFB_MHAFB_PFAS_RI_Fairchild AFB\GIS\2_MXD\F_RI - Figure 1 - Site Map.mxd mwallman

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Legend

- No Name Ditch
- Fairchild Air Force Base Boundary

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United States Air Force
Fairchild AFB, Washington

Figure 1-2:
No Name Ditch Location Map

Fairchild AFB
Phase I PFAS Remedial Investigation

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2. WORKSHEETS

This section documents the project organization, specific procedures for the execution of the work, quality control (QC) protocols, and the assessment and oversight planning that will help ensure the quality of the investigation. The format satisfies the EPA Requirements for QAPPs (EPA 2006) and follows the current UFP-QAPP Guidance (EPA, Department of Defense [DoD], and Department of Energy [DOE] 2005). The original 37 worksheets have been optimized into 28 worksheets (EPA, DoD, and DOE 2012) that are summarized in Table 1. Table 1 outlines worksheets updated in this UFP-QAPP Addendum 2.

Table 1. UFP-QAPP Worksheet Summary

Worksheet No.	Worksheet Title	Included in UFP-QAPP Addendum
1 and 2	Title and Approval Page	X
3 and 5	Project Organization and Quality Assurance Project Plan Distribution	X
4, 7, and 8	Personnel Qualifications and Sign-Off Sheet	X
6	Communication Pathways	X
9	Project Planning Session Summary	X
10	Conceptual Site Model	--
11	Project/Data Quality Objectives	--
12	Measurement Performance Criteria	--[1,2, 3]
13	Secondary Data Uses and Limitations	--
14 and 16	Project Tasks and Schedule	X
15	Project Screening Levels and Laboratory-Specific Detection Limits	X
17	Sample Design and Rationale	X
18	Sampling Locations and Methods	X
19 and 30	Sample Containers, Preservation, and Hold Times	X
20	Field Quality Control Summary	--
21	Field Standard Operating Procedures	X
22	Field Equipment Calibration, Maintenance, Testing, and Inspection	--
23	Analytical Standard Operating Procedures	X
24	Analytical Instrument Calibration	--[3]
25	Analytical Instrument and Equipment Maintenance, Testing, and Inspection	--[3]
26 and 27	Sample Handling, Custody, and Disposal	-- [1, 4]
28	Analytical Quality Control and Corrective Action	--[3, 5]
29	Project Documents and Records	-- [2, 6]
31, 32, and 33	Assessments and Corrective Action	--
34	Data Verification and Validation Inputs	--
35	Data Verification Procedures	--
36	Data Validation Procedures	X
37	Data Usability Assessment	--

Note:
(1) This worksheet is not included in this UFP-QAPP Addendum 2. However, standard operating procedure SOP021 for the collection of sediment samples applies to this worksheet. In the case of Worksheet No. 12 presented in the UFP-QAPP (EA 2021), Table 12-2 will be applied to sediment samples in addition to soil samples.
(2) This worksheet is not included in this UFP-QAPP Addendum 2. However, the Quality Systems Manual (QSM) Version 5.4 (DoD and DOE 2021) will be applied instead of Version 5.3 (DoD and DOE 2021).
(3) This worksheet is not included in this UFP-QAPP Addendum 2. However, laboratory SOPs listed in Worksheet No. 23 apply to this worksheet instead of those listed in the worksheet of the UFP-QAPP (EA 2021).
(4) This worksheet is not included in this UFP-QAPP Addendum 2. However, organizations and/or personnel identified in Worksheet No. 3 and 5 of this UFP-QAPP Addendum 2 supersede those listed in this worksheet of the UFP-QAPP (EA 2021).
(5) This worksheet is not included in this UFP-QAPP Addendum 2. However, surface water and sediment matrices apply to this worksheet of the UFP-QAPP (EA 2021) in addition to groundwater and soil.
(6) This worksheet is not included in this UFP-QAPP Addendum 2. However, laboratory electronic data deliverables will include Environmental Resources Program Information Management System (ERPIMS) and Synectics, Inc. formats instead of the formats stated in the UFP-QAPP (EA 2021).

Worksheets #1 and 2: Title and Approval Page

Project Name: Per- and Polyfluoroalkyl Substances Phase I Remedial Investigation

Site Location: Fairchild Air Force Base

Contract/Work Assignment: W912DQ-17-D-3015, Delivery Order W912DW20F2055

Document Title: Addendum 2
Uniform Federal Policy Quality Assurance Project Plan
Per- and Polyfluoroalkyl Substances Phase I Remedial Investigation for Fairchild Air Force Base

Preparation Date: June 2024

Lead Organization: Air Force Civil Engineer Center (AFCEC)

AFCEC
Remedial Project Manager
Signature: _____ **Date**: _____
Megan Riccobono

Contracting Agency: U.S. Army Corps of Engineers (USACE) – Seattle District

USACE – Seattle District
Project Manager
Signature: _____ **Date**: _____
Taylor Roberts

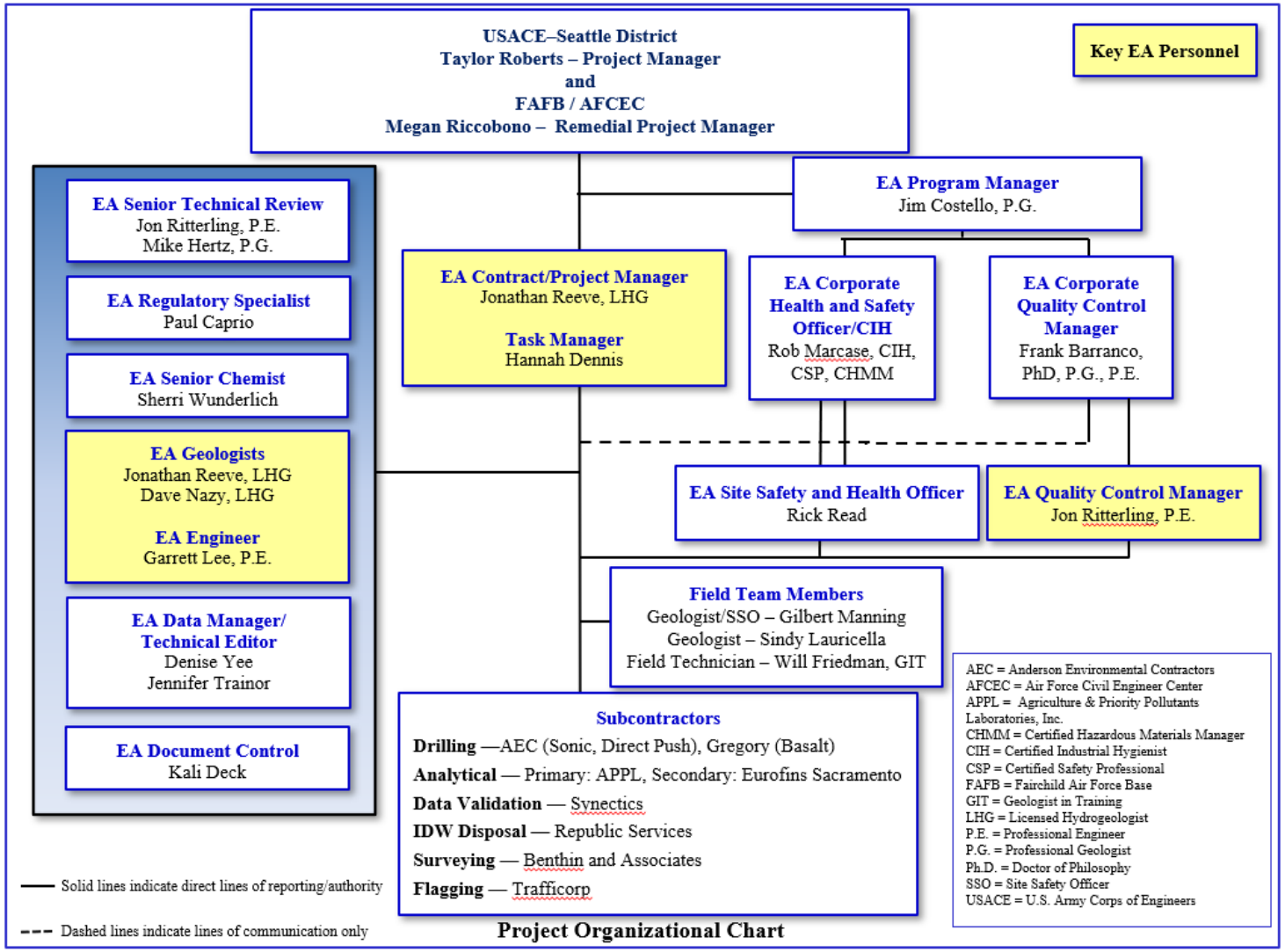
Investigative Organization: EA

EA
Project Manager **Signature**: _____ **Date**: 6/10/2024
Jonathan Reeve, Licensed Hydrogeologist (LHG)
EA

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Worksheets #3 and 5: Project Organization and Quality Assurance Project Plan Distribution

PFAS Phase I RI at FAFB



Worksheets #3 and 5: Project Organization and Quality Assurance Project Plan Distribution

Draft: 1 electronic copy to USACE (Roberts)
1 electronic copy to AFCEC (Loucks)
1 electronic copy to FAFB Remedial Project Managers (RPMs)

Draft Final: 1 electronic copy to USACE (Roberts)
1 electronic copy to AFCEC (Loucks)
1 electronic copy to FAFB RPMs
1 electronic copy and 1 hard copy to State Regulatory Agency
1 electronic copy and 1 hard copy to EPA Region 10

Final: 3 electronic copies and 2 hard copies to USACE (Roberts)
3 electronic copies and 1 hard copy to AFCEC (Loucks)
2 electronic copies and 1 hard copy to FAFB RPMs
1 electronic copy and 1 hard copy to State Regulatory Agency
1 electronic copy and 1 hard copy to EPA Region 10

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Jason Cook
Washington State Department of Ecology (Ecology)
300 Desmond Drive, P.O. Box 47600
Olympia, Washington 98504

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

Qualification of Governmental agencies are under the purview of their respective entities and will not be presented in this document. The table below summarizes the responsibilities and provides a space for the signatures of project personnel. Signatures below indicate that personnel have read and agree to implement this document as written.

Name	Organization	Project Title/Role	Education/Experience	Specialized Training and Certifications	Signature/Date
James Costello	EA	Program Manager	Bachelor of Science (B.S.) Geology, Edinboro University (1981). Mr. Costello has over 38 years of experience in program and project management for environmental restoration projects.	• Registered Professional Geologist (P.G.) in Florida	
Jonathan Reeve	EA	Project Manager, Geologist	Bacher of Arts (B.A.) Geology, Whitman College (2002). Master of Science (M.S.) Geology, University of Montana (2006). Mr. Reeve has 19 years of experience providing project management and technical expertise to environmental investigations and remediation projects throughout the western United States; analyzing soil, sediment, bedrock, and groundwater data; supervising the installation of groundwater monitoring well networks; and analyzing and modeling data.	• LHG in Washington • Licensed Geologist (LG) in Washington • Registered Geologist in Oregon	

Name	Organization	Project Title/Role	Education/Experience	Specialized Training and Certifications	Signature/Date
Hannah Dennis	EA	Task Manager	B.S. Environmental Science and B.S. Economics, Santa Clara University (2017) M.S. Environmental Science and Policy (Remediation), Johns Hopkins University (2023). Ms. Dennis has 7 years of experience in environmental science, including site characterization, long-term environmental monitoring and remediation, human health risk assessments, and geographic information systems modeling.	• USACE Construction Quality Management for Contractors Course • Occupational Safety and Health Administration (OSHA) 40-hour hazardous waste operations and emergency response training with 8-hour annual refresher training • Cardiopulmonary resuscitation (CPR) and First Aid	
Garrett Lee	EA	Engineer	B.S. Environmental Engineering and B.A. Mathematics, Syracuse University (2014) Mr. Lee has over 9 years of experience in civil/environmental engineering including disciplines such as environmental investigations and site characterization, feasibility studies, environmental monitoring and remediation, construction management/oversight, hydrologic and hydraulic modeling, and waste characterization.	• Professional Engineer in Washington • CPR and First Aid Training	

Name	Organization	Project Title/Role	Education/Experience	Specialized Training and Certifications	Signature/Date
Frank Barranco	EA	Corporate QC Manager	Doctor of Philosophy (Ph.D.) Environmental Science and Engineering, Colorado School of Mines (1998) M.S. Geology, University of Texas Arlington (1988) B.S. Geology, Duke University (1984). Dr. Barranco has more than 25 years of experience and is currently positioned as the Director of QC at EA. In this role, he is responsible for authorship and implementation of QC procedures across EA including the Senior Technical Review Program and project and program reviews.	• Ph.D., Professional Engineer (P.E.), P.G., and Certified Manager of Quality/Operational Excellence • ASTM International E50 Committee Member (Green and Sustainable Remediation) • Society of Military Engineers Student Mentoring Program • Johns Hopkins University Instructor for Engineering for Professionals Program	
Jon Ritterling	EA	Project QC Manager	B.S. Civil Engineering, University of Nebraska (1989) M.S. Civil Engineering, University of Nebraska (1996). Mr. Ritterling has 30 years of experience in environmental engineering, with specialized experience in management of environmental remediation projects from investigation through design, construction, operation, and site closeout.	• Registered P.E. in Nebraska and North Carolina • Site Investigation, RI/FS, Remedial Design/Remedial Action • Society of American Military Engineers	

Name	Organization	Project Title/Role	Education/Experience	Specialized Training and Certifications	Signature/Date
Rob Marcase	EA	Corporate Health and Safety Officer	B.S. Environmental Science, Slippery Rock University Certified Industrial Hygienist (CIH); Certified Safety Professional (CSP); Certified Hazardous Materials Manager (CHMM). Mr. Marcase has over 25 years of experience managing safety and occupational health projects, conducting industrial hygiene services including inspections and oversight on environmental remediation projects. Oversees development of: Accident Prevention Plans (APP)/Site Safety and Health Plans (SSHPs); identification/ evaluation of chemical, physical, radiological, and biological hazards; medical surveillance programs; personal protective equipment; employee training requirements; environmental monitoring; and proper reporting.	• CIH • CSP • CHMM • American Industrial Hygiene Association • OSHA Construction 30-Hour Construction Safety Training • Asbestos Building Inspector Certification	
Rick Read	EA	Site Safety and Health Officer	Associate of Applied Science Environmental Management, Mt. Hood Community College (1992). B.S. Community Development, Portland State University (2002). Mr. Read has over 28 years of experience conducting hazardous waste site investigations, preliminary site evaluations, removal and remedial actions, environmental sampling, and remediation system installation and maintenance. Mr. Read has 24 years as acting Site Safety and Health Officer at two separate Superfund cleanup sites.	• OSHA 8-hour supervisor training • OSHA 30-hour Construction Safety training • CPR and First Aid	

Name	Organization	Project Title/Role	Education/Experience	Specialized Training and Certifications	Signature/Date
Sherri Wunderlich	EA	Senior Chemist	B.A. Chemistry, Washington and Jefferson College (1985). More than 30 years of experience in the planning, technical support, management, and execution of multidisciplinary environmental consulting projects. Ten years in an environmental analytical laboratory in various positions, including organic and inorganic quantitative analysis, methods development, training analysts, QC, and management. Five years in a data validation firm. Areas of specialization include preparation of statistically defensible sampling and analysis plans for remedial activities designed for regulatory review and the statistical evaluation of environmental data.	• American Society for Quality Certified Quality Auditor • USACE Construction Quality Management for Contractors Course • OSHA 40-hour hazardous waste operations and emergency response training with 8-hour annual refresher training • CPR and First Aid	
Dave Nazy	EA	Geologist	B.S. Geology, Winona State University (1984). M.S. Geology, Portland State University (1987). Mr. Nazy has 33 years of technical experience in geology, hydrogeology, and toxics cleanup and water resources permitting. He has an extensive depth of experience across multiple technical disciplines including managed aquifer recharge, contaminant hydrogeology, basin models, watershed planning, mitigation, and water rights.	• LHG in Washington • LG in Washington	
Monica Garcia-Strikland	Agriculture & Priority Pollutants Laboratories, Inc. (APPL)	Laboratory Project Manager	Over 20 years of experience as a laboratory Department Manager and Project Manager.	On file at laboratory	

Name	Organization	Project Title/Role	Education/Experience	Specialized Training and Certifications	Signature/Date
Jill Kellmann	Eurofins Sacramento	Laboratory Project Manager	Over 20 years of experience as a laboratory Project Manager. Experience working directly on several PFAS related projects since 2014.	On file at laboratory	
Evin McKinney	Synectics, Inc.	Project Manager	B.S. Chemistry and 32 years of experience working with data validation projects.	On file at firm	

Worksheet #6: Communication Pathways

Communication Drivers	Responsible Entity	Name	Phone Number	Role/Procedure (Timing, pathways, etc.)
Contracting Officer Representative	USACE	Karl Kunas	(206) 764-3448	Overall responsibility for overseeing and monitoring the contractor's performance and assures the contractor receives impartial, fair, and equitable treatment under the Delivery Order. Ultimately responsible for the final determination of the adequacy of the contractor's performance and authorized to obligate the Government on this Delivery Order.
Project Manager	USACE	Taylor Roberts	(206)399-8368	Ms. Roberts will serve as the USACE Project Manager responsible for overseeing and monitoring the contractor's performance and verifying the contractor performs the technical requirements of the contract in accordance with the contract terms and to resolve scoping and/or performance issues, should they arise. Ms. Roberts will also review project deliverables.
Program Manager	AFCEC	Mark Loucks	(801) 821-9855	Mr. Loucks will serve as the AFCEC Program Manager and responsible for overseeing and monitoring the contractor's technical performance in accordance with the contract terms and reviewing project deliverables.
RPM	FAFB	Megan Riccobono	(509) 247-2450	Ms. Riccobono will serve as the installation primary point-of-contact for project execution and will be responsible for providing support to the contractor during execution of the project tasks. Maintains direct communications with the contractor personnel on coordination issues, facilitating access to the installation, and review of project deliverables. Ms. Riccobono is also responsible for communicating and coordinating with regulators and FAFB chain of command.
RPM	FAFB	Jack Mapes	(509) 247-2451	Mr. Mapes will serve as a secondary point-of-contact for project execution and will provide support to the contractor during execution of the project tasks.
Federal and State Regulators	EPA Ecology	Jaclyn Satira Jason Cook	-- --	Provide regulatory oversight.

Communication Drivers	Responsible Entity	Name	Phone Number	Role/Procedure (Timing, pathways, etc.)
Program Manager	EA Program Manager	James Costello	(443) 717-4674	Oversight of programmatic communication between corporate program and project management.
Contractor communication with USACE, AFCEC, and FAFB Point of Contact. Notifications of delays or changes to task execution.	EA Project Manager	Jonathan Reeve, LHG	(206) 452-5358	Communication with USACE, AFCEC, and FAFB regarding task execution and project deliverables.
Coordination of subcontractor field work, stop work in field, QAPP changes during project execution, field changes to sampling activities during or after initial field work, field corrective actions.	EA Task Manager EA Geologist	Hannah Dennis Jonathan Reeve, LHG Dave Nazy, LHG	(206) 452-5359 (206) 452-5358 (306) 789-7382	Communication with EA Project Manager regarding field activities and subcontractor coordination.
Program QC oversight Field QC oversight and corrective actions.	EA Corporate QC Manager EA Project QC Manager	Frank Barranco, Ph.D., P.E., P.G. Jon Ritterling, P.E.	(410) 286-8791 (402) 350-8624	Oversight of programmatic QC interaction between corporate program and project management. Oversight of field/project QC, communication with EA Project Manager and project staff.
Analytical corrective actions, data validation issues or non-compliance with procedures, and data review corrective actions.	Project Chemist	Sherri Wunderlich	(360) 337-0780	Communication with EA Project Manager regarding analytical quality assurance (QA)/QC issues.
Coordination of sampling supplies, sample receipt, and analytical data processing	APPL Project Manager	Monica Garcia-Strickland	(559) 825-9005	Coordination of sampling kits, confirmation of sample receipt, issues at the laboratory, and distribution of data will be communicated to the EA Project Chemist.
	Eurofins Sacramento Project Manager	Jill Kellmann	(916) 373-5600	

Communication Drivers	Responsible Entity	Name	Phone Number	Role/Procedure (Timing, pathways, etc.)
Coordination of data validation issues and corrective actions	Synectics, Inc. (third-party validator) Project Manager	Evin McKinney	(916) 737-4010	Email or verbal communication between the Data Validator and the EA Project Chemist and analytical laboratory to resolve data validation issues. Data Validator will notify the EA Project Chemist of data that are qualified as rejected, or R-flagged, in writing. Corrective action required addressing data validation issues will immediately be implemented by the Data Validator after consultation with the EA Project Chemist (written or electronic).

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Worksheet #9: Project Scoping Session Summary

The following presents the Meeting Minutes from the Modification P00002 Kick-Off Meeting.

Title: Modification P00002 Kick-Off Meeting

Project Name: PFAS Phase I RI at FAFB and Mountain Home Air Force Base

Date of Session: 6 March 2024

Participants:

Name	Affiliation	Role	
Taylor Roberts	USACE	USACE RPM	Taylor.M.Roberts@usace.army.mil
Ben McKenna	USACE	Geologist	Benino.P.Mckenna@usace.army.mil
Ted Repasky	USACE	Hydrogeologist	ted.r.repasky@usace.army.mil
Tim Wood	USACE	Engineer	timothy.s.wood@usace.army.mil
Jessica Loughman	USACE	USACE COR	jessica.loughman@usace.army.mil
Megan Riccobono	AFCEC	FAFB RPM	megan.riccobono.1@us.af.mil
Jack Mapes	AFCEC	FAFB RPM	jack.mapes.1@us.af.mil
Mark Henry	AFCEC	FAFB RPM	mark.henry.8@us.af.mil
Tom Kendall	AFCEC	MHAFB PM	thomas.kendall@us.af.mil
Jonathan Reeve	EA	MHAFB/FAFB Project Manager	jreeve@eaest.com
Hannah Dennis	EA	FAFB Task Manager	hdennis@eaest.com
Steve Morrisette	EA	MHAFB Task Manager	smorrisette@eaest.com
Stuart Anderson	EA	MHAFB Task Manager	sanderson@eaest.com

Notes:
AFCEC = Air Force Civil Engineer Center
EA = EA Engineering, Science, and Technology, Inc., PBC
FAFB = Fairchild Air Force Base
COR = Contracting Officer's Representative
MHAFB = Mountain Home Air Force Base
RPM = Remedial Project Manager
USACE = United States Army Corps of Engineers

I. Meeting Summary

Megan Riccobono provided an updated permit status for planned wells:

- City of Airway Heights: permit has been approved for planned locations. Megan will inquire about traffic control plans and provide information to EA about the process for submitting traffic control plans.

- Spokane County: permit has been approved for planned locations. Permits typically need to be renewed every year; Megan is attempting to get an updated 20-year duration permit to eliminate the need to renew annually.

- On-base wells: Megan will need at least a month to get dig permits approved. She requested EA submit dig permit information with additional lead time if possible. Dig permits will be valid for 90 days after approval. Dig permits will require photos of

planned drilling locations (which Megan can photograph if we do not already have photos).

Megan discussed sampling associated with No Name Ditch (NND):

- Megan stated that the Air Force will contact homeowners to determine if we can use their properties to access NND. Megan stated that if we are unable to get property access, EA will need to access the ditch using waders, which would also prevent the use of the Geoprobe.

- Jonathan Reeve expressed concern about accessing NND using waders, both from health and safety standpoint for EA employees and access issues because of thick vegetation. Megan agreed that the Air Force would coordinate with the homeowners to make sure there are no safety concerns for EA staff. She also indicated that one homeowner has an access point to the ditch that is flat and clear of vegetation.

The team discussed potential schedule concerns:

- Jonathan discussed the UFP-QAPP Addendum. The UFP-QAPP will need to document changes in analytical laboratories and incorporate NND sampling. As the draft schedule currently indicates, EA will not begin drilling or sampling until after the UFP-QAPP is approved. Jonathan asked if the Air Force or AFCEC had recommendations for streamlining the UFP-QAPP changes to reduce the review time. Megan requested that EA provide an outline for a streamlined UFP-QAPP format.

- Hannah Dennis asked whether review periods for the UFP-QAPP could be reduced for USACE/Air Force and regulators. Megan and Taylor agreed the USACE/Air Force timeline could be reduced.

- Hannah asked whether the Air Force wants Task 22 groundwater samples to be used specifically for monitoring well samples or held for potential additional samples at NND. Megan agreed that these could be used for monitoring well samples. Hannah explained that these samples may be combined with a mobilization to sample existing wells under Task 7. This sampling event could occur prior to or during well installation to start collecting additional data for the RI before drilling is completed.

Worksheets #14 and 16: Project Tasks and Schedule

This worksheet presents an updated Table 14-1.

Table 14-1 Tasks and Deliverables Schedule

Activity	Responsible Party	Planned Completion Date	Planned Frequency	Deliverable	Delivery Date
UFP-QAPP	EA	Summer 2021 (completed)	Once	UFP-QAPP	June 2021
Round 1 Monitoring Well Sampling (50 existing monitoring wells)	EA	Summer 2021 (completed)	Once	Sample results	45 days after sampling completed
Round 1 Synoptic Groundwater Level Measurement (50 existing monitoring wells)	EA	Summer 2021 (completed)	Once	Groundwater level map	45 days after reading
Round 2 Monitoring Well Sampling (50 existing monitoring wells)	EA	Summer 2021 (completed)	Once	Sample results	45 days after sampling completed
Round 2 Synoptic Groundwater Level Measurement (100 existing monitoring wells)	EA	Summer 2021 (completed)	Once	Groundwater level map	45 days after reading
Install Soil Borings and Collect Soil Samples	EA/Anderson Environmental Contractors (AEC)	Spring 2022 (completed)	Once	Sample results	45 days after sampling completed
UFP-QAPP Addendum 1	EA	Summer 2022 (completed)	Once	UFP-QAPP	June 2022
Investigation-Derived Waste (IDW) Sampling	EA	Fall 2022	Once	Sample results	45 days after sampling completed
No Name Ditch Investigation (Part 1)	EA/AEC	Winter 2023 (completed)	Once	Sample results	45 days after sampling completed
UFP-QAPP Addendum 2	EA	Spring 2024	Once	UFP-QAPP	Summer 2024
Installation and development of New Monitoring Wells (50 total)	EA/AEC/Gregory	Summer 2024	Once	Sample results, boring logs	45 days after sampling completed
Flowmeter and gamma logging (50 new monitoring wells, 50 existing monitoring wells)	EA	Summer 2024	Once	Geophysical logs	45 days after completion of field work

Activity	Responsible Party	Planned Completion Date	Planned Frequency	Deliverable	Delivery Date
No Name Ditch Investigation (Part 2)	EA/AEC	Summer 2024	Once	Sample results	45 days after sampling completed
Slug Testing of new monitoring wells (50 total)	EA	Fall 2024	Once	Slug test data	45 days after testing completed
Survey of New Monitoring Wells	EA/Geophysical Survey	Fall 2024	Once	Geospatial data	45 days after collection
Transducer Installation and Measurement	EA	Fall 2024	Once	Transducer data	45 days after reading
Aquifer Pumping Tests	EA	Fall 2024	Once	Aquifer pumping test data	45 days after Testing Completed
Round 3 Monitoring Well Sampling (50 new monitoring wells, 50 existing monitoring wells)	EA	Fall 2024	Once	Sample results	45 days after sampling completed
IDW Sampling	EA	Fall 2024	Once	Sample results	45 days after sampling completed
Analysis of all Samples	APPL/Eurofins Sacramento	Various	After each sampling event	Report of analysis/data package	45 days after sampling completed
Analytical Data Validation	Synectics, Inc.	Various	After each sampling event	Validation Summary	60 days after sampling completed
ERPIMS Data Submittal	EA	Various	After each sampling event	Successful submittal of ERPIMS data and receipt of AFCEC ERPIMS data loading notification	60 days after sampling completed
Phase I RI Report	EA	Summer 2025	After all fieldwork complete	Phase I RI Report	90 days after field work is completed.

Worksheet #15: Project Screening Levels and Laboratory-Specific Detection Limits

In accordance with DoD guidance (2019a) under Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), project screening levels (PSLs) have been established for matrices of concern (groundwater, soil, and sediment). The guidance memorandum stipulates toxicity values that will ultimately be used to conduct site-specific risk assessments. The PSLs are as follows:

- ***Groundwater and Surface Water*** – the PSLs for groundwater and surface water for PFAS were derived from November 2023 EPA RSLs and are consistent with presentation in the Assistant Secretary of Defense memorandum regarding *Investigating Per- and Polyfluoroalkyl Substances within the Department of Defense Cleanup Program* (DoD 2023). The PSLs for groundwater and surface water, listed in Table 15-1, use the November 2023 EPA RSLs for tap water (THQ = 0.1) for perfluorooctanesulfonic acid (PFOS), perfluorooctanoic acid (PFOA), perfluorobutanoic acid (PFBA), perfluorobutanesulfonic acid (PFBS), perfluorononanoic acid (PFNA), perfluorohexanoic acid (PFHxA), and perfluorohexanesulfonic acid (PFHxS). Due to the current absence of DoD guidance specific to surface water, comparison of surface water sample results to PSLs is considered qualitative or for informational purposes only.
- ***Soil and Sediment*** – the RSLs for soil and sediment for PFAS were derived from November 2023 EPA RSLs, which are consistent with presentation in the 24 August 2023 Assistant Secretary of Defense memorandum regarding *Investigating Per- and Polyfluoroalkyl Substances within the Department of Defense Cleanup Program* (DoD 2023). The PSLs for soil and sediment, listed in Table 15-2, use the November 2023 EPA RSLs for residential soil (THQ = 0.1) for PFOS, PFOA, PFBA, PFBS, PFNA, PFHxA, and PFHxS. Due to the current absence of DoD guidance specific to sediment, comparison of sediment sample results to PSLs is considered qualitative or for informational purposes only.

The PSLs for comparing analytical results for PFOS, PFOA, PFBA, PFBS, PFNA, PFHxA, and PFHxS for the matrices of concern (groundwater, surface water, soil, and sediment) are presented in Tables 15-1 and 15-2. Samples will be analyzed for the 24 PFAS specified in Worksheet #15 by liquid chromatography and tandem mass spectrometry (LC/MS/MS) compliant with Table B-15 of DoD/DOE QSM Version 5.4 (2021 or later).

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Table 15-1. Project Screening Levels and Laboratory-Specific Detection Limits – Water

Analytical Group: 24 PFAS
Method: LC/MS/MS compliant with Table B-15 of DoD/DOE QSM, Version 5.4 (or later)
Laboratory: APPL (primary) and Eurofins Sacramento (backup)

Analyte	Acronym	CASRN	PSL[1] (ng/L)	APPL – Laboratory Limits[2] (ng/L)			Eurofins Sacramento – Laboratory Limits[2] (ng/L)		
				LOQ	LOD	DL	LOQ	LOD	DL
4:2 Fluorotelomer sulfonic acid	4:2 FTS	75124-72-4	--	4.0	2.0	0.14	2.0	1.0	0.36
6:2 Fluorotelomer sulfonic acid	6:2 FTS	27619-97-2	--	4.0	2.0	0.16	5.0	1.0	0.38
8:2 Fluorotelomer sulfonic acid	8:2 FTS	39108-34-4	--	4.0	2.0	0.04	2.0	1.5	0.62
N-Ethyl perfluorooctanesulfonamidoacetic acid	NEtFOSAA	2991-50-6	--	1.0	0.50	0.27	5.0	1.0	0.34
N-Methyl perfluorooctanesulfonamidoacetic acid	NMeFOSAA	2355-31-9	--	1.0	0.50	0.28	5.0	1.0	0.46
Perfluorobutanesulfonic acid	PFBS	375-73-5	600	1.0	0.50	0.070	2.0	1.0	0.34
Perfluorobutanoic acid	PFBA	375-22-4	1,800	4.0	2.0	0.15	2.0	0.50	0.24
Perfluorodecanesulfonic acid	PFDS	335-77-3	--	1.0	0.50	0.32	2.0	1.5	0.55
Perfluorodecanoic acid	PFDA	335-76-2	--	1.0	0.50	0.22	2.0	1.0	0.33
Perfluorododecanoic acid	PFDoA	307-55-1	--	1.0	0.50	0.19	2.0	1.0	0.42
Perfluoroheptanoic acid	PFHpA	375-85-9	--	1.0	0.50	0.080	2.0	1.0	0.48
Perfluoroheptanesulfonic acid	PFHpS	375-92-8	--	1.0	0.50	0.12	2.0	1.5	0.71
Perfluorohexanesulfonic acid	PFHxS	355-46-4	39	1.0	0.50	0.040	2.0	1.0	0.38
Perfluorohexanoic acid	PFHxA	307-24-4	990	1.0	0.50	0.13	2.0	1.0	0.36
Perfluorononanoic acid	PFNA	375-95-1	5.9	1.0	0.50	0.20	2.0	1.0	0.56
Perfluorononanesulfonic acid	PFNS	68259-12-1	--	1.0	0.50	0.26	2.0	1.5	0.66
Perfluorooctanesulfonamide	PFOSA	754-91-6	--	4.0	2.0	0.22	2.0	1.5	0.52
Perfluorooctanesulfonic acid	PFOS	1763-23-1	4.0	1.0	0.50	0.13	2.0	1.5	0.58
Perfluorooctanoic acid	PFOA	335-67-1	6.0	1.0	0.50	0.33	2.0	1.5	0.56
Perfluoropentanoic acid	PFPA	2706-90-3	--	2.0	1.0	0.10	2.0	0.50	0.24
Perfluoropentanesulfonic acid	PFPS	2706-91-4	--	1.0	0.50	0.11	2.0	1.5	0.51
Perfluorotetradecanoic acid	PFTeDA	376-06-7	--	1.0	0.50	0.36	2.0	1.5	0.51
Perfluorotridecanoic acid	PFTriDA	72629-94-68	--	1.0	0.50	0.43	2.0	1.5	0.69
Perfluoroundecanoic acid	PFUnA	2058-94-8	--	1.0	0.50	0.37	2.0	1.5	0.73

Notes:

[1] The PSL is the EPA RSL for tap water (THQ = 0.1) dated November 2023.
[2] Laboratory LOQs, LODs, and DLs were current when this document was written and may change slightly before samples are analyzed.
CASRN = Chemical Abstract Services Registry Number
DL = Detection limit
LOD = Limit of detection

LOQ = Limit of quantitation
ng/L = nanograms per liter

Table 15-2. Project Screening Levels and Laboratory-Specific Detection Limits – Soil and Sediment

Analytical Group: 24 PFAS
Method: LC/MS/MS compliant with Table B-15 of DoD/DOE QSM, Version 5.4 (or later)
Laboratory: APPL (primary) and Eurofins Sacramento (backup)

Analyte	Acronym	CASRN	PSL[1] (mg/kg)	APPL – Laboratory Limits (mg/kg)[2]			Eurofins Sacramento – Laboratory Limits (mg/kg)[2]		
				LOQ	LOD	DL	LOQ	LOD	DL
4:2 Fluorotelomer sulfonic acid	4:2 FTS	75124-72-4	--	0.0010	0.00040	0.00020	0.00020	0.00015	0.000051
6:2 Fluorotelomer sulfonic acid	6:2 FTS	27619-97-2	--	0.0010	0.00040	0.00020	0.00030	0.00010	0.000027
8:2 Fluorotelomer sulfonic acid	8:2 FTS	39108-34-4	--	0.0010	0.00040	0.00015	0.00020	0.00010	0.000035
N-ethyl perfluorooctanesulfonamidoacetic acid	NEtFOSAA	2991-50-6	--	0.0010	0.00040	0.00020	0.00020	0.00010	0.000048
N-methyl perfluorooctanesulfonamidoacetic acid	NMeFOSAA	2355-31-9	--	0.0010	0.00040	0.00020	0.00020	0.000050	0.000023
Perfluorobutanesulfonic acid	PFBS	375-73-5	1.9	0.0010	0.00040	0.00010	0.00020	.000010	0.000038
Perfluorobutanoic acid	PFBA	375-22-4	7.8	0.0010	0.00040	0.00010	0.00030	0.00010	0.000046
Perfluorodecanesulfonic acid	PFDS	335-77-3	--	0.0010	0.00040	0.00020	0.00020	0.00015	0.000052
Perfluorodecanoic acid	PFDA	335-76-2	--	0.0010	0.00040	0.00015	0.00020	0.00010	0.000048
Perfluorododecanoic acid	PFDoA	307-55-1	--	0.0010	0.00040	0.00015	0.00020	0.00010	0.000030
Perfluoroheptanoic acid	PFHpA	375-85-9	--	0.0010	0.00040	0.00010	0.00020	0.00010	0.000038
Perfluoroheptanesulfonic acid	PFHpS	375-92-8	--	0.0010	0.00040	0.00015	0.00020	0.00010	0.000049
Perfluorohexanesulfonic acid	PFHxS	355-46-4	0.13	0.0010	0.00040	0.00015	0.00020	0.00010	0.000029
Perfluorohexanoic acid	PFHxA	307-24-4	3.2	0.0010	0.00040	0.00010	0.00020	0.00010	0.000031
Perfluorononanoic acid	PFNA	375-95-1	0.019	0.0010	0.00040	0.00010	0.00020	0.000050	0.000022
Perfluorononanesulfonic acid	PFNS	68259-12-1	--	0.0010	0.00040	0.00039	0.00020	0.00010	0.000029
Perfluorooctanesulfonamide	PFOSA	754-91-6	--	0.0010	0.00040	0.00010	0.00020	0.00010	0.000033
Perfluorooctanesulfonic acid	PFOS	1763-23-1	0.013	0.0010	0.00040	0.00010	0.00030	0.00010	0.000043
Perfluorooctanoic acid	PFOA	335-67-1	0.019	0.0010	0.00040	0.00015	0.00030	0.00015	0.000053
Perfluoropentanoic acid	PFPA	2706-90-3	--	0.0010	0.00040	0.00015	0.00020	0.00010	0.000041
Perfluoropentanesulfonic acid	PFPS	2706-91-4	--	0.0010	0.00090	0.00041	0.00020	0.00010	0.000037
Perfluorotetradecanoic acid	PFTeDA	376-06-7	--	0.0010	0.00040	0.00020	0.00020	0.00010	0.000037
Perfluorotridecanoic acid	PFTriDA	72629-94-68	--	0.0010	0.00040	0.00010	0.00020	0.000050	0.000021
Perfluoroundecanoic acid	PFUnA	2058-94-8	--	0.0010	0.00040	0.00010	0.00020	0.00010	0.000042

Notes:
(1) The PSL is the EPA residential Regional Screening Level (THQ = 0.1) for soil, dated November 2023.
(2) Laboratory LOQs, LODs, and DLs were current when this document was written and may change slightly before samples are analyzed. Soil and sediment sample results (after adjusted for sample amount, dilution, and moisture content) will be reported on a dry-weight basis and likely will be higher than the values listed here.
CASRN = Chemical Abstract Services Registry Number

DL = Detection limit
LOD = Limit of detection
LOQ = Limit of quantitation
mg/kg = milligram(s) per kilogram

Worksheet #17: Sampling Design and Rationale

Sampling associated with CLIN 0029 (Fairchild Additional Soil, Groundwater, Sediment, and Surface Water Sampling) will include groundwater, surface water, surface soils, subsurface soils, and sediment. This investigation focuses on the off-base portion of NND and flowage easement. Surface and subsurface soil samples and groundwater samples will be collected from 20 borings within the off-base portion of NND and within the flowage easement southeast of NND to determine the concentration of PFAS at each boring. Surface water and sediment samples will be collected from 15 locations within the off-base portion of NND to determine the concentration of PFAS, if present. Samples will be analyzed for the 24 PFAS compounds specified in Worksheet #15 of the UFP-QAPP.

17.1 Sampling and Data Collection – Groundwater and Soil

Borings will be advanced at the off-base portion of NND and at the NND flowage easement for collection of soil and groundwater sampling. Ten locations will be advanced in the off-base portion of NND (NND-47 through NND-56) using direct-push technology (DPT) drill rig capable of collecting groundwater sampled via temporary well point. Boring locations are shown in Figure 17-3. Borings will be logged by a licensed geologist or geologist under the supervision of a licensed geologist. Borings will be advanced until groundwater is encountered. At each of the 10 DPT borings, a surface sample (0.0-0.5 feet below ground surface [ft bgs]) and three subsurface soil samples will be collected. The first two subsurface samples will be collected at depths of 2-3 ft bgs and 7-8 ft bgs. The third subsurface sample will be collected directly above the first encountered groundwater interface. A groundwater sample will be collected either by inserting a temporary well screen and collecting a sample using a peristaltic pump, or through the use of a grab sampler such as a Hydropunch sampler. The method of sample collection will depend on whether the depth to groundwater is above or below the peristaltic limit (approximately 25 ft bgs). Following completion, DPT borings will be abandoned with bentonite grout comprised of portland cement and 3-5 percent bentonite by dry weight.

Ten locations will be advanced in the NND flowage easement (NND-57 through NND-66) with a sonic drill rig capable of collecting groundwater samples using a sonic push-ahead sampler. Boring locations are shown on Figure 17-4. Borings will be logged by a licensed geologist or geologist under the supervision of a licensed geologist. In each of the 10 DPT borings, a surface sample (0.0-0.5 ft bgs) and seven subsurface soil samples will be collected. Borings will be advanced to groundwater, which is expected to vary widely across the site. Six subsurface samples will be collected at intervals of approximately 5 feet beginning at 2 ft bgs. The sample will be collected from the middle of each 5-foot DPT boring sleeve, to keep a consistent 5 feet interval from the first subsurface sample collected at 2 ft bgs. In the event of poor recovery, available soil will be collected for sampling and marked as being collected at the shallowest depth for that interval. The seventh subsurface sample will be collected directly above the groundwater interface of the first encountered groundwater. A groundwater sample will be collected using a sonic push-ahead sampler. Following completion, DPT borings will be abandoned with bentonite grout comprised of portland cement and 3-5 percent bentonite by dry weight.

17.2 Sampling and Data Collection – Surface Water and Sediment

Surface water and sediment samples will be collected at 15 locations (NND-67 through NND-81) within the off-base portion of NND. Surface water and sediment sampling locations are shown on Figure 17-3. Surface water samples will be collected from the stream in NND using a peristaltic pump and PFAS-free tubing, at target depth of 10 centimeters below the water surface. Sediment samples will be collected below shallow water using a PFAS-free scoop. After decanting water slowly to minimize loss of fine particles, the sediment will be mixed using a PFAS-free spatula and transferred to sample containers.

17.3 Sampling and Analysis and Laboratory Procedures

With the following exceptions, there are no changes to the corresponding section of the UFP-QAPP (EA 2021):

- Samples will be analyzed by a laboratory identified in Worksheet No. 3 and 5 and Worksheet No. 19 and 30 of this UFP-QAPP Addendum 2. This supersedes the laboratories listed in this worksheet of the UFP-QAPP (EA 2021).

- Quality Systems Manual Version 5.4 (DoD and DOE 2021) will be applied instead of Version 5.3 (DoD and DOE 2019).

- Data validation at Stage 2B (100 percent of data) and Stage 4 (minimum 10 percent of the data) will be performed in accordance with DoD Data Validation Guidelines Module 3 (DoD 2020) as stated in the UFP-QAPP (EA 2021); however, Modules 1,2,3, and 4 Revised Table for Sample Qualification in the Presence of Blank Contamination (DoD 2022) will be applied.

17.4 Investigation-Derived Waste

IDW will be managed in accordance with the Waste Management Plan presented in Appendix D in the UFP-QAPP (EA 2021). As stated in the Waste Management Plan, liquid IDW associated with groundwater and surface water sampling, as applicable, will be stored in frac tanks while on site and will be transported off site in a vacuum truck. Solid IDW associated with soil or sediment sampling and drilling, as applicable, will be containerized in lined rolloff containers or drums. Other solids (i.e., personal protective equipment and sampling equipment) will be placed in trash bags and disposed as non-hazardous solid waste in an appropriate off-base Subtitle D landfill.

Representative liquid and/or solid IDW samples may require laboratory analysis for the following analyses and methods, which are subject to change based on disposal requirements:

- PFAS compliant with Table B-15 of DoD/DOE QSM, Version 5.4 (or later)

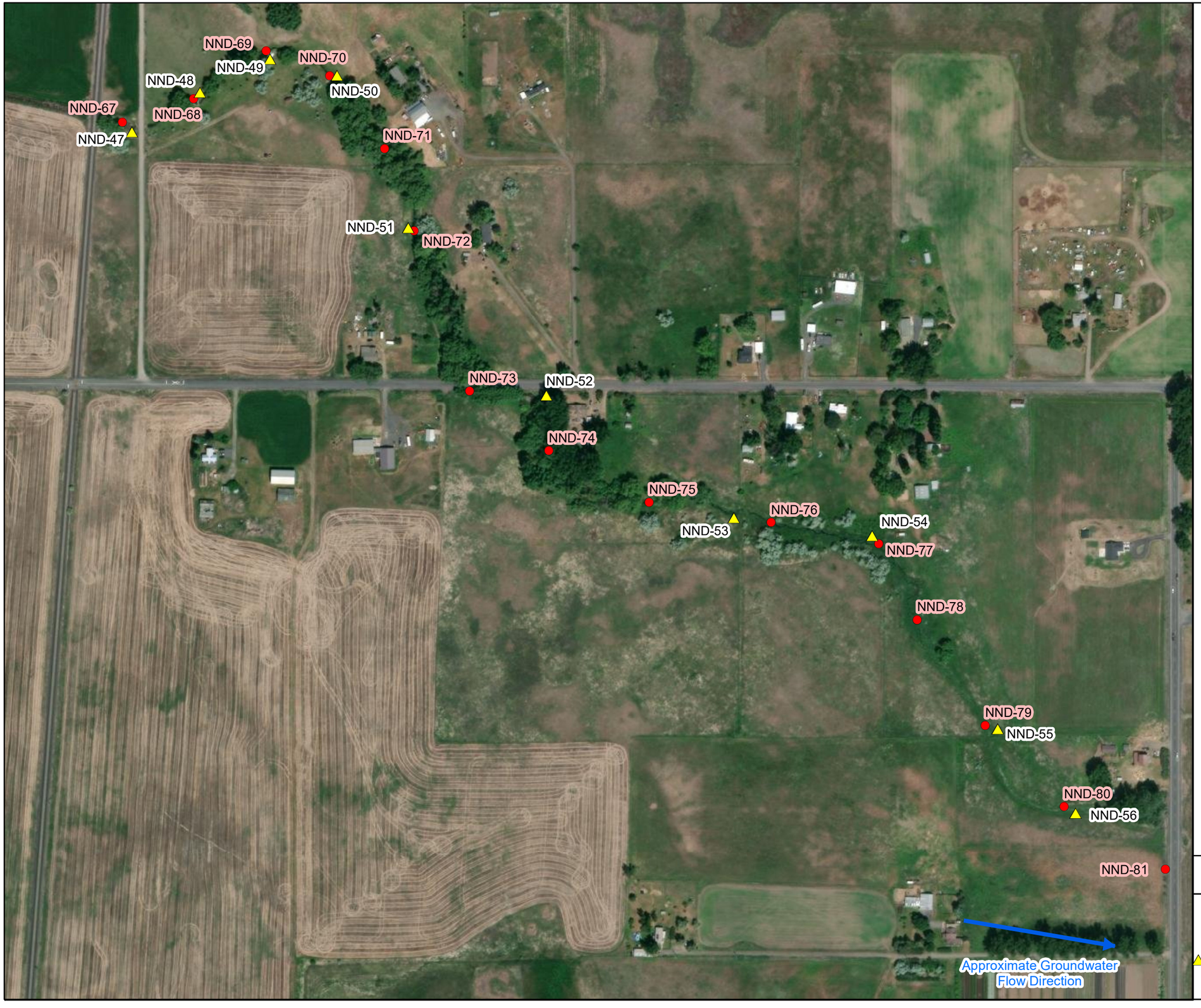
- Volatile organic compounds by EPA SW-846 Method 8260D

- Semivolatile organic compounds by EPA SW-846 Method 8270E

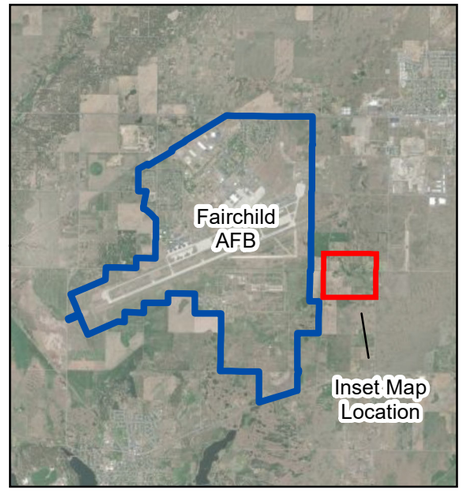
- Resource Conservation Recovery Act metals by EPA SW-846 Methods 6010D, 6020B, and/or 7470A following the Toxicity Characteristic Leaching Procedure by EPA SW-846 Method 1311

No field QC samples (including trip blanks) will be collected in association with IDW samples. The Project Chemist or designee will complete a Stage 2A-equivalent data review for waste characterization data, as defined in the General Data Validation Guidelines (DoD 2019b). Third-party data validation will not be performed on waste characterization data as stated in Worksheet #36.

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VICINITY MAP



Legend

- Soil Boring (No Name Ditch)
- Surface Water and Sediment Sample

N

0 200 400 600 800

Feet

For Official Use Only

Date: 3/14/2024

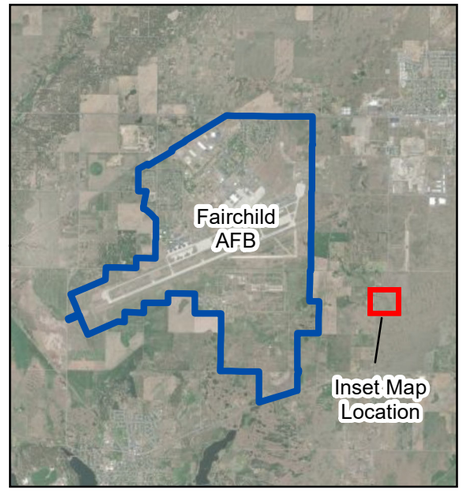
United States Air Force
Fairchild AFB, Washington

Figure 17-3:
Off-Base No Name Ditch
Sample Locations

Fairchild AFB
Phase I Remedial Investigation (RI)



VICINITY MAP



Legend

- Soil Boring (Flowage Easement)
- Surface Water and Sediment Sample

N

0 110 220 330 440

Feet

For Official Use Only

Date: 3/14/2024

United States Air Force
Fairchild AFB, Washington

Figure 17-4:
Flowage Easement
Sample Locations

Fairchild AFB
Phase I Remedial Investigation (RI)

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Worksheet #18: Sampling Locations and Methods

A summary of the samples to be collected under CLIN 0032/Task 28 is below. Location maps for NND are presented as part of Sample Design in Worksheet 17, as Figure 17-3 (Off-Base No Name Ditch) and Figure 17-4 (Flowage Easement). Sample identifications and descriptions are shown below in Table 18-1.

Table 18-1 Sample Identifications and Descriptions: No Name Ditch

Sample Identification	Matrix	Depth (ft bgs)	Type	Analytical Group	Sampling SOP
Soil Boring Samples - Off-Base No Name Ditch					
NND-47-A	Soil	(0-0.5)	Soil Boring	PFAS	SOP 025/ SOP 047/ SOP 073
NND-47-B	Soil	(2-3)	Soil Boring	PFAS	SOP 025/ SOP 047/ SOP 073
NND-47-C	Soil	(7-8)	Soil Boring	PFAS	SOP 025/ SOP 047/ SOP 073
NND-47-D	Soil	(above GW)	Soil Boring	PFAS	SOP 025/ SOP 047/ SOP 073
NND-47-GW	Aqueous	At GW	Soil Boring	PFAS	SOP 047/ SOP 073
NND-48-A	Soil	(0-0.5)	Soil Boring	PFAS	SOP 025/ SOP 047/ SOP 073
NND-48-B	Soil	(2-3)	Soil Boring	PFAS	SOP 025/ SOP 047/ SOP 073
NND-48-C	Soil	(7-8)	Soil Boring	PFAS	SOP 025/ SOP 047/ SOP 073
NND-48-D	Soil	(above GW)	Soil Boring	PFAS	SOP 025/ SOP 047/ SOP 073
NND-48-GW	Aqueous	At GW	Soil Boring	PFAS	SOP 047/ SOP 073
NND-49-A	Soil	(0-0.5)	Soil Boring	PFAS	SOP 025/ SOP 047/ SOP 073
NND-49-B	Soil	(2-3)	Soil Boring	PFAS	SOP 025/ SOP 047/ SOP 073
NND-49-C	Soil	(7-8)	Soil Boring	PFAS	SOP 025/ SOP 047/ SOP 073
NND-49-D	Soil	(above GW)	Soil Boring	PFAS	SOP 025/ SOP 047/ SOP 073
NND-49-GW	Aqueous	At GW	Soil Boring	PFAS	SOP 047/ SOP 073
NND-50-A	Soil	(0-0.5)	Soil Boring	PFAS	SOP 025/ SOP 047/ SOP 073
NND-50-B	Soil	(2-3)	Soil Boring	PFAS	SOP 025/ SOP 047/ SOP 073
NND-50-C	Soil	(7-8)	Soil Boring	PFAS	SOP 025/ SOP 047/ SOP 073
NND-50-D	Soil	(above GW)	Soil Boring	PFAS	SOP 025/ SOP 047/ SOP 073
NND-50-GW	Aqueous	At GW	Soil Boring	PFAS	SOP 047/ SOP 073
NND-51-A	Soil	(0-0.5)	Soil Boring	PFAS	SOP 025/ SOP 047/ SOP 073

Sample Identification	Matrix	Depth (ft bgs)	Type	Analytical Group	Sampling SOP
NND-51-B	Soil	(2-3)	Soil Boring	PFAS	SOP 025/ SOP 047/ SOP 073
NND-51-C	Soil	(7-8)	Soil Boring	PFAS	SOP 025/ SOP 047/ SOP 073
NND-51-D	Soil	(above GW)	Soil Boring	PFAS	SOP 025/ SOP 047/ SOP 073
NND-51-GW	Aqueous	At GW	Soil Boring	PFAS	SOP 047/ SOP 073
NND-52-A	Soil	(0-0.5)	Soil Boring	PFAS	SOP 025/ SOP 047/ SOP 073
NND-52-B	Soil	(2-3)	Soil Boring	PFAS	SOP 025/ SOP 047/ SOP 073
NND-52-C	Soil	(7-8)	Soil Boring	PFAS	SOP 025/ SOP 047/ SOP 073
NND-52-D	Soil	(above GW)	Soil Boring	PFAS	SOP 025/ SOP 047/ SOP 073
NND-52-GW	Aqueous	At GW	Soil Boring	PFAS	SOP 047/ SOP 073
NND-53-A	Soil	(0-0.5)	Soil Boring	PFAS	SOP 025/ SOP 047/ SOP 073
NND-53-B	Soil	(2-3)	Soil Boring	PFAS	SOP 025/ SOP 047/ SOP 073
NND-53-C	Soil	(7-8)	Soil Boring	PFAS	SOP 025/ SOP 047/ SOP 073
NND-53-D	Soil	(above GW)	Soil Boring	PFAS	SOP 025/ SOP 047/ SOP 073
NND-53-GW	Aqueous	At GW	Soil Boring	PFAS	SOP 047/ SOP 073
NND-54-A	Soil	(0-0.5)	Soil Boring	PFAS	SOP 025/ SOP 047/ SOP 073
NND-54-B	Soil	(2-3)	Soil Boring	PFAS	SOP 025/ SOP 047/ SOP 073
NND-54-C	Soil	(7-8)	Soil Boring	PFAS	SOP 025/ SOP 047/ SOP 073
NND-54-D	Soil	(above GW)	Soil Boring	PFAS	SOP 025/ SOP 047/ SOP 073
NND-54-GW	Aqueous	At GW	Soil Boring	PFAS	SOP 047/ SOP 073
NND-55-A	Soil	(0-0.5)	Soil Boring	PFAS	SOP 025/ SOP 047/ SOP 073
NND-55-B	Soil	(2-3)	Soil Boring	PFAS	SOP 025/ SOP 047/ SOP 073
NND-55-C	Soil	(7-8)	Soil Boring	PFAS	SOP 025/ SOP 047/ SOP 073
NND-55-D	Soil	(above GW)	Soil Boring	PFAS	SOP 025/ SOP 047/ SOP 073
NND-55-GW	Aqueous	At GW	Soil Boring	PFAS	SOP 047/ SOP 073
NND-56-A	Soil	(0-0.5)	Soil Boring	PFAS	SOP 025/ SOP 047/ SOP 073
NND-56-B	Soil	(2-3)	Soil Boring	PFAS	SOP 025/ SOP 047/ SOP 073
NND-56-C	Soil	(7-8)	Soil Boring	PFAS	SOP 025/ SOP 047/ SOP 073

Sample Identification	Matrix	Depth (ft bgs)	Type	Analytical Group	Sampling SOP
NND-56-D	Soil	(above GW)	Soil Boring	PFAS	SOP 025/ SOP 047/ SOP 073
NND-56-GW	Aqueous	At GW	Soil Boring	PFAS	SOP 047/ SOP 073
Soil Boring Samples - No Name Ditch Flowage Easement					
NND-57-A	Soil	(0-0.5)	Soil Boring	PFAS	SOP 025/ SOP 047/ SOP 073
NND-57-B	Soil	(2-3)	Soil Boring	PFAS	SOP 025/ SOP 047/ SOP 073
NND-57-C	Soil	(7-8)	Soil Boring	PFAS	SOP 025/ SOP 047/ SOP 073
NND-57-D	Soil	(12-13)	Soil Boring	PFAS	SOP 025/ SOP 047/ SOP 073
NND-57-E	Soil	(17-18)	Soil Boring	PFAS	SOP 025/ SOP 047/ SOP 073
NND-57-F	Soil	(22-23)	Soil Boring	PFAS	SOP 025/ SOP 047/ SOP 073
NND-57-G	Soil	(27-28)	Soil Boring	PFAS	SOP 025/ SOP 047/ SOP 073
NND-57-H	Soil	(above GW)	Soil Boring	PFAS	SOP 025/ SOP 047/ SOP 073
NND-57-GW	Aqueous	At GW	Soil Boring	PFAS	SOP 047/ SOP 073
NND-58-A	Soil	(0-0.5)	Soil Boring	PFAS	SOP 025/ SOP 047/ SOP 073
NND-58-B	Soil	(2-3)	Soil Boring	PFAS	SOP 025/ SOP 047/ SOP 073
NND-58-C	Soil	(7-8)	Soil Boring	PFAS	SOP 025/ SOP 047/ SOP 073
NND-58-D	Soil	(12-13)	Soil Boring	PFAS	SOP 025/ SOP 047/ SOP 073
NND-58-E	Soil	(17-18)	Soil Boring	PFAS	SOP 025/ SOP 047/ SOP 073
NND-58-F	Soil	(22-23)	Soil Boring	PFAS	SOP 025/ SOP 047/ SOP 073
NND-58-G	Soil	(27-28)	Soil Boring	PFAS	SOP 025/ SOP 047/ SOP 073
NND-58-H	Soil	(above GW)	Soil Boring	PFAS	SOP 025/ SOP 047/ SOP 073
NND-58-GW	Aqueous	At GW	Soil Boring	PFAS	SOP 047/ SOP 073
NND-59-A	Soil	(0-0.5)	Soil Boring	PFAS	SOP 025/ SOP 047/ SOP 073
NND-59-B	Soil	(2-3)	Soil Boring	PFAS	SOP 025/ SOP 047/ SOP 073
NND-59-C	Soil	(7-8)	Soil Boring	PFAS	SOP 025/ SOP 047/ SOP 073
NND-59-D	Soil	(12-13)	Soil Boring	PFAS	SOP 025/ SOP 047/ SOP 073
NND-59-E	Soil	(17-18)	Soil Boring	PFAS	SOP 025/ SOP 047/ SOP 073
NND-59-F	Soil	(22-23)	Soil Boring	PFAS	SOP 025/ SOP 047/ SOP 073

Sample Identification	Matrix	Depth (ft bgs)	Type	Analytical Group	Sampling SOP
NND-59-G	Soil	(27-28)	Soil Boring	PFAS	SOP 025/ SOP 047/ SOP 073
NND-59-H	Soil	(above GW)	Soil Boring	PFAS	SOP 025/ SOP 047/ SOP 073
NND-59-GW	Aqueous	At GW	Soil Boring	PFAS	SOP 047/ SOP 073
NND-60-A	Soil	(0-0.5)	Soil Boring	PFAS	SOP 025/ SOP 047/ SOP 073
NND-60-B	Soil	(2-3)	Soil Boring	PFAS	SOP 025/ SOP 047/ SOP 073
NND-60-C	Soil	(7-8)	Soil Boring	PFAS	SOP 025/ SOP 047/ SOP 073
NND-60-D	Soil	(12-13)	Soil Boring	PFAS	SOP 025/ SOP 047/ SOP 073
NND-60-E	Soil	(17-18)	Soil Boring	PFAS	SOP 025/ SOP 047/ SOP 073
NND-60-F	Soil	(22-23)	Soil Boring	PFAS	SOP 025/ SOP 047/ SOP 073
NND-60-G	Soil	(27-28)	Soil Boring	PFAS	SOP 025/ SOP 047/ SOP 073
NND-60-H	Soil	(above GW)	Soil Boring	PFAS	SOP 025/ SOP 047/ SOP 073
NND-60-GW	Aqueous	At GW	Soil Boring	PFAS	SOP 047/ SOP 073
NND-61-A	Soil	(0-0.5)	Soil Boring	PFAS	SOP 025/ SOP 047/ SOP 073
NND-61-B	Soil	(2-3)	Soil Boring	PFAS	SOP 025/ SOP 047/ SOP 073
NND-61-C	Soil	(7-8)	Soil Boring	PFAS	SOP 025/ SOP 047/ SOP 073
NND-61-D	Soil	(12-13)	Soil Boring	PFAS	SOP 025/ SOP 047/ SOP 073
NND-61-E	Soil	(17-18)	Soil Boring	PFAS	SOP 025/ SOP 047/ SOP 073
NND-61-F	Soil	(22-23)	Soil Boring	PFAS	SOP 025/ SOP 047/ SOP 073
NND-61-G	Soil	(27-28)	Soil Boring	PFAS	SOP 025/ SOP 047/ SOP 073
NND-61-H	Soil	(above GW)	Soil Boring	PFAS	SOP 025/ SOP 047/ SOP 073
NND-61-GW	Aqueous	At GW	Soil Boring	PFAS	SOP 047/ SOP 073
NND-62-A	Soil	(0-0.5)	Soil Boring	PFAS	SOP 025/ SOP 047/ SOP 073
NND-62-B	Soil	(2-3)	Soil Boring	PFAS	SOP 025/ SOP 047/ SOP 073
NND-62-C	Soil	(7-8)	Soil Boring	PFAS	SOP 025/ SOP 047/ SOP 073
NND-62-D	Soil	(12-13)	Soil Boring	PFAS	SOP 025/ SOP 047/ SOP 073
NND-62-E	Soil	(17-18)	Soil Boring	PFAS	SOP 025/ SOP 047/ SOP 073

Sample Identification	Matrix	Depth (ft bgs)	Type	Analytical Group	Sampling SOP
NND-62-F	Soil	(22-23)	Soil Boring	PFAS	SOP 025/ SOP 047/ SOP 073
NND-62-G	Soil	(27-28)	Soil Boring	PFAS	SOP 025/ SOP 047/ SOP 073
NND-62-H	Soil	(above GW)	Soil Boring	PFAS	SOP 025/ SOP 047/ SOP 073
NND-62-GW	Aqueous	At GW	Soil Boring	PFAS	SOP 047/ SOP 073
NND-63-A	Soil	(0-0.5)	Soil Boring	PFAS	SOP 025/ SOP 047/ SOP 073
NND-63-B	Soil	(2-3)	Soil Boring	PFAS	SOP 025/ SOP 047/ SOP 073
NND-63-C	Soil	(7-8)	Soil Boring	PFAS	SOP 025/ SOP 047/ SOP 073
NND-63-D	Soil	(12-13)	Soil Boring	PFAS	SOP 025/ SOP 047/ SOP 073
NND-63-E	Soil	(17-18)	Soil Boring	PFAS	SOP 025/ SOP 047/ SOP 073
NND-63-F	Soil	(22-23)	Soil Boring	PFAS	SOP 025/ SOP 047/ SOP 073
NND-63-G	Soil	(27-28)	Soil Boring	PFAS	SOP 025/ SOP 047/ SOP 073
NND-63-H	Soil	(above GW)	Soil Boring	PFAS	SOP 025/ SOP 047/ SOP 073
NND-63-GW	Aqueous	At GW	Soil Boring	PFAS	SOP 047/ SOP 073
NND-64-A	Soil	(0-0.5)	Soil Boring	PFAS	SOP 025/ SOP 047/ SOP 073
NND-64-B	Soil	(2-3)	Soil Boring	PFAS	SOP 025/ SOP 047/ SOP 073
NND-64-C	Soil	(7-8)	Soil Boring	PFAS	SOP 025/ SOP 047/ SOP 073
NND-64-D	Soil	(12-13)	Soil Boring	PFAS	SOP 025/ SOP 047/ SOP 073
NND-64-E	Soil	(17-18)	Soil Boring	PFAS	SOP 025/ SOP 047/ SOP 073
NND-64-F	Soil	(22-23)	Soil Boring	PFAS	SOP 025/ SOP 047/ SOP 073
NND-64-G	Soil	(27-28)	Soil Boring	PFAS	SOP 025/ SOP 047/ SOP 073
NND-64-H	Soil	(above GW)	Soil Boring	PFAS	SOP 025/ SOP 047/ SOP 073
NND-64-GW	Aqueous	At GW	Soil Boring	PFAS	SOP 047/ SOP 073
NND-65-A	Soil	(0-0.5)	Soil Boring	PFAS	SOP 025/ SOP 047/ SOP 073
NND-65-B	Soil	(2-3)	Soil Boring	PFAS	SOP 025/ SOP 047/ SOP 073
NND-65-C	Soil	(7-8)	Soil Boring	PFAS	SOP 025/ SOP 047/ SOP 073
NND-65-D	Soil	(12-13)	Soil Boring	PFAS	SOP 025/ SOP 047/ SOP 073

Sample Identification	Matrix	Depth (ft bgs)	Type	Analytical Group	Sampling SOP
NND-65-E	Soil	(17-18)	Soil Boring	PFAS	SOP 025/ SOP 047/ SOP 073
NND-65-F	Soil	(22-23)	Soil Boring	PFAS	SOP 025/ SOP 047/ SOP 073
NND-65-G	Soil	(27-28)	Soil Boring	PFAS	SOP 025/ SOP 047/ SOP 073
NND-65-H	Soil	(above GW)	Soil Boring	PFAS	SOP 025/ SOP 047/ SOP 073
NND-65-GW	Aqueous	At GW	Soil Boring	PFAS	SOP 047/ SOP 073
NND-66-A	Soil	(0-0.5)	Soil Boring	PFAS	SOP 025/ SOP 047/ SOP 073
NND-66-B	Soil	(2-3)	Soil Boring	PFAS	SOP 025/ SOP 047/ SOP 073
NND-66-C	Soil	(7-8)	Soil Boring	PFAS	SOP 025/ SOP 047/ SOP 073
NND-66-D	Soil	(12-13)	Soil Boring	PFAS	SOP 025/ SOP 047/ SOP 073
NND-66-E	Soil	(17-18)	Soil Boring	PFAS	SOP 025/ SOP 047/ SOP 073
NND-66-F	Soil	(22-23)	Soil Boring	PFAS	SOP 025/ SOP 047/ SOP 073
NND-66-G	Soil	(27-28)	Soil Boring	PFAS	SOP 025/ SOP 047/ SOP 073
NND-66-H	Soil	(above GW)	Soil Boring	PFAS	SOP 025/ SOP 047/ SOP 073
NND-66-GW	Aqueous	At GW	Soil Boring	PFAS	SOP 047/ SOP 073
Surface Water/Sediment - Off-Base No Name Ditch					
NND-67-SED	Sediment	NA	Grab	PFAS	SOP 021/ SOP 073
NND-67-SW	Aqueous	NA	Grab	PFAS	SOP 007/ SOP 073
NND-68-SED	Sediment	NA	Grab	PFAS	SOP 021/ SOP 073
NND-68-SW	Aqueous	NA	Grab	PFAS	SOP 007/ SOP 073
NND-69-SED	Sediment	NA	Grab	PFAS	SOP 021/ SOP 073
NND-69-SW	Aqueous	NA	Grab	PFAS	SOP 007/ SOP 073
NND-70-SED	Sediment	NA	Grab	PFAS	SOP 021/ SOP 073
NND-70-SW	Aqueous	NA	Grab	PFAS	SOP 007/ SOP 073
NND-71-SED	Sediment	NA	Grab	PFAS	SOP 021/ SOP 073
NND-71-SW	Aqueous	NA	Grab	PFAS	SOP 007/ SOP 073
NND-72-SED	Sediment	NA	Grab	PFAS	SOP 021/ SOP 073
NND-72-SW	Aqueous	NA	Grab	PFAS	SOP 007/ SOP 073
NND-73-SED	Sediment	NA	Grab	PFAS	SOP 021/ SOP 073
NND-73-SW	Aqueous	NA	Grab	PFAS	SOP 007/ SOP 073
NND-74-SED	Sediment	NA	Grab	PFAS	SOP 021/ SOP 073
NND-74-SW	Aqueous	NA	Grab	PFAS	SOP 007/ SOP 073
NND-75-SED	Sediment	NA	Grab	PFAS	SOP 021/ SOP 073
NND-75-SW	Aqueous	NA	Grab	PFAS	SOP 007/ SOP 073

Sample Identification	Matrix	Depth (ft bgs)	Type	Analytical Group	Sampling SOP
NND-76-SED	Sediment	NA	Grab	PFAS	SOP 021/ SOP 073
NND-76-SW	Aqueous	NA	Grab	PFAS	SOP 007/ SOP 073
NND-77-SED	Sediment	NA	Grab	PFAS	SOP 021/ SOP 073
NND-77-SW	Aqueous	NA	Grab	PFAS	SOP 007/ SOP 073
NND-78-SED	Sediment	NA	Grab	PFAS	SOP 021/ SOP 073
NND-78-SW	Aqueous	NA	Grab	PFAS	SOP 007/ SOP 073
NND-79-SED	Sediment	NA	Grab	PFAS	SOP 021/ SOP 073
NND-79-SW	Aqueous	NA	Grab	PFAS	SOP 007/ SOP 073
NND-80-SED	Sediment	NA	Grab	PFAS	SOP 021/ SOP 073
NND-80-SW	Aqueous	NA	Grab	PFAS	SOP 007/ SOP 073
NND-81-SED	Sediment	NA	Grab	PFAS	SOP 021/ SOP 073
NND-81-SW	Aqueous	NA	Grab	PFAS	SOP 007/ SOP 073

Notes:
GW = Groundwater
NA = Not applicable
NND = No Name Ditch
SED = Sediment
SW = Surface water

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Worksheets #19 and 30: Sample Containers, Preservation, and Hold Times

Laboratories:

APPL
908 N. Temperance Ave., Clovis, California 93611
Contact: Monica Strickland-Garcia, email: monica.garcia-strickland@metirigroup.com
Phone (559) 825-9005

Eurofins Sacramento
880 Riverside Parkway, West Sacramento, California 95605
Contact: Jill Kellman, email: Jill.Kellmann@et.eurofinsus.com
Phone (916) 373-5600

Sample Delivery Method: Expedited courier service

Analyte Group	Matrix	Method/SOP	Accreditation Expiration Date	Container(s) (number, size, and type per sample)[(1)]	Preservation	Preparation Holding Time	Analytical Holding Time	Data Package Turnaround
PFAS	Ground-water and Surface Water	LC/MS/MS compliant with Table B-15 of DoD/DOE QSM, Version 5.4 (or later)/ APPL SOP: HPL537 Eurofins Sacramento SOP: WS-LC-0025	Appendix C	Two 250-mL HDPE bottles with HDPE-lined cap	Cool to ≤6°C, not frozen	28 days from sample collection until extraction	28 days from extraction until analysis	15 working days from sample receipt
PFAS	Soil and Sediment	LC/MS/MS compliant with Table B-15 of DoD/DOE QSM, Version 5.4 (or later)/ APPL SOP: HPL537 Eurofins Sacramento SOP: WS-LC-0025	Appendix C	50-mL or 4-oz HDPE bottles with HDPE-lined cap	Cool to ≤6°C, not frozen	28 days from sample collection until extraction	28 days from extraction until analysis	15 working days from sample receipt

Notes:
[(1)] The actual number and size of container will be coordinated with the laboratory performing the analyses and may be slightly different than listed here. For soil and sediment, sufficient material will be provided to the laboratory to determine dry weight.
°C = degrees Celsius
HDPE = high density polyethylene
mL = milliliter(s)
oz = ounce(s)

Worksheet #21: Field Standard Operating Procedures

SOP 021 has been added to Appendix A as indicated in the following table. The following SOPs have newer versions and have been added to Appendix A: SOP 007, SOP 010, SOP 025, SOP 028, SOP 033, SOP 047, and SOP 073.

SOP Reference No.	Responsible Organization	Title, Revision Number, and/or Revision Date[(1)]	Equipment Type or Instrument	Modified for Project Work?
SOP 007	EA	SOP for Surface Water Sampling, Revision 2, March 2020	Sample collection equipment and containers	Note that the requirements listed in EA SOP No. 073 such as prohibition of the use of materials containing Teflon will be followed.
SOP 010	EA	SOP for Water Level and Well Depth Measurements, Revision 2, March 2021	Solinst® Model 101 water level meter, interface probe, and field forms	No.
SOP 021	EA	SOP for Sediment Sampling, Revision 2, March 2019	Sampler (scoops, spoons, or similar), sample bottles, and appropriate field forms	Note that the requirements listed in EA SOP No. 073 such as prohibition of the use of materials containing Teflon will be followed.
SOP 025	EA	SOP for Soil Sampling, Revision 2, September 2023	Sampler (push tube, split-spoon, core barrel, or similar), stainless steel bowl, spoon, spoon, trowel, knife, spatula, and appropriate field forms	Note that the requirements listed in EA SOP No. 073 such as prohibition of the use of materials containing Teflon will be followed.
SOP 028	EA	SOP for Well and Boring Abandonment, Revision 1, January 2021	Drill rig, bentonite, cement	No.
SOP 047	EA	SOP for Direct-Push Technology Sampling, Revision 1, April 2023	Drilling equipment, photoionization detector, and field forms	Note that the requirements listed in EA SOP No. 073 such as prohibition of the use of materials containing Teflon will be followed.

Worksheet #21: Field Standard Operating Procedures (Continued)

SOP Reference No.	Responsible Organization	Title, Revision Number, and/or Revision Date[(1)]	Equipment Type or Instrument	Modified for Project Work?
SOP 073	EA	SOP for Sampling for Per- and Polyfluorinated Alkyl Substances, Revision 2, November 2023	Delineates protocols for collecting environmental samples for analysis of PFAS, also known generally as perfluoroalkyl compounds or chemicals	No.

Note:
[(1)] Field SOPs are provided in Appendix A.

Worksheet #23: Analytical Standard Operating Procedures

Lab SOP No.	Title and Revision Date	Organization Performing Analysis	Definitive or Screening Data	Matrix/ Analytical Group	SOP Option or Equipment Type	Modified for Project Work? (Yes/No)
HPL537	Instrumental Analysis of PFAS by LC/MS/MS (EPA Method 537.1, 533, and DoD QSM Table B-15); Revision 9 Effective date: 31 August 2024	APPL	Definitive	Groundwater, Surface Water, Soil, and Sediment / PFAS	LC/MS/MS	No
WS-LC-0025	PFAS in Waters, Soils, Sediments and Tissue [Method 537 (Modified), Method PFAS by LCMSMS Compliant with QSM Table B-15, Revision 5.3 and higher]; Revision: 4.0; Effective date: 27 January 2021; Last review date: 29 January 2024	Eurofins Sacramento	Definitive	Groundwater, Surface Water, Soil, and Sediment / PFAS	LC/MS/MS	No

Worksheet #36: Data Validation Procedures

Data validation is an analyte- and sample-specific process for evaluating the compliance with contract requirements, methods, SOPs, and method performance criteria. The criteria that will be used to evaluate project data include the UFP-QAPP (EA 2021), this addendum, the QSM Version 5.4 (DoD and DOE 2021), Module 3 Data Validation Guidelines: Data Validation Procedure for Per- and Polyfluoroalkyl Substances Analysis by Quality Systems Manual for Environmental Laboratories Table B-15 (DoD 2020), and Modules 1,2,3, and 4 Revised Table for Sample Qualification in the Presence of Blank Contamination (DoD 2022).

Validation will be performed by a third-party (Synectics, Inc.). The planned data validation will follow the required activities for a Stage 2B validation (100 percent of project data) with an additional Stage 4 validation on a subset (minimum of 10 percent of project data). The data validation stages are described in Module 3 Data Validation Guidelines: Data Validation Procedure for Per- and Polyfluoroalkyl Substances Analysis by Quality Systems Manual for Environmental Laboratories Table B-15 (DoD 2020). A data validation report will be completed for every laboratory data package, with the exception of IDW data packages as discussed in Worksheet #17 Section 14.4.

There are no substantive changes to the UFP-QAPP (EA 2021) Worksheet #36, with the exception that Modules 1,2,3, and 4 from the Revised Table for Sample Qualification in the Presence of Blank Contamination (DoD 2022) will be applied when evaluating the impact of detected target analytes in blanks (e.g., method, field, and/or equipment blanks) on associated sample results. Following is a summary of data validation criteria that will be applied when detections of target analytes are reported in blanks.

Table 36-1 Sample Qualification in the Presence of Blank Contamination

Sample Result (as Reported by the Laboratory)	Validated Sample Result	Validation Qualifier
Non-detect or ≤ LOD	Report at LOD	U
> LOD and ≤ five times the blank concentration	Report at Sample Result	J (indication of potential high bias)
> Five times the blank concentration	Report at Sample Result	None

Note:
LOD = limit of detection
U = undetected

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3. REFERENCES

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Appendix A

Standard Operating Procedure Addition

Standard Operating Procedure No. 007
for
Surface Water Sampling

Prepared by

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Revision: 02
March 2020

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PROJECT-SPECIFIC VARIANCE FORM

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SOP No. 007	
SOP Section	**Variance**

Project Manager (Name)

Project Manager (Signature) Date

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DOCUMENT REVISION HISTORY

ORIGINAL (MASTER) DOCUMENT REVISION HISTORY				
Revision Number	**Revision Date**	**Revision Summary**	**Revised By**	**Reviewed By**
02	March 2020	Systematic Review and Update	Jason Stroup Kevin Kowalk	Matthew Bowman

1. SCOPE AND APPLICATION

The purpose of this standard operating procedure (SOP) is to delineate protocols for sampling surface water. This procedure can be applied to the collection of surface water samples from marine and estuarine systems, streams, rivers, ditches, lakes, ponds, and lagoons. Surface water samples provide an indication of the amount of contaminant in the surface water. It is, therefore, important to collect a representative sample.

2. MATERIALS

The following materials may be required:

0.45-micrometer (µm) disposable filters	Sample bottles
Cooler with ice	Short-handled dip sampler (PTFE or stainless steel)
Long-handled dip sampler (polytetrafluoroethelyne [PTFE] or stainless steel)	Stainless steel or PTFE-lined bucket
Peristaltic pump	Niskin bottle (or similar sampling device)
Disposable peristaltic head tubing	Disposable Teflon and/or Teflon lined poly tubing

3. PROCEDURE

For all surface water samples, use a Global Positioning System to record sampling coordinates and mark the sampling locations on a site map. Photograph (if cameras are allowed onsite) and describe each location, place a numbered stake above the visible high-water mark on the bank closest to the sampling location, and/or mark adjacent trees with surveyor's flagging. The photographs and descriptions must be adequate to allow the sampling station to be relocated at some future date by someone other than the original sampling crew. Use a long-handled dip sampler where access is poor or non-contact with water is suggested in the Health and Safety Plan.

Sampling should be performed deliberately and methodically to minimize disturbance of bottom sediments, yet as quickly as possible to ensure a representative sample. If wading in a stream, sample upstream at the sampling location to prevent disturbance of the stream bottom from impacting the sample. To prevent contamination of the exterior of the sample container, and/or potential contamination of the surface water sample by laboratory contaminants on the exterior of the bottle, the sample container should never be dipped into the water; rather, a decontaminated sampling device should be used to collect unfiltered samples.

Sampling with the PTFE or stainless steel sampler (long-handled or measuring cup-type):

- Remove the cap from the sample bottle.
- Dip a sample of surface water using the sampler.

- Tilt sample bottle and gently pour sample from sampler into the bottle. Allow the sample to trickle down the side of the bottle. Avoid aerating the sample.
- Add preservative as required. Replace cap, and place in cooler immediately.

Sampling with stainless steel or PTFE-lined bucket:

- Remove cap from sample bottle.
- Gently dip collection bucket in the water. Fill bucket and carefully lift from water body.
- Tilt sample bottle and gently pour sample from sampler into the bottle. Allow the sample to trickle down the side of the bottle. Avoid aerating the sample.
- Add preservative as required. Replace cap, and place in cooler immediately.

– OR –

- Use smaller sampling cup to transfer sample from bucket to sample bottle as described above.

Sampling with a Niskin bottle (or similar device):

- Prepare the bottle for deployment by placing the ends of the bottle in the open position and lock the ends into the trigger mechanism.
- Lower the bottle to the desired depth of sampling (on either a wire cable or rope).
- Place a messenger (triggering device) on the cable/rope and deploy by allowing free-fall down the cable/rope.
- Bring the bottle back to the surface and pour sample into a sample container.

Sampling with a peristaltic pump and Teflon® or Teflon® lined tubing:

- Cut a length of Teflon® tubing to the depth of sampling specified by the client or project-specific Sampling and Analysis Plan.
- Insert one end of the tubing into the intake hose on the peristaltic pump.
- Place a stainless steel weight on the tubing and lower to the specified depth;
- Cut a length of tubing and insert into the output (out-flow) hose on the peristaltic pump.

- After applying power to the peristaltic pump, proceed to pump site water through the tubing apparatus. The hose volume should be pumped approximately five times through the tubing before sampling.

- Fill the required sample containers.

- If filtering is required, obtain filtered sample by placing a 0.45-µm in-line filter on the end of the output tube and fill the required sample containers.

Both filtered and unfiltered samples may be required for metals analyses. Bulk samples for filtration will be collected using the stainless steel or PTFE-lined bucket method described above. Sample filtration must be performed immediately upon retrieval of the bulk sample as follows.

Filtration will be performed immediately after collecting sample. Set up filtration equipment prior to collecting sample. Filtration may be accomplished by gravity or, if necessary due to slow filtering, a peristaltic pump will be used to pressure filter the sample. Vacuum filtration will not be used due to the possibility of analyte volatilization.

Gravity filtration will be accomplished as follows:

- Using decontaminated forceps, place a 0.45-µm membrane in a decontaminated filter funnel.

- Slowly pour sample into the funnel and collect filtrate directly into appropriate sample container(s).

- Add preservative(s) as required by project-specific Sampling and Analysis Plan. Immediately cap container and place in cooler.

- Dispose of filter membrane.

Pressure filtration will be accomplished as follows:

- Using previously assembled disposable tubing, 45-µm in-line filter, and peristaltic pump, filter sample from collection bucket into appropriate container.

- Adjust pump rate to avoid aeration of sample.

- Fill container, add preservative as required immediately cap container, and place in cooler.

- Dispose of filter and tubing.

4. MAINTENANCE

Refer to manufacturer's specifications for maintenance procedures on generators and pumps.

5. PRECAUTIONS

The following precautions should be taken:

- Avoid disturbing bottom sediments.
- Consult the Health and Safety Plan prior to collecting any samples for personal protective equipment such as dermal and respiratory protection and personal flotation devices when sampling in or near deep water or from boats.
- Always decontaminate the sampling and filtration equipment, and change gloves between sampling locations to minimize the risk of cross-contamination.

6. REFERENCES

None.

Standard Operating Procedure No. 010
for
Water Level and Well Depth Measurements

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☐ **A. Variances required; cite section(s) of the SOP to which there is a variance**

☐ **B. No variances**

SOP No. 010	
SOP Section	**Variance**

Project Manager (Name)

Project Manager (Signature) Date

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Revision Number	**Revision Date**	**Revision Summary**	**Revised By**	**Reviewed By**
01	September 2018	Systematic update and review	Cristina Radu Amanda Kohn	Matthew Bowman
02	March 2021	Added "Relative Elevation Survey" section	AnnMarie Ricchino	Matthew Bowman

1. SCOPE AND APPLICATION

The purpose of this Standard Operating Procedure (SOP) is to present the protocols for measuring depth to groundwater, presence and thickness of non-aqueous phase liquid (NAPL), and well depth in groundwater wells. This procedure is applicable to the sampling of monitoring wells and must be performed prior to any activities that may disturb the water level (i.e., purging or aquifer testing).

2. MATERIALS

The following materials may be required:

- Electronic sounding device with calibrated cable or tape measured at 0.01-foot increments (i.e., water level meter or oil/water interface probe) OR transducer and datalogger
- Plastic sheeting
- Photoionization detector or intrinsically safe flame ionization detector
- Materials required for decontamination per SOP Number (No.) 005
- A leveling rod and an auto level equipped with a telescope tube and tripod if conducting a relative elevation survey
- Well construction diagrams, well records, and/or survey information
- Field forms (i.e., well gauging forms, well assessment forms, purge logs) and/or field logbook.

3. PROCEDURE

3.1 PRELIMINARY STEPS

Compile well construction data/forms, survey information, and historical data, if available, prior to field mobilization. The type and length of electronic sounding device to be used will be based on the monitoring well diameter, well installation depth, and the presence/absence of NAPL. Oil/water interface probes will be used in all wells for the first round of sampling, regardless of site history.

When planning on measuring depth to water at a site where product may be present in wells, the wells should be segregated between potentially contaminated and not contaminated categories.

The sequence of well gauging should be established to minimize the potential of cross contamination by generally gauging clean wells first.

Ensure that the electronic sounding device is working prior to mobilization by submerging the probe in a container of potable or deionized water. Keep the indicator probe in its protective case when not in use. Locate the well and verify its position on the site map. Record on the applicable field form(s) or in the field logbook whether positive identification was obtained, including the well number/identification and any identifying marks, codes, or tags contained on the well casing or protective casing.

3.2 RELATIVE ELEVATION SURVEY

A relative elevation survey of groundwater monitoring wells is essential to produce accurate groundwater elevation measurements. This task requires a minimum of two people and necessitates the use of an auto level equipped with a telescope tube and tripod (referred to as the instrument) as well as a leveling rod. The telescope tube is designed to impose a set of cross hairs on the image viewed through the telescope, which will intersect with a numbered graduated line on the leveling rod when held in its line of site.

All measurements should be taken relative to an accurately surveyed and clearly visible elevation reference point on the monitoring well. For consistency, the reference point shall be located on the north side of the inner well casing and be clearly visible with a notch or some other permanent method. The proper steps to conduct the relative elevation survey are as follows:

- The survey process is started from a benchmark (BM) of known elevation or that has been assigned an arbitrary elevation. This can be a monitoring well or other known location.

- The instrument should be set up within 300 feet of the BM to reduce the potential of reading errors.

- A check should be done to ensure the bubble is in the center of the small bullseye level located on the instrument, indicating a horizontal line of sight. (Large adjustments can be made using the legs of the tripods whereas smaller adjustments can be made using the leveling screws.)

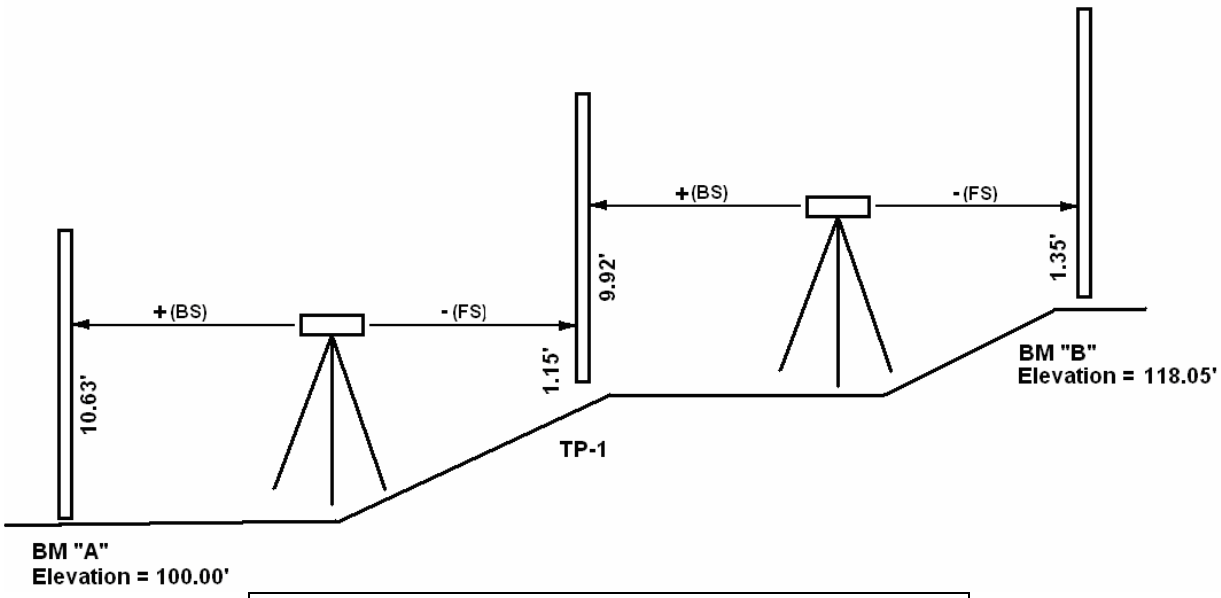
- The rod person will hold the rod vertically on the BM with the face of the rod containing the numbered graduations facing the instrument. The instrument person will look through the telescope and take note of the graduated line reading where the crosshairs intersect. This reading is the backsight (BS).

- The BS reading should be added to the known BM elevation to calculate the height of instrument (HI).

- Once the HI is known, multiple points can be determined from that setup if a rod reading is visible on the point. If the instrument person is unable to observe a rod reading on the point, establishment of a turning point (TP) is necessary.

- To establish a TP, keep the instrument in its current setup location and move the leveling rod to the chosen TP location. Take a rod reading and note it as a foresight (FS). Subtract the FS reading from the HI to determine the elevation of that TP. The instrument can then be moved ahead, and the entire process repeated with the TP as the new BM (Figure 1 provides an example diagram and accompanying notes below). Be sure to mark TP locations on a map of the site. If multiple TPs are established during surveying, number them accordingly (e.g., TP1, TP2, etc.).

- If a line of levels is run involving two or more setups, run a line of levels back to the original BM or to another BM to check for accuracy of work.



Surveying notes				
STA.	**BS (+)**	**HI**	**FS (-)**	**Elev.**
BM A	10.63	110.63		100.0
TP-1			1.15	109.48
TP-1	9.92	119.40		
BM B			1.35	118.05

Figure 1. Differential leveling instrument setup and elevation calculations including one turning point (Archuleta and Gilbert 2000).

Leveling Term	Definition
Benchmark (BM)	Monument or point with known elevation
Backsight (BS)	Rod reading taken on a point of known elevation (always add to determine elevation)
Foresight (FS)	Rod reading taken on a point to determine the elevation at that point (always subtract from HI to determine elevation)
Height of Instrument (HI)	The elevation of the level line sight projected by the instrument
Turning Point (TP)	Intermediate reference point used when it is necessary to move the instrument ahead while running a line of levels

3.3 WELL HEADSPACE SCREENING

Refer to the Health and Safety Plan or applicable planning documents to determine if well headspace screening is required. At a site where historical information is available, well headspace screening may be omitted.

Headspace screening will be conducted using an organic vapor meter (photoionization detector or flame ionization detector). All headspace screening should be performed at arm's length and from the upwind side of the well, if possible. Refer to SOP Nos. 011, 023, or 024 as appropriate.

Screen the ambient air in the breathing area around the wellhead and record the reading on the applicable field form(s) and/or in the field logbook. Once the breathing area is deemed safe, unlock/open the well protective casing to get access to the wellhead. Re-screen the ambient air again to determine if organic vapors may have accumulated.

Screen the air in the wellhead (headspace) for gross organic vapors. This will indicate the presence of gross volatile contaminants as well as potential sampler exposure. Most well casings are covered with a cap, some are outfitted with pump assemblies, while some may not have a cap at all. If a cap is present, sample the air in the wellhead for gross organic vapors by lifting the well cap only high enough for the organic vapor meter probe to be entered into the well casing. If a pump assembly is present on top of the casing, locate the gauging port, remove the cap, and insert the probe to make the measurement. If a cap is not present, insert the probe in the well casing. Record the reading on the applicable field form(s) and/or in the field logbook.

If volatiles are detected, allow the well to vent for 60-90 seconds and re-screen and record the headspace readings. If the second reading is lower than the first, use the second reading to determine whether respiratory protection will be required during subsequent activities.

3.4 WELL ASSESSMENT

Once the breathing zone at the wellhead is deemed safe or applicable respiratory protection is donned if needed, conduct the well assessment. Record the well assessment information on applicable field forms (well assessment form) or in the field logbook.

Assess and record the condition of the well casing, well pad and bollards, well cover, and any equipment (pump assembly). Record any observations and remarks regarding the completion

characteristics and well condition (i.e., evidence of cracked casing or surface seals, security of the well [locked cap], or evidence of tampering). Note if there are discrepancies between current well condition/completion and well construction diagrams/records or well survey data (i.e., damage or modifications to the well including but not limited to frost heaving, broken or otherwise damaged casing, conversion to/from flush mount or stick-up, installation or removal of polyvinyl chloride collar or other material on inner casing, installation or removal of a pump assembly, etc.).

Next, locate the measurement reference point from where water, NAPL, and well depth measurements will be performed. This reference point should be scribed, notched, or otherwise noted and the elevation included in the documentation of the well survey data. It is critical that the actual survey point is known and used consistently throughout monitoring events.

If no reference marks are present or if changes have been made to the well casing since the survey, measure depths based on the highest point of the well casing. If there is no high point, measure depths to the northern side of either the well polyvinyl chloride casing or the pump assembly cover. Permanently mark the measurement location for future survey and/or measurement purposes. Determine the new reference point elevation by measuring the distance from a known surveyed point (surveyed elevation of the protective casing or ground surface). Record this difference on the applicable field form(s) or in the field logbook for use in groundwater elevation calculations.

3.5 LIQUID LEVEL AND WELL DEPTH MEASUREMENTS

Typically, a complete round of static liquid levels and monitoring well depths is conducted as one of the first steps during groundwater monitoring. However, if monitoring wells are to be sampled for per- and polyfluoroalkyl substances, gauging should be completed after groundwater sampling to mitigate the possibility of cross-contamination.

Equipment should be decontaminated prior to first use in the field and after each use. Refer to SOP No. 005 for decontamination procedures. Keep all equipment and supplies protected from gross contamination; use clean plastic sheeting and keep the electronic sounding device probe in its protective case when not in use.

Measure NAPL and water levels and well depths as detailed in the subsections below. When measuring depths, grasp the cable with the thumb and forefingers at the top of the casing and record the depth based on the measurement reference point detailed in Section 3.3.

Gauging information including dates/times, water depths, NAPL depths and thicknesses, and well depths will be recorded on applicable field forms (i.e., well gauging form, well assessment form, purge form, etc.) and/or in the field logbook.

3.5.1 Non-Aqueous Phase Liquid Level Measurements

Always perform NAPL checks for the following conditions:

- The first time a well is sampled
- In wells installed in or near areas with suspected or confirmed NAPL contamination
- If headspace test reveals presence of volatiles.

Use an oil/water interface probe to determine the presence and thickness of NAPL. An oil/water interface probe will have a different alarm tone (continuous or intermittent) for NAPL versus water. The air/liquid interface depth measurements will be more accurate if the probe is lowered into liquid. The NAPL/water depths will be more accurate if the probe is moved from water into NAPL. Always lower and raise the interface probe slowly to prevent undue mixing of media. Complete all measurements as follows:

- Upon removing the well cap as a part of headspace screening described in Section 3.2, ensure that enough time (a couple of minutes) has passed for the air pressure in the well to have equalized with atmospheric pressure.

- Turn the interface probe on and test the alarm and liquid indication light.

- Remove the indicator probe from the protective case. Slowly lower the probe and cable into the well, allowing the cable reel to unwind. Continue lowering until the alarm sounds and the liquid indication light comes on.

- If light non-aqueous phase liquid (LNAPL) is detected on top of the water column, record the depth of the initial level/first alarm (top of the product layer). Continue to slowly lower the probe until it passes into the water phase. Slowly retract the probe until the NAPL alarm sounds and record the product/water interface depth (base of the product layer). Calculate and record the LNAPL thickness.

- Continue to slowly lower the interface probe through the water column to check for the presence of dense non-aqueous phase liquid (DNAPL). If DNAPL is encountered, measure and record the product interface depths (top and base of the DNAPL layer[s]) and calculate and record the DNAPL thickness(es).

- Continue lowering the probe until the base of the well is encountered. Measure the depth of the well as detailed in Section 3.5.3.

- Slowly raise the interface probe, recording the depth to each interface as the probe is withdrawn. While raising the probe, wipe the wetted portion of the tape with a clean laboratory wipe or disposable cloth (shop towel or similar) that has been soaked with non-phosphate laboratory detergent solution to remove gross contamination. If there is a discrepancy in depths, clean the probe sensors and re-measure the depths.

- Decontaminate the measuring tape and probe between well locations as detailed in SOP No. 005 to minimize the potential of cross contamination.

3.5.2 Water Level Measurements

If a well has been sampled previously and no NAPLs were present, or if none of the preceding NAPL check conditions are met, the NAPL check may be omitted and an electronic water level detector can be used to measure water levels.

- Upon removing the well cap, ensure that enough time (a couple of minutes) has passed for the air pressure in the well to have equalized with atmospheric pressure.

- Turn the water level meter and test the alarm and liquid indication light. Adjust the sensitivity scale as needed.

- Remove the water level indicator probe from the case, and slowly lower the probe and cable into the well, allowing the cable reel to unwind. Continue lowering until the alarm sounds and the liquid indication light comes on. Very slowly, raise and lower the probe until the point is reached where the alarm just sounds. Record the depth to water.

- Slowly raise the probe and wipe the wetted portion of the tape (if any) with a clean laboratory wipe or disposable cloth (shop towel or similar) that has been soaked with non-phosphate laboratory detergent solution to remove gross contamination.

- Decontaminate the measuring tape and probe between well locations as detailed in SOP No. 005 to minimize the potential of cross contamination.

3.5.3 Well Depth Measurements

The depth of a well is a stable value established during well construction; changes in well depth are usually indicative of a potential problem with the well. Fluctuations in well depth may be caused by either settlement of fine-grained material (i.e., silt) at the bottom of the well or damage to the well casing or screen.

Do not attempt to measure the depth of a well when a dedicated pump is installed in the casing. The weighted tape or the electric water level indicator will likely get snagged onto the tubing and damage the pump assembly. The depth of the well should also not be measured in wells in which passive diffusion samplers have been deployed; tag the bottom of the well after the samplers have been removed and before their re-deployment for the next sampling round.

A weighted tape is the preferred tool for measuring well depths. For shallow wells, an electronic water level indicator probe may be employed. In deeper wells, a weight may be attached to the probe to aid in measuring the well depth. Well depths will be measured as follows:

- Lower the probe until it is resting on the bottom of the well. Slowly pull upward on the tape until a tug can be felt while lifting the probe off the well bottom.

- Record the depth of the well. If the tape distance markings on the electronic sounding device are not marked to the end of the probe (i.e., markings are referenced to an electrode in the middle of the probe), add the length of the probe beneath the electrode to the measured depth to obtain the true depth of the well.

- Compare the recorded depth to the installation depth in the well construction diagram/record and note any discrepancies. If discrepancies exist, re-measure the well depth. Note the presence of sediment at the base of the well (i.e., hard bottom versus soft bottom).

- Withdraw the probe and tape. While raising the probe, wipe the wetted portion of the tape with a clean laboratory wipe or disposable cloth (shop towel or similar) that has been soaked with non-phosphate laboratory detergent solution to remove gross contamination.

- Decontaminate the measuring tape and probe between well locations as detailed in SOP No. 005 to minimize the potential of cross contamination.

3.6 TRANSDUCERS AND DATALOGGERS

Transducers and dataloggers may be used for depth to water measurements in wells where water level fluctuations over time are to be measured, such as tidal fluctuation studies (SOP No. 045) and aquifer (hydraulic) tests (SOP No. 033). Note that transducers are inappropriate for measuring well depth.

No calibration is necessary before use. Depending upon the device used, correction factors may be required for some measurements. Check instrument batteries prior to each use. Exercise care not to break the seals at the top of the electric water level indicator probe.

3.6.1 Transducers Deployment

Attach the transducer umbilical leads to the datalogger. Turn datalogger on. Program the transducer following instructions provided in the instrument user manual. Refer to the planning document(s) for site-specific parameters and recording frequency.

Measure and record the depth to water and well depth using an electronic sounding device as detailed in Sections 3.5.2 and 3.5.3. Slowly lower the transducer into the well until it is below the lowest possible piezometric level (typically 2-3 feet below the water table). Attach the cable grip to the well protective casing and/or tape the cable to the casing to prevent the transducer from falling further.

Record the following information and computations in the field logbook during transducer deployment:

- Date and time of deployment
- Weather
- Casing elevation
- NAPL surface elevation = casing elevation – depth to NAPL
- NAPL thickness = depth to bottom of NAPL – depth to top of NAPL
- Water level elevation = casing elevation – depth to water
- Well bottom elevation = casing elevation – depth to bottom (or read directly from tape)
- Method of measurement.

With the transducer deployed and the umbilical secured to the protective casing, ensure that the transducer unit is programmed to start logging at a desired date and time, or manually start logging. Record the logging start time. View real-time readings using the data logger and download a series of data using the data logger to verify proper operation. If the transducer is logging as desired, allow the transducer to continue logging. If the data are not logging as required in the planning documents, stop data collection, re-program the transducer, and restart logging.

3.6.2 Transducer Data Recording and Manipulation

Periodically check and download data per the manufacturer's instructions at the frequency detailed in the planning document(s) using a datalogger or computer and instrument software to download the transducer. If data are downloaded onto a datalogger, upload the data to a computer upon returning to the office.

Use the transducer manufacturer's software and transducer deployment information to make the following updates to the transducer data as needed:

- Correct the raw water pressure data files from the submersible transducer(s) for barometric effects

- Convert the transducer-reported values to equivalent feet of water over the sensor

- Normalize the transducer water levels as depths to groundwater in feet below the water level measuring point.

3.6.3 Transducer Retrieval

Upon completion of data collection, withdraw the transducer and cable from the well. Decontaminate the transducer and cable as detailed in SOP No. 005.

4. SPECIAL CONSIDERATIONS

Measurement of depth to water in new wells should only be performed after the water elevation in the well has stabilized. This may take as long as 72 hours; however, if the formation in which the well was installed is tight, the well may take even longer to achieve steady state. Ensure that steady-state conditions have been reached before making measurements as determined by the project geologist.

Electronic sounding devices may sometimes give erroneous readings due to water droplets along the side of polyvinyl chloride casing or on sample/pump tubing within a well. To check for erroneous readings, raise the probe above the point where the first sound was noted; a continued buzzer alarm indicates that the water table has not been reached. Shake the tape to remove water adhered to the tape and continue lowering to the water table.

5. CALIBRATION

No calibration is required. If more than one instrument is used at a site during the same gauging event, consider comparing the markings of the tapes on all instruments by stretching them on clean plastic sheeting to the anticipated length to be used. If the delta is known between the tapes, corrections of the measurements can be done at the time data are processed.

6. PRECAUTIONS

Depending upon the device used, correction factors may be required for some measurements. Check instrument batteries prior to each use. Exercise care not to break the seals at the top of the electric water level indicator probe.

7. REFERENCES

Archuleta, E. and A. Gilbert. 2000. *Basic Surveying*. Link: codot.gov/programs/tetp/construction-inspector-qualification/self-study-manuals/BasicSurveying.pdf.

Standard Operating Procedure No. 021
for
Sediment Sampling

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March 2019

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PROJECT-SPECIFIC VARIANCE FORM

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☐ **A. Variances required; cite section(s) of the SOP to which there is a variance**

☐ **B. No variances**

SOP No. 021	
SOP Section	**Variance**

Project Manager (Name)

Project Manager (Signature) Date

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Revision Number	**Revision Date**	**Revision Summary**	**Revised By**	**Reviewed By**
02	March 2019	Systematic review and update	Caryn Kiehl-Simpson Peggy Derrick	Matthew Bowman

1. SCOPE AND APPLICATION

This standard operating procedure (SOP) delineates protocols for sampling sediments from streams, rivers, ditches, lakes, ponds, lagoons, and marine and estuarine systems.

EA recognizes that other protocols have been developed that meet the criteria of quality and reproducibility. Clients may have their own sediment sampling protocols, which may contain methodologies and procedures that address unique or unusual site-specific conditions or may be in response to local regulatory agency requirements. In such cases, EA will compare its and the client's protocols. The goal is to provide the client with the most quality; therefore, if the client's protocols provide as much or more quality assurance than EA's protocols for the particular site or project, EA will adopt those particular protocols and this SOP will be superseded in those respects. If EA is required to implement the client's protocols in lieu of EA's protocols, EA will make the client formally aware of any concerns regarding differences in protocols that might affect data quality and will document such concerns in the project file.

2. PROCEDURES

The water content of sediment varies. Sediments range from soft to dense and fine to rocky. A variety of equipment may be necessary to obtain representative samples, even at a single site. Factors to consider in selecting the appropriate sampling equipment include sample location (edge or middle of the waterbody), depth of water and sediment, grain size, water velocity, and analytes of interest.

3. GENERAL PROCEDURES

1. All samples must be handled in a manner that satisfies the project Quality Assurance Project Plan, SOPs, and data quality objectives. Prior to a field effort, verify general sample requirements such as sample numbers, volume requirements, holding times, sample preservation requirements, and duplicate and other quality assurance/quality control sample requirements. Verify general sampling logistics such as site access, access to temporary and secure field storage, designated sample transport procedures, laboratory shipping address(es), and points of contact.

2. Comply with the Health and Safety Plan specifications for proper personal protective equipment (steel-toed boots, safety glasses, hard hats, splash shields, and Tyvek as appropriate and designated in the site-specific Health and Safety Plan). Wear chemically-protective gloves when collecting samples appropriate for the potential constituents to be sampled. Complete review of emergency plans and equipment. If sampling from a boat or near waterbodies with depths of 4 feet or more, the sampling team will wear life jackets. Review and comply with SOP Number (No.) 035 Small Boat Operations, if applicable.

3. Verify local One Call service has been contacted prior to sampling activities and proper utility clearance has been obtained. Verify site access, dockage, other required communications (e.g., U.S. Coast Guard, local authorities, etc.) have been secured.

4. Review specific responsibilities of each field team member and conduct daily safety briefings as specified by the site-specific Safety and Health Plan.

5. Confirm sampling equipment and supplies are adequate for the field effort. In addition to the sampling equipment and vessel requirements, verify that support equipment including, but not limited to, spatulas, scoops, spoons, pans, buckets, bowls, gloves, measuring implements, plastic sheeting, data forms, and logbooks are available. Appropriate sample storage and transport equipment may include a refrigeration unit, ice chests, dry ice or ice, insulation or other stabilization material to protect sample containers, custody seals, sampling containers, and shipping paperwork. Confirm decontamination supplies and equipment are sufficient for the duration of the field effort.

6. Collect samples first from areas suspected of being the least contaminated to minimize the risk of cross-contamination.

7. If surface water and sediment samples are to be collected at the same location or co-located (if both are required in the project-specific Sampling and Analysis Plan), collect the surface water sample first (refer to SOP No. 007 for surface water sampling). Sediment sampling usually results in disturbance of the sediments, which may influence the analytical results of the surface water samples.

8. Water quality measurements may be required at the same locations as the surface water and/or sediment sample locations. Collect the water quality measurements before the collection of surface water or sediment samples (refer to SOP No. 043 for water quality measurement collection).

9. Minimize the potential for sediment disturbance prior to sampling. Care should be taken when wading into a waterbody and/or during vessel operations prior to sampling. These activities can disturb the sediment. Move slowly and cautiously, approach the sample location from downstream. If flow is not strong enough to move entrained particles away from the sample location, wait for the sediment to resettle before sampling.

10. Collecting samples directly into sample containers is not recommended. Sediment samples should be placed in Teflon®, stainless steel, or glass trays, pans, or bowls for sample preparation and processing.

11. Use the proper equipment and material construction for the analytes of interest. For example, for volatile organic compound analysis, the sampling material in direct contact with the sediment or surface water must consist of Teflon, polyethylene, or stainless steel.

12. Refer to EA SOP No. 005 (Field Decontamination) for proper decontamination methods before and after sampling and between samples.

13. Collect samples for volatile organic compound analysis and acid volatile sulfide analysis first. Do not mix such samples before placing them in the sample containers. For composite volatile organic compound and acid volatile sulfide samples, place equal aliquots of each subsample in the sample container with no headspace. To maintain sample integrity, exposure to oxygen/air should be limited to the extent possible.

14. Sediment that will be analyzed for other constituents should be prepared as follows:

    - Place the sediment in a mixing container.
    - Divide the sediment into equal quarters by volume.
    - Mix each quarter separately and thoroughly.
    - Combine the quarters and mix thoroughly.
    - For composite samples, mix each subsample as described above. Place equal aliquots of each subsample in a mixing container and follow the procedure described above.
    - Sediment preparation activities should be performed where the potential of contamination from external sources (e.g., running engines) can be minimized or eliminated.

15. Mark the sampling location on a site map. Record sampling location coordinates with a Global Positioning System unit, photograph (optional, recommended), describe each location, and place a numbered stake above the visible high water mark on the bank closest to the sampling location (if appropriate). The photographs and description must be adequate to allow the sampling station to be relocated at a future date.

16. Dispose of investigation-derived wastes according to applicable rules and regulations.

4. CORERS

A corer provides a vertical profile of the sediment that may be useful in tracing historical contaminant trends, geological characterization and dating, and characterizing the depth of impacts at a site. Because displacement is minimal, a corer is particularly useful for maintaining the integrity of the vertical sediment profile. Core samplers are also useful when it is important to maintain an oxygen-free environment as they limit oxygen exchange with the air more effectively than grab samplers. Corers can be constructed out of a variety of materials.

4.1 EQUIPMENT

The following list of equipment may be needed during the collection of sediment core samples. Depending upon the actual collection method used and the analyses that will be conducted in the samples, not all equipment on the list may be used.

- Probing equipment for pre-sampling testing for utilities
- Sampling vessel, floating platform (properly equipped and sized barge or boat), and waders and plan for collecting samples by hand (may significantly limit sample depth)
- Winch
- Crane, boom arm or A-frame
- Sediment core sampler (Vibracore, piston tube, Wildco tube sampler, etc.)
- Core liners, core catchers, liner caps, etc.
- Saw, knife, and cutters to open or split core liners
- Sampling vessel
- Propulsion method for sampling vessel or floating platform
- Containers, buckets, and tubs
- Small trays
- Calibration bucket
- Wash box
- Glassware
- Logbook
- Labels
- Coolers
- Spoons
- Water filters
- Gloves for sampling
- Gloves for other sampling activities such as cutting, equipment handling, etc.

- Measuring device
- Decontamination chemicals and de-ionized water.

4.2 PROCEDURE

4.2.1 Manual Sampling

When sampling manually, a polyvinyl chloride pipe (commonly 2-inch in diameter) with a Teflon or polyethylene liner (as an example) can be lowered into the sediment; a well cap can be used to form an airtight seal and negative pressure as the pipe is withdrawn.

1. Ensure that the corer and (optional) liner and other sampling equipment are properly cleaned.

2. Position downstream of the sample location.

3. Force the corer into the sediment with a smooth continuous motion. Rotate (not rock) the corer if necessary to penetrate the sediment.

4. Twist the corer to detach the sample; then withdraw the corer in a single smooth motion. If the corer does not have a nosepiece, place a cap on the bottom to keep the sediment in place.

5. Remove the top of the corer and decant the water in a slow controlled manner (into appropriate sample containers for surface water analysis, if required).

6. Remove the nosepiece or cap and begin sample description, logging, and processing per the work planning documents.

7. Decontaminate the sediment coring apparatus as described in SOP No. 005 or work planning documents.

8. Repeat the process at an offset location until sufficient sample quantity has been recovered. Additional cores may need to be obtained if the core recovery is insufficient to achieve the required volume. Verify recovery limits are in accordance with work planning documents and data quality objectives.

9. Process the core samples as described in work planning documents.

4.2.2 Sampling from a Vessel

1. Select a sediment core sampler (Vibracore, piston tube, Wildco tube sampler, etc.) suitable for the bottom conditions, water depth expected, water velocity, the volume of material needed, and the planned/targeted depth of sampling.

2. Select sediment coring tools of sufficient diameter and length to obtain the needed sample volume and depth of penetration. Depending on the volume of sediment needed, multiple sediment cores may be required. To the extent possible, predetermine the number of cores required to avoid having to return to a location for additional cores/sample volume.

3. Set up the sediment coring tool and install the core liner tube, drive head, drive shoe, and/or core catcher, piston, and piston line, as appropriate for the specific sampler chosen and the proposed depth of sample/penetration.

4. Securely attach the core sampler to a winch with cable or line of sufficient length and strength to accommodate the weight of the sampler and sample (Vibracore) or other sampler (piston tube or Wildco tube sampler) to sufficient pipe to reach the maximum proposed sample depth.

5. A measurement system should be in place capable of documenting the depth to the sediment surface, depth of penetration, and depth of recovery. Location coordinates should be collected at each sample location (if a vessel navigation system will be used to collect the location coordinates, an offset may be required between the antenna and the sampler deployment location).

6. Slowly lower the sampler through the moon pool or over the side until the sampler reaches the water/sediment interface. The sampler may be lowered using a crane or on a winch cable and A-frame or other mechanical mechanism capable of carry/control the weight of the sampler. The crane, A-frame, or boom arm must have enough clearance to accommodate the length of the sample and sampling apparatus and enough strength to safely accommodate the weight of the sample and sampling apparatus. Note the depth to the top of sediment.

7. Advance the sediment core sampler into the sediment to the proposed depth or refusal, whichever comes first. Vibracore samplers will be advanced by the vibrating head. Vibracore samplers will continue to be attached to the winch line and the rate of descent will be controlled during penetration into the sediment. Piston tube or Wildco tube samplers will be advanced manually. If necessary, a piston tube or Wildco tube sampler may be advanced by tapping the top of the pipe with a rubber mallet. These samplers are intended for soft sediment and will not tolerate heavy abuse from pounding in an attempt to penetrate through debris, shell beds, or consolidated material.

8. Slowly retrieve the sediment coring tool. As soon as possible, cap the bottom of the sample tube to prevent loss of sample. Secure the sampling apparatus.

9. Remove the sediment core liner from the sampling apparatus.

10. Allow the core to drain or siphon water, taking care not to disturb the surface of the sediment. At the first sign of sediment in the drained water sample, cease draining and tie or cap the sample liner to ensure that the surficial layer remains intact in the sample.

11. Cut off any empty core liner to eliminate headspace. Measure core recovery. Acceptable core recoveries may be specified in the work planning documents. Typically, recoveries of 70 or 80 percent are favorable for results interpretation and data evaluations. Lesser recoveries may not sufficiently represent the sediment column. The data quality objectives of a specific project will dictate the selected recoveries. If the sampler meets refusal above the proposed depth, offset the initial location and make up to the required number of attempts. Work planning documents should specify the maximum number of attempts to be made to obtain a core with sufficient recovery. If sufficient recovery cannot be obtained, other drilling and sampling methods and/or location abandonment may be appropriate.

12. If sufficient recovery was obtained in the interval penetrated, process the core and obtain samples from that interval.

13. Write the location identification and orientation (up arrow) on the outside of the core tube with a permanent marker. Write the location identification, date, and time of collection on the core tube cap.

14. The location (Global Positioning System coordinates), collection date and time, penetration depth, recovery depth, and identification for each core should be recorded in the field logbook.

15. Transport sediment cores to the onshore processing area throughout the day, if possible. Data quality objectives and work planning documents may require that core tubes be maintained in a vertical orientation. When possible, transport sediment cores to shore after each location or at an interval that will maintain the integrity of the samples. Cores should be stored under refrigeration or iced on the sampling vessel to maintain sample integrity.

16. Decontaminate the sediment coring apparatus as described in SOP No. 005 or work planning documents.

17. Repeat the process at an offset location until sufficient sample quantity has been recovered. Additional cores may be needed if the core recovery is insufficient to achieve the required volume. Debris and obstructions are possible that may prevent the full penetration and recovery of all of the advanced cores. Observation of debris, obstructions, or hard bottom conditions that preclude advancement of the sampler should be documented in the field logbook.

18. Water quality measurements may be required at each coring location or locations specified in the project work plan. The measurements should be conducted on the same day as the core collection, and prior to the core collection, if possible.

19. Verify that all field measurements and documentation are complete prior to moving off location.

20. Process the core samples as described in work planning documents.

5. SCOOPS AND SPOONS

When sampling at the margins of a waterbody or in shallow water, scoops and spoons may be the most appropriate sampling equipment. For sample collection several feet from shore or in deeper water, the scoop or spoon may be attached to a pole or conduit. Equipment will be a subset of that described above in Section 4.1.

- Stand downstream of the sample location.
- Collect the sample slowly and gradually to minimize disturbing the fine particles.
- Decant the water slowly to minimize the loss of fine particles.
- Transfer the sediment to sample containers or mixing trays, as appropriate.
- Process the samples as indicated by the project work plan.
- Verify that all field measurements and documentation are complete prior to moving off location.

6. DREDGES

Three types of dredges are most frequently used: Peterson, Ponar, and Eckman. Many other dredge types are available; their applicability will depend upon site-specific factors. Equipment will be a subset of that described above in Section 4.1.

6.1 PETERSON, VAN VEEN, AND PONAR DREDGES

These dredges are suitable for hard, rocky substrates, deep waterbodies, and streams with fast currents. Ponars have top screens and side plates to prevent sample loss during retrieval.

- Open the jaws and place the cross bar into the proper notch.
- Lower the dredge to the bottom in a controlled manner, making sure it settles flat.
- When tension is removed from the line, the cross bar will drop, enabling the dredge to close as the line is pulled upward during retrieval.

- Pull the dredge to the surface. Make sure the jaws are closed and that no sample was lost during retrieval through incomplete closure due to rocks, shells, or other debris; penetration at an angle; or tilting during retrieval. The sampler should not be overfilled such that the sediment surface is touching the top of the sampler. Overlying water should be present indicating minimal leakage; this water should be siphoned off, not decanted, prior to sample processing. The sediment water interface should be intact with no signs of washout or channeling.

- Open the jaws and transfer the sediment to sample containers or to a mixing tray.

- Verify that all field measurements and documentation are complete prior to moving off location.

6.2 ECKMAN DREDGE

The Eckman dredge works best in soft substrates in waterbodies with slow or no flow.

- Open the spring-loaded jaws and attach the chains to the pegs at the top of the sampler.

- Lower the dredge to the bottom in a controlled manner, making sure it settles flat.

- Holding the line taut, send down the message to close the jaws.

- Pull the dredge to the surface. Make sure the jaws are closed and that no sample was lost during retrieval through incomplete closure due to rocks, shells, or other debris; penetration at an angle; or tilting during retrieval. The sampler should not be overfilled such that the sediment surface is touching the top of the sampler. Overlying water should be present indicating minimal leakage; this water should be siphoned off, not decanted, prior to sample processing. The sediment water interface should be intact with no signs of washout or channeling.

- Open the jaws and transfer the sediment to sample containers or to a mixing tray.

- Verify that all field measurements and documentation are complete prior to moving off location.

7. REFERENCES

Not applicable.

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Standard Operating Procedure No. 025
for
Soil Sampling

Prepared by

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Revision No. 02
September 2023

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PROJECT-SPECIFIC VARIANCE FORM

This form is to be completed to indicate if there are any client-, project-, or site-specific variances to this Standard Operating Procedure (SOP).

SOP No. 025	
SOP Section	**Variance**

Project Manager (Name)

Project Manager (Signature) Date

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DOCUMENT REVISION HISTORY

ORIGINAL (MASTER) DOCUMENT REVISION HISTORY				
Revision Number	**Revision Date**	**Revision Summary**	**Revised By**	**Reviewed By**
00	December 2014	Create document	Matt Bowman	Matt Bowman
01	April 2023	Systematic review and update	Catherine Maxwell Dave Cookston	Matt Bowman
02	September 2023	Inclusion of En Core® and Terra Core™ sampling for volatile organic compounds	Caron Mierczak	Frank Barranco

1. SCOPE AND APPLICATION

The purpose of this standard operating procedure (SOP) is to delineate protocols for sampling surface soils using handheld tooling and sampling subsurface soils from drill rig-associated equipment typically used to collect discrete interval samples at depth such as split spoons, core barrel with liners, and Shelby tubes. Soil samples give an indication of the area and depth of site contamination; therefore, a representative sample is very important.

2. MATERIALS

The following materials may be required:

Polyethylene sheeting	Buckets, drums, etc. as required for waste containerization
Drill rig and associated equipment	Stainless-steel bowl and/or zip-top bags
En Core® and Terra Core™ sub-sampling devices, if necessary	Field logbook and forms
Personal protective equipment as required by the Health and Safety Plan	Stainless-steel spoon, trowel, knife, spatula, and/or other sampling tools such as scoops and sample plungers (as needed)
Decontamination supplies	Sample bottles/jars with appropriate preservatives
Approved water source (as needed)	Field soil screening equipment and calibration supplies
Soil classification supplies (hand lens, color chart, etc.)	Hand auger or push-tube sampler (as needed)

3. PROCEDURE

3.1 SUBSURFACE SAMPLES

The objective of this method is to obtain representative samples from the selected drilling methodology from below the ground surface. Selection of the appropriate drill method is extremely important based on the sampling requirements. Note that some drill methodologies use water to advance tooling; use of water can cause cross-contamination of samples collected below the depth of water use. Only use approved water sources and at appropriate depths. Consider water-free methods as needed to minimize investigation-derived waste.

Don personal protective equipment. Collect using a split-spoon, core barrel, Shelby Tube, or other appropriate sample collection device during drilling. Set up a clean work station to place, observe, and sample the soils collected. Work stations should be lined with polyethylene sheeting and situated upwind of any possible cross-contamination sources (drill rig exhaust, etc.). Upon opening sampler, sample liner, or extruded sample, record soil interval information on the boring log forms and/or field logbook.

Sample depth, soil classification, sample recovery, presence of fill materials/staining/ discoloration, olfactory observations (always using equipment and not your nose), color, and soil moisture should be noted by the project geologist on the boring log.

As soon as practical, screen soil for volatile organic compounds (VOCs) using either a photoionization detector or flame ionization detector. If required, collect sample aliquot for field screening to assess sample selection for laboratory analyses. Keep sample covered with its sampler/liner or clean polyethylene sheeting and out of direct sunlight if there is a delay in VOC screening/sampling. If VOC screening is required during cold weather months, place the sample aliquot on the floor of the vehicle to warm the sample for screening. If sampling for VOCs, determining the area of highest concentration or target sample depth, use a decontaminated or dedicated sampling tool to sample this area. VOC sampling for laboratory analyses will be performed using En Core® (metal T-handle) or Terra Core™ (disposable plastic T-handle) samplers following the steps below.

3.1.1 En Core® (Metal T-Handle)

1. Hold coring body and push plunger down until small o-ring rests against tabs.

2. Depress locking lever on En Core® T-handle. Place coring body, plunger end first, into open end of T-handle, aligning the 2 slots on the coring body with the 2 locking pins on the T-handle. Twist coring body clockwise to lock pins in slots. Check to ensure sampler is locked in place. Sampler is ready to use.

3. Turn T-handle with T up and coring body down. This positions the plunger bottom flush with bottom of coring body (ensure that plunger bottom is in position). Using the T-handle, push sampler into soil until coring body is completely full. When full, small o-ring will appear centered in T-handle viewing hole. Remove sampler from soil. Wipe excess soil from coring body exterior.

4. Cap coring body while still on T-handle. Push cap over flat area of ridge and twist to lock cap into place. **CAP MUST BE SEATED TO SEAL SAMPLER**.

5. Remove the capped sampler by depressing locking lever on T-handle while twisting and pulling sampler from T-handle.

6. Lock plunger by rotating extended plunger rod fully counter-clockwise until wings rest firmly against tabs.

7. Fill in sample description on En Core® sampler bag.

8. Return En Core® sampler to zipper bag provided. Seal/label bag and place on ice in cooler(s).

3.1.2 Terra Core™ (Disposable Plastic T-Handle)

1. Using T-handle, push sampler into soil until coring body is completely full. Remove sampler from soil. Wipe excess soil from coring body exterior.

2. Lift the interlocking top portion of T-handle perpendicular by twisting and depress plunger while T-handle is above sample container.

3. Cap sample container and invert container to cover soil with preservative.

4. Fill in sample description on Terra Core® sampler bag.

5. Place samples on ice in cooler(s). Dispose of T-handle.

Sampling tools may be specific to each type of sampling/project needs and may include stainless-steel knives, trowels, laboratory spatulas, or volumetric samplers. Place the sample into the required number of sample jars. For those samples being collected for laboratory analysis, preserve samples as required and place in an ice chest with ice.

Peel and transfer the remaining sample or target depth interval in a decontaminated stainless-steel bowl or large zip-top bag. For most chemical environmental sampling, large rocks/gravel should be removed from the sample matrix to facilitate placement in jars and laboratory processing. Mix thoroughly with a decontaminated or dedicated sampling tool. If any field screening is required for a homogenized sample (i.e., handheld x-ray fluorescence screening for metals or total petroleum hydrocarbons soil test kits), collect an aliquot from the bowl or zip-top bag and proceed with screening. Place the homogenized sample into the required number of sample jars prioritizing analyses that may have cross-contamination concerns (i.e., per- and polyfluoroalkyl substances). Preserve samples as required. Discard any remaining sample per project specifications and EA SOP No. 042 (Disposal of Investigation-Derived Material). Decontaminate non-dedicated sampling implements and any non-dedicated sample retrieval equipment (split- spoons) prior to use for any additional soil samples.

If sample recoveries are poor, it may be necessary to composite samples (either duplicate cores or additional depth intervals) before placing them in jars to achieve the required sample volume. In this case, the procedure will be the same, except that two split-spoon samples/or other approved sampling techniques will be mixed together. The field logbook should clearly state that the samples have been composited, which samples were composited, and why the compositing was done.

Samples taken for geotechnical analysis may require undisturbed samples. If so, the samples should be collected using a thin-walled (Shelby tube) sampler.

3.2 SURFICIAL/NEAR-SURFICIAL SOIL SAMPLES

Don personal protective equipment and prepare/decontaminate sampling equipment. Remove vegetative mat and set aside. Collect a sample from under the vegetative mat using a stainless-steel trowel, push tube sampler, or hand auger to the target depth interval, typically 0-6 inches or 0-12 inches. Begin with the collection of VOC field screening and samples as these are not collected from homogenized sample volume. VOC sampling will be performed using En Core® (metal T-handle) or Terra Core™(disposable plastic T-handle) samplers following the numerically specified procedures listed in Section 3.1 (Subsurface Samples).

Use a decontaminated or dedicated sampling tool to obtain sample volume and aliquot for field screening directly from the trowel/auger. Sampling tools may be specific to each type of sampling/project needs and may include stainless-steel knives, trowels, laboratory spatulas, or volumetric samplers. Place the sample into the required number of VOC sample jars. Preserve samples as required. Screen soil for VOCs using either a photoionization detector or flame ionization detector.

For the remainder of the sample analyses, a representative sample is desired over the depth of the shallow bore; therefore, homogenize the sample as follows:

- As each sample aliquot is collected, place a standard volume in a stainless-steel bowl or zip-top bag until the desired volume is reached.
- If several shallow samples are to be taken to represent an area, composite these samples in a similar fashion.
- After all samples from each hole or area are in the bowl or bag, homogenize the sample thoroughly with a decontaminated stainless-steel spoon or spatula.

If any field screening of a homogenized sample (i.e., handheld x-ray fluorescence screening for metals or total petroleum hydrocarbons soil test kits) is required, collect an aliquot from the bowl or zip-top bag and proceed with screening. Place sample directly into the sample jars prioritizing analyses that may have cross-contamination concerns (i.e., per- and polyfluoroalkyl substances). Detail sample characteristics in field notes, sample form, or boring log. Sample depth, soil classification, sample recovery, presence of fill materials/staining/discoloration, olfactory observations (always using equipment and not your nose), and soil moisture should be noted. Record, locate, or flag sample geographical location as required per project specifications.

Place the leftover soil in the boreholes left by sampling or dispose of per project specifications. If necessary, add clean sand to bring the subsampling areas back to original grade. Replace the vegetative mat over the disturbed areas. Decontaminate sampling implements.

4. MAINTENANCE

Not applicable.

5. PRECAUTIONS

Refer to the project Health and Safety Plan. Ensure subsurface utility clearance has been obtained prior to breaking ground for sampling.

Soil samples will not include vegetative matter, rocks, or pebbles unless the latter are part of the overall soil matrix.

Refer to additional EA SOPs for completion of sample labels, chain-of-custodies, sample cooler packing, and shipping.

All downhole equipment should be thoroughly cleaned before arrival at the work site, between test holes, and prior to being moved out of a work area as required per project specifications. Scrub all metal parts with a stiff, long bristle brush and a non-phosphate soap solution. Steam cleaning may be substituted where available. Rinse with distilled water and allow to air dry before assembly.

6. REFERENCES CONSULTED

QED En Core® Sampling Specifications. 2023. Website: https://www.qedenv.com/en-us/products/en-core-soil-sampler/#:~:text=The%20En%20Core%C2%AE%20Sampler,are%20involved%20in%20the%20field. Accessed on 5 September.

Terra Core™ Sampling Specifications. 2023. Website: https://www.qedenv.com/en-us/products/terra-core-soil-sampler/. Accessed on 5 September.

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Standard Operating Procedure No. 028
for
Well and Boring Abandonment

Prepared by

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Revision 1
January 2021

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PROJECT-SPECIFIC VARIANCE FORM

This form is to be completed to indicate if there are any client-, project-, or site-*specific* variances to this Standard Operating Procedure (SOP) (**also check Box A**), or if this SOP is being used with no changes (**only check Box B**).

☐ **A. Variances required; cite section(s) of the SOP to which there is a variance**

☐ **B. No variances**

SOP No. 028	
SOP Section	**Variance**

Project Manager (Name)

Project Manager (Signature) Date

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DOCUMENT REVISION HISTORY

ORIGINAL (MASTER) DOCUMENT REVISION HISTORY				
Revision Number	**Revision Date**	**Revision Summary**	**Revised By**	**Reviewed By**
1	January 2021	Systematic review and update	Luis Vega Michael Kelly	Matthew Bowman

1. SCOPE AND APPLICATION

The purpose of this Standard Operating Procedure is to establish the protocols by which all wells and borings will be safely abandoned. The primary objective of well abandonment is to ensure that the abandoned well or boring does not provide a conduit for the vertical migration of contamination between aquifers. This Standard Operating Procedure applies to boreholes and monitoring wells.

2. MATERIALS

The following materials may be required:

Drill rig	Bentonite pellets (seal)
Filter pack material	Cement (Portland Type II or V)
Pure sodium bentonite with no additives (bentonite) powder (grout)	Approved water

3. PROCEDURE

The procedures used in boring abandonment will ideally accomplish two objectives: (1) protect aquifers from cross-contamination by sealing the borehole, and (2) restore the strata in the borehole to nearly original conditions by selective placement of fill material.

State and local regulations often apply to well and boring abandonment requiring notifications, permits, and licensing. A thorough review of state and local regulations and requirements should be performed while planning well and boring abandonment activities. Be aware that multiple regulatory jurisdictions may apply depending on the location and type of well abandonment activity.

3.1 GROUT

Grout used in construction will be composed, by weight, of the following:

- Twenty parts cement (Portland cement, Type II or V)
- 0.4-1 part (maximum) (2-5 percent) bentonite
- Eight gallons (maximum) of approved water per 94-pound bag of cement.

Neither additives nor borehole cuttings will be mixed with the grout. Bentonite will be added after the required amount of cement is mixed with the water.

All grout material will be combined in an aboveground container and mechanically blended to produce a thick, lump-free mixture. The mixed grout will be recirculated through the grout pump prior to placement.

Grout placement will be performed using a commercially available grout pump and a rigid tremie pipe removal; and grouting will be accomplished in stages, aquifer by aquifer, sealing the boring from the bottom to ground surface. This will be accomplished by placing a grout pipe to the bottom and pumping grout through the pipe until undiluted grout reaches the bottom of the next higher section of casing or, for the top-most section, until grout comes to 3 feet (ft) of the ground surface, then monitored for settlement and finished with mounded cement. Efforts will be made to grout incrementally as the casing is removed.

After 24 hours, the abandoned drilling site will be checked for grout settlement. On that day, any settlement depression will be filled with grout and rechecked 24 hours later. This process will be repeated until firm grout remains at the ground surface.

3.2 BORINGS

The term "Borings" as used in this Standard Operating Procedure applies to any drilled hole made during the course of a remedial investigation that is not completed as a well. This includes soil test borings, soil sampling borings, and deep stratigraphic borings. Whether completed to the planned depth or aborted for any reason prior to reaching that depth, borings will be grouted and normally closed within 4 hours, or within 4 hours of completion of logging.

3.2.1 Shallow Borings Not Penetrating Water Table

Shallow borings made for the collection of subsurface soil samples will be abandoned by backfilling the hole with cuttings from the hole, **if and only if the boring does not penetrate the water table.** Clean sand will be used to make up any volume not filled by the cuttings.

3.2.2 Borings Penetrating the Water Table

Shallow borings made for the collection of subsurface soil samples **that penetrate the water table** will be abandoned by grouting the hole from the bottom to the top.

3.2.3 Deep Stratigraphic Borings

Deep stratigraphic borings will normally be located in areas that, by virtue of the historical record, are presumed relatively uncontaminated. Therefore, these borings are usually over 100 ft from any sampling well locations. Any boring located within 10 ft of a proposed well location, or located directly upgradient or downgradient (on anticipated flow line) of a proposed well location, will be abandoned by placing clean sand in the aquifer intervals and bentonite or grout in aquitard intervals as described below. If the boring is over 10 ft from and/or not upgradient of a proposed well location, the boring will be completely filled with grout.

3.3 WELLS

The following procedure applies to wells aborted prior to completion and existing wells determined to be no longer required for its original purpose, ineffective, or otherwise in need of closure.

If the well is within 10 ft of another monitoring well in the same aquifer, or a replacement well is to be installed within 10 ft of the well, casing will be pulled, drilled out, or thoroughly pierced. Using tremie pipe, the hole will then be backfilled with filter pack material opposite sand strata and bentonite or grout opposite substantial (2 ft or thicker) clay and silt strata. Where sand as backfill approaches the ground surface, 2 ft of bentonite will be placed above the sand and below the concrete plug near the surface. Backfill materials will be placed from the bottom of the hole to within 3 ft of the ground surface. These materials will be allowed to settle for 24 hours. The remainder of the hole will be filled with concrete. The surface of the concrete will be mounded, smoothed, and inscribed with "ABD," for abandoned, any assigned well or boring designation, and the date the hole was abandoned. All boring logs, samples, completion records, and abandonment procedures will be included in the records of work on the site cluster.

If the well is not within 10 ft of another monitoring well, and is not to be replaced by another well within 10 ft of the original location, casing will be pulled, drilled out, or thoroughly pierced. Using tremie pipe, grout will be placed from the bottom of the hole to within 3 ft of the ground surface, and allowed to settle for 24 hours. The remainder of the hole will be filled with concrete. The surface of the concrete will be mounded, smoothed, and inscribed with "ABD," for abandoned, any assigned well or boring designation, and the date the hole was abandoned. All boring logs, samples, completion records, and abandonment procedures will be included in the records of work on the site cluster.

4. REPLACEMENT WELLS

Replacement wells (if any) will normally be offset at least 10 ft from any abandoned well in a presumed upgradient or crossgradient groundwater direction. Site-specific conditions may necessitate variation to this placement.

5. PRECAUTIONS

None.

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Standard Operating Procedure No. 047
for
Direct-Push Technology Operations

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April 2023

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PROJECT-SPECIFIC VARIANCE FORM

This form is to be completed to indicate if there are any client-, project-, or site-specific variances to this Standard Operating Procedure (SOP) (**also check Box A**), or if this SOP is being used with no changes (**only check Box B**).

☐ **A. Variances required; cite section(s) of the SOP to which there is a variance**

☐ **B. No variances**

SOP No. 047	
SOP Section	**Variance**

Project Manager (Name)

Project Manager (Signature) Date

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DOCUMENT REVISION HISTORY

ORIGINAL (MASTER) DOCUMENT REVISION HISTORY				
Revision Number	**Revision Date**	**Revision Summary**	**Revised By**	**Reviewed By**
00	December 2014	Create document	Matt Bowman	Matthew Bowman
01	April 2023	Systematic review and update	Catherine Maxwell Dave Cookston	Matthew Bowman

1. SCOPE AND APPLICATION

This standard operating procedure (SOP) establishes the protocol for using direct-push technology (DPT) in media sampling and performing subsurface characterization. This SOP includes the following DPT methods: Geoprobe®, Hydropunch®, cone penetrometer testing (CPT), and Site Characterization and Analysis Penetrometer System (SCAPS).

2. MATERIALS

The following materials may be required:

Appropriately sized all-terrain vehicle-skid-or track-mounted; DPT equipment and supplies (i.e., hydraulic derrick and hammer assembly, DPT stainless-steel rods if available)	Personal protective equipment
Bentonite grout and clean sand for DPT hole abandonment	Phosphate-free, laboratory-grade detergent (e.g., Liquinox, Alconox, etc.) long-handled bristle brushes and other decontamination supplies
Hydraulic oil spill kit	Source of approved water
Heavy plastic/polyethylene sheeting with alligator clamps	Steam cleaner/sprayer and water obtained from approved source for decontaminating DPT equipment
Logbook and field forms	Steel drums for investigation-derived wastes (e.g., contaminated personal protective equipment, decontamination solutions, etc.)
Soil classification supplies (hand lens, color chart, etc.)	Wash and rinse tubs
Stainless steel bowl and/or zip-top bag	Sample bottles/jars with appropriate preservatives
Bailer or tubing and peristaltic pump (groundwater sampling only)	Field screening equipment

2.1 MATERIALS

Water sources for DPT methods described in this SOP must be approved by the Project Manager/Field Team Lead prior to mobilization. Information required for the water source includes: water source, manufacturer/owner, address and telephone number, type of treatment and filtration prior to tap, time of access, cost per gallon (if applicable), dates and results associated with all available chemical analysis over the past 2 years, and the name and address of the analytical laboratory (if applicable).

Pure sodium bentonite with no additives will be the only additive allowed, and its use must be approved by the Project Manager prior to mobilization. The information required for evaluation includes: brand name, manufacturer, manufacturer's address and telephone number, product number, product description, and intended use for the product.

Portland Type II cement will be used for grout.

Only solid vegetable shortening (e.g., Crisco®) without flavoring or additives may be used on downhole equipment.

3. GEOPROBE® AND HYDROPUNCH®

Methodologies presented in this section can be advanced using a variety of DPT rigs sizes, strengths, and mounting types. Ensure that the rig selected for your project is able to meet project objectives through obtaining samples at target depths in the given geology, being free of cross-contamination substances, and able to access the selected drill locations (tracked/tired/barge mounted/low clearance).

3.1 GROUNDWATER – HYDRAULIC PUSHING AND SAMPLING

The objective of the selected DPT sampling technique is to allow grab groundwater samples to be taken at a selected subsurface depth to facilitate vertical aquifer characterization and analysis of contaminants. This methodology is more generally referred to as vertical profiling. The analytical results from sampling can also be used to determine the placement of monitoring wells. Profiling locations may have samples collected at multiple target depth intervals, beginning with the shallowest and proceeding with depth.

A site geologist will be present during all sampling and installation procedures, and will fully document all procedures in the Field Logbook. The site geologist will have on hand, at a minimum, a copy of the approved Health and Safety Plan, this SOP, and the Field Investigation Work Plan; a hand lens (10X); a standard color chart; and a grain size chart.

The DPT operator will use the equipment-specific guidelines for installation of the DPT equipment. Probe rods will be forced into the ground by hydraulic means within the limitations of the equipment.

- Drive the profiling sampler to the desired groundwater sampling interval. At the desired depth, insert extension rods down the inside diameter of the probe rods until the extension reaches the bottom of the screen. Remove the probe rods and sampler sheath while holding the screen in place.

- Gauge the depth to water in the profiling point following the protocols using a decontaminated water level indicator.

- Purge and monitor groundwater quality at the point using a bailer, peristaltic pump, or other acceptable small diameter pump per project specifications. Note that profiling points typically may not achieve low turbidity samples due to the limited sand pack. Record water quality measurements on field forms if required by project specifications.

- Once groundwater quality stability or purge volume requirements have been met, collect the groundwater sample in the screen interval with the sampling device while maintaining a consistent flow rate. Place sample into the required number of sample bottles, prioritizing analyses as appropriate (i.e., volatiles, per- and poly-fluoroalkyl substances).

- The head of the rod may be equipped with a sensing device for characterization of soil properties or the contaminant content.

Alternatively, the Hydropunch equipment can be used for specific interval groundwater sampling. The method varies slightly from bullets above and should comply with manufacturer specific recommendations. The Hydropunch Rods will be driven by hydraulic force into the ground.

- The Hydropunch tool is a double cylinder, designed to be sealed until the desired sampling depth is reached. Upon reaching the desired sampling depth, the outer cylinder is pulled back, exposing a perforated, stainless steel sampling barrel covered with filter material.

- The water sample enters the barrel and the sample is retrieved by pulling the probe rods from the hole with the hydraulic derrick and hammer assembly. Groundwater is the only media that is sampled by Hydropunch equipment.

- The head of the rod may be equipped with a sensing device for characterization of the soil properties or the contaminant content.

- The sample volume collected with this technique is approximately 500-1,000 milliliters. Larger sample volumes can be collected by inserting tubing attached to a peristaltic pump into the rods to obtain water samples. Use general techniques described above for purging, monitoring, and sampling.

Once sampling is complete at that interval, proceed to additional target depths at the profiling location, as necessary.

Once all vertical depth intervals have been sampled, a small diameter monitoring well may be installed at the borehole. Refer to SOP No. 019 (Monitoring Well Installation). If a well will not be installed, the rods will be removed as the borehole is simultaneously filled with a bentonite/grout mixture. A polyvinyl chloride (PVC) tube fed into the rod casing will allow the addition of grout.

3.2 SOIL – HYDRAULIC PUSHING AND SAMPLING

The objective of the selected DPT sampling technique is to allow continuous or grab soil samples to be collected for characterization of the stratigraphy and analysis of contaminants.

A geologist will be present during all DPT sampling and soil characterization. All procedures and soil characteristics will be fully documented in the Field Logbook (refer to SOP No. 016). The site geologist will have on hand, at a minimum, a copy of the approved Health and Safety Plan, this SOP, the Field Investigation Plan, a hand lens (10X), a standard color chart, and a grain-size chart.

The drill rig operator will use the equipment specific guidelines for advancement of the DPT equipment. Probe rods will be advanced into the ground by hydraulic means within the limitations of the equipment. Additional rods will be added until the leading edge of the sampler reaches the top of the desired sampling interval.

Once the desired sampling depth has been reached, insert extension rods down the inside diameter of the probe rods until they reach the top of the sampler assembly. Attach the extension rod handle to the top extension rod. Turn the handle clockwise until the stop-pin detaches from the drive head. Remove the extension rods and the stop-pin. Attach a drive cap to the probe and drive the sampler the length of the desired sample using hydraulic derrick. The head of the rod may be equipped with a sensing device for characterization of the soil properties or the contaminant content.

The DPT sampler can be retrieved by pulling the probe rods from the hole with the hydraulic derrick and hammer assembly and a clean new acetate liner will placed within the core barrel sampler for collection of the subsequent sample interval The core barrel will be deconned prior to the insertion of a new acetate liner. The acetate liner within the sampler will contain a core of soil from the target depth. The liner should be cut open lengthwise on two sides to provide undisturbed access to the soil core.

Set up a clean work station upon which to place, observe, and sample the soils collected. Work stations should be lined with polyethylene sheeting and situated upwind of any possible cross-contamination sources (drill rig exhaust, etc.). Upon opening liner, record soil interval information on boring log and/or field book. Sample depth, unified soil classification system, sample recovery, presence of fill materials/staining/discoloration, olfactory observations (using proper field equipment), and color should be noted by the project geologist. As soon as practical, collect sample aliquot to screen soil for volatile organic compounds (VOCs) using either a photoionization detector or flame ionization detector. Keep sample unopened within its liner and out of direct sunlight if there is a delay in VOC screening/sampling. If sampling for VOC, determining the area of highest concentration or target sample depth, use a decontaminated or dedicated sampling tool to sample this area. Sampling tools may be specific to each type of sampling/project needs and may include stainless-steel knives, trowels, laboratory spatulas, or volumetric sampling systems. Place the sample into the required number of sample jars. Preserve samples as required.

Peel and transfer the remaining sample or target depth interval in a decontaminated stainless steel bowl or large zip-top bag. For most chemical environmental sampling, large rocks/gravel should be removed from the sample matrix to facilitate placement in jars and laboratory processing. Mix thoroughly with a decontaminated or dedicated sampling tool. If any field screening is required of a homogenized sample (such as handheld x-ray fluorescence screening for metals or total petroleum hydrocarbon soil test kits), collect an aliquot from the bowl or zip-top bag and proceed with screening. Place the homogenized sample into the required number of sample jars prioritizing analyses which may have cross-contamination concerns (i.e., per- and polyfluoroalkyl substances). Preserve samples as required and place those samples collected for

analytical analysis into a cooler with ice. Discard any remaining sample per project specifications. Decontaminate non-dedicated sampling implements and any non-dedicated sample retrieval equipment (split spoons) prior to use for any additional soil samples.

If sample recoveries are poor, it may be necessary to composite samples (either duplicate cores or additional depth intervals) before placing them in jars to achieve the required sample volume. In this case, the procedure will be the same, except that two split-spoon samples will be mixed together. The field logbook should clearly state that the samples have been composited, which samples were composited, and why the compositing was done.

Repeat the above steps to sample an additional soil depth interval in the same borehole. Use a new acetate liner for each sample interval collected. Decontaminate downhole equipment between locations if required by project specifications. After decontamination, a new clean liner will be installed and all parts will be inspected for wear or damage.

3.3 ABANDONMENT

Abandonment requirements will be project-, client-, and state-specific. Verify abandonment requirements prior to mobilization. Generally, pure bentonite or a bentonite/grout mixture (20:1) will be used to fill the resulting borehole if the water table is penetrated. Boreholes that do not penetrate the water table will typically be backfilled with cuttings from the hole and topped with a bentonite seal. Clean sand will be used to fill any remaining volume in the borehole.

4. CONE PENETROMETER TESTING

4.1 MATERIALS

A CPT rig typically consists of an enclosed 20- to 40-ton truck equipped with vertical hydraulic rams that are used to advance a sensor probe into the ground. The weight of the CPT rig is dependent upon the thrust required at the site. The majority of CPT rigs are mounted in heavy-duty trucks that are ballasted to a total dead weight of approximately 15 tons. Screw anchors are utilized to develop the extra reaction to reach the maximum thrust of 20 tons. The rig is separated into two separate workspaces: data acquisition and hydraulic push areas.

4.2 SUBSURFACE CHARACTERIZATION

The objective of this technology is to collect stratigraphic information using CPT equipment to determine subsurface stratigraphy and geotechnical properties at a particular location/depth. CPT activities will be performed in accordance with ASTM International D 3441-86 and ASTM International D 5778-95. The stratigraphic information gathered can be used to facilitate the selection of vertical groundwater profiling sampling screen intervals. At the same time, it is possible to install a 0.25-inch diameter pre-packed PVC monitoring well (Section 3.1).

CPT rods are used to hydraulically push the CPT probe into the subsurface. Probes cannot be pushed into hard rock, and significant gravel or cobble content in the formation may impede or preclude penetration of the probe. The depth of penetration achievable depends on the type of formation, type of sampling probe, and size of the hydraulic equipment used.

The CPT probe includes the following components:

- A conical tip to measure vertical resistance beneath the tip.
- A friction sleeve to measure frictional resistance on the side of the probe, as a function of depth.
- Two internal strain gauge-type load cells, which independently measure the vertical resistance and side friction.
- A cone pressure gauge to measure the water pressure as the probe is pushed into the ground.
- Inclinometer to determine potential drifting of the probe (optional).
- Seismic transducers to perform downhole seismic surveys (optional). Therefore, stratigraphic data collected with the CPT include: tip resistance, local friction, friction ratio, pore pressure, and resistivity.

Data will be transferred from the probe to the data acquisition system or logger through an electrical cable. The hole will be advanced continuously at a rate of 0.6-1.0 inches per second.

The data will be logged at every 0.4-0.8 inches of penetration. Monitor the probe's stratigraphic position as it advances downward. Perform pore water pressure dissipation tests in representative hydrostratigraphic intervals. Record dissipated pore water pressures to represent hydraulic head values.

Once the confining unit underlying the surficial aquifer or the required depth has been reached, the CPT is pulled from the ground. Target interval samples can be collected during CPT hole advancement using direct-push sampling techniques (i.e., Geoprobe® or Hydropunch®).

4.3 ABANDONMENT

If the push hole was developed for the stratigraphic test only, once the testing is completed, grout the hole from bottom to top. If the hole has not collapsed after removing the CPT, PVC piping will be used to grout the hole. If the hole has collapsed after removing the CPT, then hollow CPT rods and a sacrificial tip will be used to grout the hole. The PVC pipe or CPT rods will be pushed to the bottom of the hole. Grout will then be pumped to the bottom of the hole as the PVC pipe or CPT rods are withdrawn.

5. SITE CHARACTERIZATION AND ANALYSIS PENETROMETER SYSTEM

Laser-induced fluorescence (LIF) is a method for real-time, in situ field screening of residual and non-aqueous phase organic contaminants in undisturbed vadose, capillary fringe, and saturated subsurface soils and groundwater. The technology is intended to provide highly detailed, qualitative to semiquantitative information about the distribution of subsurface contamination that fluoresces (i.e., petroleum products containing polycyclic aromatic hydrocarbons).

5.1 MATERIALS

SCAPS cone penetrometer and LIF technology requires the use of a specialized 20-ton truck. The truck has two separate enclosed compartments. Each compartment is temperature controlled and monitored for air quality. The two rooms are the data acquisition and processing room, and the hydraulic ram/rod handling room. Approximately 20 feet of overhead clearance is required to fully extend the hydraulic ram and allow for leveling jack movement.

All materials required to complete SCAPS analysis are provided by the subcontractor to include cone penetrometer equipment. All hydraulic equipment, SCAPS rods, nitrogen lasers, etc. are included within the vehicle.

5.2 HYDRAULIC PUSHING AND SAMPLING

The objective of the SCAPS technique is to allow grab samples and stratigraphic information to be collected at a selected site to facilitate subsurface characterization and for analysis of potential contaminants. The analytical results obtained can also be used to determine the placement of monitoring wells. At the same time, it is possible to install a small diameter well for sampling

purposes. If a well will not be installed, the borehole can be grouted as the equipment is removed.

A geologist will be present during all installation and sampling procedures and will fully document all procedures and soil characteristics in the field logbook. The site geologist will have on hand, at a minimum, a copy of the approved Health and Safety Plan, this SOP, the Field Investigation Work Plan, a hand lens (10X), a standard color chart, and a grain-size chart.

The subcontractor will use the equipment specific guidelines for installation of the SCAPS DPT equipment. Prior to SCAPS field activities, calibration soil samples will be collected and analyzed in order to determine the LIF sensor fluorescence threshold and detection limits for the site. SCAPS LIF technology uses a pulsed nitrogen laser coupled with an optical detector to make fluorescence measurements via optical fibers. The LIF sensor is mounted on a cone penetrometer probe so that soil classification data and fluorescence data are collected simultaneously. The laser consumes nitrogen gas, which is supplied from cylinders stored on the accompanying trailer.

The SCAPS CPT sensors are used to gather stratigraphic information. Section 4 details the CPT operating procedures.

Target interval samples can be collected during SCAPS hole advancement using direct push sampling techniques such as Geoprobe® or Hydropunch®.

5.3 ABANDONMENT

SCAPS automatically grouts the penetrometer cavity as the rods are removed. The grout is pumped at high pressure through a 0.25-inch diameter tube in the center of the penetrometer rods. The tip is sacrificed at the bottom of the cavity to allow release of the grout. A trailer attached to the back of the vehicle contains the 300-gallon grout mixing bin and pump. If the automatic grout feed does not work, the cavity will be manually filled with grout.

6. MAINTENANCE

Not applicable.

7. PRECAUTIONS

Refer to the site-specific Health and Safety Plan for discussion of hazards and preventive measures during intrusive activities. Ensure subsurface utility clearance has been obtained prior to breaking ground for sampling.

All downhole equipment should be thoroughly cleaned before arrival at the work site, between test holes, and prior to being moved out of a work area as required per project specifications.

Scrub all metal parts with a stiff, long bristle brush and a non-phosphate soap solution. Steam cleaning may be substituted where available. Rinse with distilled water and allow to air-dry before assembly.

Decontamination of SCAPS equipment is automated after initialization by a field team member. A pressurized hot water system is used to decontaminate the push rods as they are retracted from the ground. The SCAPS vehicle is equipped with a decontamination collar mounted to the bottom that cleans the rods. The decontamination water is removed by vacuum and transferred to a storage drum prior to disposal or treatment. A trailer attached to the back of the vehicle contains the water pump, heater for decontamination, and decontamination water containment drum.

8. REFERENCES

None consulted.

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Standard Operating Procedure No. 073
for
Sampling for Per- and Polyfluoroalkyl Substances

Prepared by

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November 2023

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PROJECT-SPECIFIC VARIANCE FORM

This form is to be completed to indicate if there are any client-, project-, or site-specific variances to this Standard Operating Procedure (SOP).

SOP No. 073	
SOP Section	**Variance**

Project Manager (Name)

Project Manager (Signature) Date

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Revision Number	**Revision Date**	**Revision Summary**	**Revised By**	**Reviewed By**
01	June 2019	Note regarding water-tight lids	Frank Barranco	Frank Barranco
02	November 2023	Updated protocols based on industry developments	Samantha Saalfield	Frank Barranco

1. SCOPE AND APPLICATION

The objective of this Standard Operating Procedure (SOP) is to delineate protocols for collecting environmental samples for analysis of per- and polyfluoroalkyl substances (PFAS), also known generally as perfluoroalkyl compounds (or chemicals) (PFCs).

This SOP includes sampling procedures and requirements specific to analysis of PFAS, which are ubiquitous and have a high potential for cross-contamination from common consumer products and sampling materials, even when new and clean. This SOP should be used in combination with appropriate SOPs applicable to the target medium and sampling methodology (e.g., but not limited to SOP No. 007 Surface Water Sampling, SOP No. 013 Collection of Monitoring Well Samples, SOP No. 21 Sediment Sampling, SOP No. 25 Soil Sampling, or SOP No. 047 Direct-Push Technology Sampling).

This SOP was developed primarily based on guidance from the U.S. Army Corps of Engineers (2016) and the Interstate Technology and Regulatory Council (ITRC) (2023).

2. ACCEPTABLE MATERIALS

Table 1 provides a summary of Prohibited Items that should NOT be used or present during sampling for PFAS because they may contain PFAS, along with Acceptable (PFAS-free) Alternatives that may be used if appropriate for project requirements. In general, in the context of sampling events, PFAS are commonly found in waterproof and nonstick materials (including food packaging, rain gear, and anything containing Teflon®), personal care products, and certain plastics (e.g., low-density polyethylene [LDPE]) and synthetic fibers.

Table 1. Prohibited Items and Acceptable Alternatives for Use during PFAS Sampling

Prohibited Items	Acceptable Alternatives
Field Equipment	
Teflon-containing or LDPE materials (including tubing, bailers, tape)	HDPE or silicone materials
Waterproof field books, plastic clipboards, binders, or spiral hard cover notebooks *unless confirmed PFAS-free*	Loose paper (non-waterproof) on aluminum, polypropylene, or Masonite clipboards
Sharpies®/markers, waterproof pens *unless specifically allowed by project*	Non-waterproof ballpoint pens or pencils
Sticky notes (e.g., Post-It®) and glues	Not applicable
Re-usable chemical (blue) ice packs *unless confirmed PFAS-free and approved for project use*	Regular ice in polyethylene bags (double bagged)
Aluminum foil	Thin HDPE sheeting
Plastic spoons used in soil/sediment sampling	Stainless steel trowels/spoons
Reusable core liners	Single-use PVC or acetate liners
LDPE HydraSleeve	HDPE HydraSleeve

Prohibited Items	Acceptable Alternatives
Field Clothing and Personal Protective Equipment	
New, unwashed clothing; synthetic water resistant, waterproof, or stain-treated clothing (e.g., containing Gore-Tex™ or Scotchgard™)	Well-laundered clothing made of natural fibers (preferably cotton)
Field Clothing and Personal Protective Equipment (continued)	
Clothing laundered using fabric softener	No fabric softener
Boots (e.g., steel-toed or waders) containing Gore-Tex™ or waterproof coatings; if worn, these should not be touched in the sampling area.	Boots made with polyurethane or PVC with no waterproof coating
Coated Tyvek® suits	Uncoated/plain Tyvek suits not containing PFAS
Cosmetics, shampoo, conditioner, body gel, moisturizers, hand cream, waxed dental floss, or other personal care products are used *on the day of sampling*.	Use bar soap not containing moisturizers and rinse well on the day of sampling (including for hand washing). Use any other required products the night before (rather than the day of) sampling.
Paper towels	Air dryers (for hand drying)
No sunscreens or insect repellents except approved products such as those noted in the Alternatives column.	**Examples of Acceptable Sunscreens:** Banana Boat Sport Performance, Coppertone Ultra Guard or Sport High-Performance AccuSpray, Neutrogena Ultra-Sheer or Pure & Free, Alba Organics Natural Sunscreen, Yes to Cucumbers, Aubrey Organics, Jason Natural Sun Block, Kiss My Face, "free" or "natural" sunscreens for babies. **Examples of Acceptable Insect Repellents:** OFF Deep Woods, Sawyer Permethrin, Jason Natural Quit Bugging Me, Repel Lemon Eucalyptus Insect Repellant, Herbal Armor, California Baby
Sample Containers	
LDPE or glass containers	HDPE containers (or polypropylene if required)
Teflon-lined caps	Unlined HDPE (or polypropylene if required) caps
Rain Events	
Rain gear that has been treated to make it waterproof/resistant and breathable (e.g., Gore-Tex™ treated)	PVC, rubber, or neoprene or polyurethane- or wax-coated rain gear that is confirmed not to contain PFAS or utilize a gazebo tent that is only touched or moved prior to and following sampling activities.
Equipment Decontamination	
Decon 90	Alconox®, Liquinox®, and/or Citranox®
Water from an on-site well	"PFAS-free" water, for example water provided and certified by the laboratory, or potable water from municipal drinking water supply that has been verified "PFAS-free." A project definition of "PFAS-free water" should be developed and the water used must meet project requirements.
Food Considerations	
All food and drink, with exceptions noted in the Alternatives column. Paper food packaging (e.g., fast food wrappers, drink cups, paper bags) and foil often contain PFAS.	Bottled water and hydration drinks (i.e., Gatorade® and Powerade®) to be brought and consumed only in the staging area

Notes: HDPE = High-density polyethylene
PVC = Polyvinyl chloride

If a plastic product or chemical not included in the Acceptable Alternatives column of Table 1 is proposed for use, it is recommended that Safety Data Sheets and other references be reviewed

prior to use to confirm that the material does not contain PFAS. Indications of potential PFAS ingredients, in addition to the items listed in Table 1, include the following materials (ITRC 2023):

- Polytetrafluoroethylene (fluorocarbon solids such as Teflon)
- Fluorinated ethylene-propylene (FEP)
- Ethylene fluoroethylene (ETFE)
- Polyvinylidene fluoride (PVDF)
- Pipe thread compound and tape
- Generally, any other ingredient names containing the prefix "fluoro"

Specific to the use of HDPE sample containers, note that the associated lids are not typically "water-tight." Therefore, HDPE sample containers should be individually placed in water-tight bags prior to placement in shipping containers loaded with ice.

3. PROCEDURES

As stated above, this SOP includes procedures specific to analysis of PFAS, and should be used in combination with the appropriate SOPs applicable to the target medium and sampling methodology.

3.1 GENERAL CONSIDERATIONS

Materials listed in the Prohibited Items column of Table 1 and other materials containing PFAS ingredients should not be used. However, in some cases, these materials must be used due to factors outside the control of the scope of the work or utility of the project team (e.g., health and safety requirements where other hazardous chemicals are present, or where the sampling requirements are prescriptive, unexpected, or time-sensitive). In these cases, the sampling team should purge/rinse equipment adequately with PFAS-free water where available and collect additional quality control samples (Section 3.7) to assess the degree of cross-contamination associated with the use of known or suspected PFAS-containing materials during sampling.

NOTE: Most steel-toed boots are made from coated leather and synthetic fibers. PVC or polyurethane are preferred PFAS-free materials for boots. If not possible to obtain PFAS-free footwear that comply with specified health and safety requirements for personal protective equipment, then field personnel should minimize contact with footwear while in the sampling area, and always change gloves after touching footwear.

Disposable nitrile gloves shall always be worn during PFAS sampling activities. A new pair of nitrile gloves shall be donned after contacting potential contaminants including all non-decontaminated surfaces. New gloves shall also be donned before touching containers used for storage of PFAS samples, decontaminating re-usable sampling equipment, or handling quality control samples (Section 3.7).

Food shall not be eaten within 10 meters of any sampling area. Before eating or drinking, sampling personnel shall remove their gloves and any outer garments (e.g., coveralls) and leave the work area. When finished, sampling personnel shall wash their hands, remove any visible residue, and put new gloves and any outer garments back on prior to returning to the work area.

Visitors to the sampling area shall remain at least 10 meters at a distance.

As indicated in Table 1, some personal care products (e.g., shampoo, cosmetics, dental floss) may contain PFAS. Sampling personnel shall not handle these personal care products or cosmetics in the sampling area or while wearing clothing/protective equipment that will be present during sampling. Additionally, if waterproof, water repellent, or dirt/stain resistant clothing is to be worn during sampling, the clothing should be verified to be made of PFAS-free materials.

Other personnel who come within 2-3 meters of the sample collection area should follow the guidelines above and in Table 1.

Fluids used during laboratory or fieldwork (e.g., drilling for monitoring well installation or for deep soil sampling) should be confirmed "PFAS-free." As noted in Table 1, definitions of "PFAS-free" are project- or program-specific. Examples of definitions that may be used for "PFAS-free" include target analyte concentrations less than the detection limit, limit of detection, or reporting limit/limit of quantitation, or less than some higher concentration of interest.

When sampling on a surface water body, associated gear (e.g., waders, life preservers) should be confirmed PFAS-free.

3.2 EQUIPMENT DECONTAMINATION

Wherever possible, dedicated, or disposable equipment shall be used to avoid the need for decontamination, which introduces additional potential for cross-contamination.

Large field equipment (e.g., drill rigs) should be decontaminated with potable water using steam or high-pressure water. Certified or otherwise verified "PFAS-free" water should be used to perform a final rinse of portions of the sampling equipment that will be in direct contact with samples, wherever practical.

Hand-held, non-dedicated sampling equipment, which is used at multiple field sampling locations, shall be decontaminated prior to use, and following each sample location using the procedure below:

- Rinse with a non-PFAS-containing detergent (e.g., Alconox, Liquinox, or Citranox)
- Rinse twice with potable water or other approved water
- Triple rinse with "PFAS-free" water, either provided by the laboratory or from another source verified PFAS-free and approved for project use.

The Safety Data Sheet for the selected detergent should be reviewed to ensure that it does not contain fluoro-surfactant ingredients.

Wherever possible, equipment should be rinsed with "PFAS-free" water immediately prior to use at each sampling location.

3.3 SAMPLE COLLECTION AND PRESERVATION

The sampling team shall coordinate with the analyzing laboratory regarding requirements for sample bottle, volume, and preservation requirements for samples for PFAS analysis, and the laboratory should provide certified "PFAS-free" containers. HDPE bottles with unlined caps are typically used for collection of samples for PFAS analyses. Polypropylene may also be used for specific applications.

Containers for collection of PFAS samples shall never be left uncapped, either before or after sample collection, and the lid/cap shall be kept in a gloved hand and not be set down while removed from the container.

Sampling personnel shall put on a clean pair of nitrile gloves immediately prior to collection of each sample for PFAS analyses, prior to removing the lid from the sampling container. After the sample is collected and the container is closed, pens or pencils, but not markers (unless approved for project use), shall be used in completing sample labels or in the vicinity of samples during collection.

Following sample collection and the addition of preservative (if required), sample containers for PFAS analyses shall be placed in coolers with new, double-bagged ice and not re-usable chemical ice packs unless confirmed PFAS-free and regulatorily accepted, such that meltwater does not contact sample containers during transport.

3.4 SOIL/SEDIMENT SAMPLING CONSIDERATIONS

Surface soil and sediment samples for PFAS analyses should be collected using a clean, stainless-steel tool (e.g., a trowel or Ponar grab sampler).

For field collection of soil and sediment cores, single-use PVC, HDPE, or acetate liners shall be used, and samples for PFAS analysis should be collected from the cores directly or using a stainless-steel tool.

3.5 GROUNDWATER SAMPLING CONSIDERATIONS

Inert materials such as HDPE or silicone tubing shall be used for purging and sample collection, where applicable. Teflon and LDPE shall NOT be used. During sampling, sampling personnel shall ensure that no tubing or other equipment contacts the inside or rim of the sample bottle. Any foaming observed in the sample during collection should be noted on the chain-of-custody form that accompanies the samples to the analytical laboratory.

If analyses to be performed by the laboratory include less common PFAS chemicals that have relatively high volatility (including fluorotelomers and sulfonamide/alcohols such as fluorotelomer alcohols, fluorotelomer acrylates, and methyl/ethyl fluorosulfonamides and sulfonamidoethanols), then precautions should be taken during sample collection to minimize loss of volatiles (e.g., minimizing turbulence in water as it flows into the sample container).

If use of passive/no-purge sample collection technology is to be utilized, it is critical to confirm that the sampling device does not contain LDPE (e.g., HydraSleeves made of HDPE rather than LDPE may be requested for PFAS sampling).

Filtration should not be performed because the filter may sorb PFAS or be a source of PFAS contamination. Sample turbidity should be addressed, as necessary, at the laboratory in accordance with published methods and approved laboratory SOPs.

3.6 SURFACE WATER AND POREWATER SAMPLING CONSIDERATIONS

Capped surface water sample containers shall be rinsed multiple times with site surface water prior to sampling.

Because PFAS tend to accumulate at the air/water interface, specific procedures for surface water sampling shall be followed. After rinsing, the capped container shall be lowered into the surface water, with the top pointed down. The container shall then be reoriented with the top pointed upward and opened underwater at the depth targeted for sampling, ideally at least 10 centimeters from both the sediment surface and the water surface. During sample collection, the sample collection point shall be positioned upstream of the sampler, gloves, etc. If an extension rod must be used due to the depth of sampling, the rod shall be made of clean, PFAS-free material.

For porewater sampling, the common stainless-steel and PVC samplers, with HDPE and silicone tubing, are acceptable. The samplers should not be reused at multiple sampling locations.

As for groundwater samples, filtration of surface water samples should not be performed.

3.7 FIELD QUALITY CONTROL SAMPLES

It is recommended that field blanks and equipment (i.e., rinsate) blanks be collected at least daily, using “PFAS-free” water from the laboratory or another appropriate source, to detect any cross-contamination that occurred despite precautions taken during sampling. If a peristaltic pump is used for sample collection, then at least one equipment blank should be collected by pumping “PFAS-free” water through the pump with clean HDPE tubing.

Field duplicates should also be collected to assess the precision of the results.

Analysis of trip blanks may be advisable on a project-specific basis, particularly if relatively volatile PFAS chemicals are analyzed.

For local water be used during the field effort (e.g., during drilling or decontamination), a source water blank should be collected to verify that it meets the project definition of "PFAS free."

The same precautions taken during collection of specified samples should be taken during the collection of quality control samples (Section 3.7).

4. MAINTENANCE

Not applicable.

5. PRECAUTIONS

See detailed precautions noted above.

6. REFERENCES CONSULTED

Department of Defense (DoD). 2017. *Bottle Selection and other Sampling Considerations When Sampling for Per-and Poly-Fluoroalkyl Substances (PFAS)*. Environmental Data Quality Workgroup, Revision 1.2. July. *https://www.denix.osd.mil/edqw/denix-files/sites/43/2019/02/EDQW-PFAS-Sampling-Factsheet-Rev-1.2-July-2017.pdf.*

Interstate Technology and Regulatory Council (ITRC). 2023. *Fact Sheet: Sampling Precautions and Laboratory Analytical Methods for Per- and Polyfluoroalkyl Substances (PFAS).* September. *https://pfas-1.itrcweb.org/wp-content/uploads/2023/10/Sampling_and_Lab_PFAS_Fact-Sheet_Sept2023_final.pdf.*

U.S. Army Corps of Engineers. 2016. *Standard Operating Procedure 047: Per/Poly Fluorinated Alkyl Substances (PFAS) Field Sampling*. March.

U.S. Environmental Protection Agency (EPA). 2019. *Field Equipment Cleaning and Decontamination at the FEC.* ASBPROC-206-R4. Athens, GA: Laboratory Services and Applied Science Division EPA Region 4. October. *https://www.epa.gov/quality/field-equipment-cleaning-and-decontamination-fec.*

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Appendix B

Laboratory Accreditation Update
(Provided electronically)

SCOPE OF ACCREDITATION TO ISO/IEC 17025:2017

AGRICULTURE & PRIORITY POLLUTANTS LABORATORIES, INC. (APPL, INC.)
908 N. Temperance Ave.
Clovis, CA 93611
Paula McCartney Phone: 559-275-2175

ENVIRONMENTAL

Valid To: June 30, 2025 Certificate Number: 4064.01

In recognition of the successful completion of the A2LA evaluation process, (including an assessment of the laboratory's compliance with the requirements of the DoD Environmental Laboratory Accreditation Program (DoD ELAP) as detailed in version 5.4 of the DoD/DOE Quality Systems Manual for Environmental Laboratories) accreditation is granted to this laboratory to perform recognized EPA methods using the following testing technologies and in the analyte categories identified below:

Testing Technologies

High Resolution Gas Chromatography/Mass Spectrometry, ICP-OES, ICP-Mass Spectrometry, Atomic Absorption Spectrometry, Gas Chromatography/ECD/FID, Liquid Chromatography- Mass Spectrometry, High Performance Liquid Chromatography, Ion Chromatography, Titrimetry

Parameter/Analyte	**Non-potable Water**	**Solid Hazardous Waste**	
		Aqueous	**Solid/Chemical**
Metals			
Aluminum	EPA 6010B/6010C/6010D EPA 6020/6020A/6020B	EPA 6010B/6010C/6010D EPA 6020/6020A/6020B	EPA 6010B/6010C/6010D EPA 6020/6020A/6020B
Antimony	EPA 6010B/6010C/6010D EPA 6020/6020A/6020B	EPA 6010B/6010C/6010D EPA 6020/6020A/6020B	EPA 6010B/6010C/6010D EPA 6020/6020A/6020B
Arsenic	EPA 6010B/6010C/6010D EPA 6020/6020A/6020B	EPA 6010B/6010C/6010D EPA 6020/6020A/6020B	EPA 6010B/6010C/6010D EPA 6020/6020A/6020B
Barium	EPA 6010B/6010C/6010D EPA 6020/6020A/6020B	EPA 6010B/6010C/6010D EPA 6020/6020A/6020B	EPA 6010B/6010C/6010D EPA 6020/6020A/6020B
Beryllium	EPA 6010B/6010C/6010D EPA 6020/6020A/6020B	EPA 6010B/6010C/6010D EPA 6020/6020A/6020B	EPA 6010B/6010C/6010D EPA 6020/6020A/6020B
Boron	EPA 6010B/6010C/6010D EPA 6020/6020A/6020B	EPA 6010B/6010C/6010D EPA 6020/6020A/6020B	EPA 6010B/6010C/6010D EPA 6020/6020A/6020B
Cadmium	EPA 6010B/6010C/6010D EPA 6020/6020A/6020B	EPA 6010B/6010C/6010D EPA 6020/6020A/6020B	EPA 6010B/6010C/6010D EPA 6020/6020A/6020B
Calcium	EPA 6010B/6010C/6010D EPA 6020/6020A/6020B	EPA 6010B/6010C/6010D EPA 6020/6020A/6020B	EPA 6010B/6010C/6010D EPA 6020/6020A/6020B
Chromium	EPA 6010B/6010C/6010D EPA 6020/6020A/6020B	EPA 6010B/6010C/6010D EPA 6020/6020A/6020B	EPA 6010B/6010C/6010D EPA 6020/6020A/6020B
Cobalt	EPA 6010B/6010C/6010D EPA 6020/6020A/6020B	EPA 6010B/6010C/6010D EPA 6020/6020A/6020B	EPA 6010B/6010C/6010D EPA 6020/6020A/6020B

5202 Presidents Court, Suite 220 | Frederick, MD 21703-8398 | Phone: 301 644 3248 | Fax: 240 454 9449 | www.A2LA.org

Parameter/Analyte	Non-potable Water	Solid Hazardous Waste	
		Aqueous	Solid/Chemical
Copper	EPA 6010B/6010C/6010D EPA 6020/6020A/6020B	EPA 6010B/6010C/6010D EPA 6020/6020A/6020B	EPA 6010B/6010C/6010D EPA 6020/6020A/6020B
Iron	EPA 6010B/6010C/6010D EPA 6020/6020A/6020B	EPA 6010B/6010C/6010D EPA 6020/6020A/6020B	EPA 6010B/6010C/6010D EPA 6020/6020A/6020B
Lead	EPA 6010B/6010C/6010D EPA 6020/6020A/6020B	EPA 6010B/6010C/6010D EPA 6020/6020A/6020B	EPA 6010B/6010C/6010D EPA 6020/6020A/6020B
Magnesium	EPA 6010B/6010C/6010D EPA 6020/6020A/6020B	EPA 6010B/6010C/6010D EPA 6020/6020A/6020B	EPA 6010B/6010C/6010D EPA 6020/6020A/6020B
Manganese	EPA 6010B/6010C/6010D EPA 6020/6020A/6020B	EPA 6010B/6010C/6010D EPA 6020/6020A/6020B	EPA 6010B/6010C/6010D EPA 6020/6020A/6020B
Mercury	EPA 245.1 EPA 7470A	EPA 7470A	EPA 7471A/7471B
Molybdenum	EPA 6010B/6010C/6010D EPA 6020/6020A/6020B	EPA 6010B/6010C/6010D EPA 6020/6020A/6020B	EPA 6010B/6010C/6010D EPA 6020/6020A/6020B
Nickel	EPA 6010B/6010C/6010D EPA 6020/6020A/6020B	EPA 6010B/6010C/6010D EPA 6020/6020A/6020B	EPA 6010B/6010C/6010D EPA 6020/6020A/6020B
Potassium	EPA 6010B/6010C/6010D EPA 6020/6020A/6020B	EPA 6010B/6010C/6010D EPA 6020/6020A/6020B	EPA 6010B/6010C/6010D EPA 6020/6020A/6020B
Selenium	EPA 6010B/6010C/6010D EPA 6020/6020A/6020B	EPA 6010B/6010C/6010D EPA 6020/6020A/6020B	EPA 6010B/6010C/6010D EPA 6020/6020A/6020B
Silver	EPA 6010B/6010C/6010D EPA 6020/6020A/6020B	EPA 6010B/6010C/6010D EPA 6020/6020A/6020B	EPA 6010B/6010C/6010D EPA 6020/6020A/6020B
Sodium	EPA 6010B/6010C/6010D EPA 6020/6020A/6020B	EPA 6010B/6010C/6010D EPA 6020/6020A/6020B	EPA 6010B/6010C/6010D EPA 6020/6020A/6020B
Strontium	EPA 6010B/6010C/6010D EPA 6020/6020A/6020B	EPA 6010B/6010C/6010D EPA 6020/6020A/6020B	EPA 6010B/6010C/6010D EPA 6020/6020A/6020B
Thallium	EPA 6010B/6010C/6010D EPA 6020/6020A/6020B	EPA 6010B/6010C/6010D EPA 6020/6020A/6020B	EPA 6010B/6010C/6010D EPA 6020/6020A/6020B
Tin	EPA 6010B/6010C/6010D EPA 6020/6020A/6020B	EPA 6010B/6010C/6010D EPA 6020/6020A/6020B	EPA 6010B/6010C/6010D EPA 6020/6020A/6020B
Titanium	EPA 6010B/6010C/6010D EPA 6020/6020A/6020B	EPA 6010B/6010C/6010D EPA 6020/6020A/6020B	EPA 6010B/6010C/6010D EPA 6020/6020A/6020B
Total Phosphorus	EPA 6010B/6010C/6010D EPA 6020/6020A/6020B	EPA 6010B/6010C/6010D EPA 6020/6020A/6020B	EPA 6010B/6010C/6010D EPA 6020/6020A/6020B
Vanadium	EPA 6010B/6010C/6010D EPA 6020/6020A/6020B	EPA 6010B/6010C/6010D EPA 6020/6020A/6020B	EPA 6010B/6010C/6010D EPA 6020/6020A/6020B
Zinc	EPA 6010B/6010C/6010D EPA 6020/6020A/6020B	EPA 6010B/6010C/6010D EPA 6020/6020A/6020B	EPA 6010B/6010C/6010D EPA 6020/6020A/6020B
Pesticides/Herbicides/PCBs/TPH/Fumigants			
1,2,3-Trichloropropane	EPA 8011	----------	EPA 8011
1,2-Dibromo-3-chloropropane (DBCP)	EPA 8011	----------	EPA 8011
1,2-Dibromomethane (EDB, Ethylene dibromide)	EPA 8011	----------	EPA 8011
DRO (Diesel Range Organics), C10-C28	EPA 8015B/8015C/8015D	EPA 8015B/8015C/8015D	EPA 8015B/8015C/8015D
RRO (Residual Range Organics), C25-C36	EPA 8015B/8015C/8015D	EPA 8015B/8015C/8015D	EPA 8015B/8015C/8015D
DRO (Diesel Range Organics),	AK102	AK102	AK102

Parameter/Analyte	Non-potable Water	Solid Hazardous Waste	
		Aqueous	Solid/Chemical
C10-C25			
RRO (Residual Range Organics), C25-C36	AK103	AK103	AK103
MRH (Mid-range Hydrocarbons), C9-C18	KS-MRH/HRH	KS-MRH/HRH	KS-MRH/HRH
HRH (High-range Hydrocarbons), C19-C35	KS-MRH/HRH	KS-MRH/HRH	KS-MRH/HRH
DRO (Diesel Range Organics)	WA-NWTPH-Dx	WA-NWTPH-Dx	WA-NWTPH-Dx
RRO (Residual Range Organics)	WA-NWTPH-Dx	WA-NWTPH-Dx	WA-NWTPH-Dx
GRO (Gasoline Range Organics), C6-C10	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D
GRO (Gasoline Range Organics), C6-C10	AK101-MS	AK101-MS	AK101-MS
LRH (Low-Range Hydrocarbons), C5-C8	KS-LRH	KS-LRH	KS-LRH
GRO (Gasoline Range Organics)	WA-NWTPH-Gx	WA-NWTPH-Gx	WA-NWTPH-Gx
Methane	RSK-175	RSK-175	----------
Ethane	RSK-175	RSK-175	----------
Ethene	RSK-175	RSK-175	----------
4,4'-DDD	EPA 8081A/8081B	EPA 8081A/8081B	EPA 8081A/8081B
4,4'-DDE	EPA 8081A/8081B	EPA 8081A/8081B	EPA 8081A/8081B
4,4'-DDT	EPA 8081A/8081B	EPA 8081A/8081B	EPA 8081A/8081B
a-BHC	EPA 8081A/8081B	EPA 8081A/8081B	EPA 8081A/8081B
a-Chlordane	EPA 8081A/8081B	EPA 8081A/8081B	EPA 8081A/8081B
Aldrin	EPA 8081A/8081B	EPA 8081A/8081B	EPA 8081A/8081B
b-BHC	EPA 8081A/8081B	EPA 8081A/8081B	EPA 8081A/8081B
Chlordane	EPA 8081A/8081B	EPA 8081A/8081B	EPA 8081A/8081B
d-BHC	EPA 8081A/8081B	EPA 8081A/8081B	EPA 8081A/8081B
Dieldrin	EPA 8081A/8081B	EPA 8081A/8081B	EPA 8081A/8081B
Endosulfan I	EPA 8081A/8081B	EPA 8081A/8081B	EPA 8081A/8081B
Endosulfan II	EPA 8081A/8081B	EPA 8081A/8081B	EPA 8081A/8081B
Endosulfan sulfate	EPA 8081A/8081B	EPA 8081A/8081B	EPA 8081A/8081B
Endrin	EPA 8081A/8081B	EPA 8081A/8081B	EPA 8081A/8081B
Endrin aldehyde	EPA 8081A/8081B	EPA 8081A/8081B	EPA 8081A/8081B
Endrin ketone	EPA 8081A/8081B	EPA 8081A/8081B	EPA 8081A/8081B
g-BHC (Lindane)	EPA 8081A/8081B	EPA 8081A/8081B	EPA 8081A/8081B
g-Chlordane	EPA 8081A/8081B	EPA 8081A/8081B	EPA 8081A/8081B
Heptachlor	EPA 8081A/8081B	EPA 8081A/8081B	EPA 8081A/8081B
Heptachlor epoxide	EPA 8081A/8081B	EPA 8081A/8081B	EPA 8081A/8081B
Hexachlorobenzene	EPA 8081A/8081B	EPA 8081A/8081B	EPA 8081A/8081B
Methoxychlor	EPA 8081A/8081B	EPA 8081A/8081B	EPA 8081A/8081B
Toxaphene	EPA 8081A/8081B	EPA 8081A/8081B	EPA 8081A/8081B
Aroclor-1016/1242	EPA 8082/8082A	EPA 8082/8082A	EPA 8082/8082A
Aroclor-1016 (PCB-1016)	EPA 8082/8082A	EPA 8082/8082A	EPA 8082/8082A
Aroclor-1221 (PCB-1221)	EPA 8082/8082A	EPA 8082/8082A	EPA 8082/8082A
Aroclor-1232 (PCB-1232)	EPA 8082/8082A	EPA 8082/8082A	EPA 8082/8082A
Aroclor-1242 (PCB-1242)	EPA 8082/8082A	EPA 8082/8082A	EPA 8082/8082A
Aroclor-1248 (PCB-1248)	EPA 8082/8082A	EPA 8082/8082A	EPA 8082/8082A
Aroclor-1254 (PCB-1254)	EPA 8082/8082A	EPA 8082/8082A	EPA 8082/8082A

Parameter/Analyte	Non-potable Water	Solid Hazardous Waste	
		Aqueous	Solid/Chemical
Aroclor-1260 (PCB-1260)	EPA 8082/8082A	EPA 8082/8082A	EPA 8082/8082A
Aroclor-1262 (PCB-1262)	EPA 8082/8082A	EPA 8082/8082A	EPA 8082/8082A
Aroclor-1268 (PCB-1268)	EPA 8082/8082A	EPA 8082/8082A	EPA 8082/8082A
Dalapon	----------	EPA 8151/8151A	----------
Dicamba	EPA 8151/8151A	EPA 8151/8151A	EPA 8151/8151A
Dichlorprop (2,4-DP)	EPA 8151/8151A	EPA 8151/8151A	EPA 8151/8151A
Dinoseb	EPA 8151/8151A	EPA 8151/8151A	EPA 8151/8151A
2,4-D	EPA 8151/8151A	EPA 8151/8151A	EPA 8151/8151A
2,4-DB	EPA 8151/8151A	EPA 8151/8151A	EPA 8151/8151A
MCPA	EPA 8151/8151A	EPA 8151/8151A	EPA 8151/8151A
MCPP	EPA 8151/8151A	EPA 8151/8151A	EPA 8151/8151A
Pentachlorophenol	EPA 8151/8151A	EPA 8151/8151A	EPA 8151/8151A
Silvex (2,4,5-TP)	EPA 8151/8151A	EPA 8151/8151A	EPA 8151/8151A
2,4,5-T	EPA 8151/8151A	EPA 8151/8151A	EPA 8151/8151A
Azinphos-methyl (Guthion)	EPA 8141A/8141B	EPA 8141A/8141B	EPA 8141A/8141B
Chlorpyrifos (Dursban)	EPA 8141A/8141B	EPA 8141A/8141B	EPA 8141A/8141B
Demeton-S	----------	----------	EPA 8141A/8141B
Diazinon	EPA 8141A/8141B	EPA 8141A/8141B	EPA 8141A/8141B
Dichlorvos	EPA 8141A/8141B	EPA 8141A/8141B	EPA 8141A/8141B
Dimethoate	EPA 8141A/8141B	EPA 8141A/8141B	EPA 8141A/8141B
Disulfoton	EPA 8141A/8141B	EPA 8141A/8141B	EPA 8141A/8141B
Ethoprop	EPA 8141A/8141B	EPA 8141A/8141B	EPA 8141A/8141B
Malathion	EPA 8141A/8141B	EPA 8141A/8141B	EPA 8141A/8141B
Parathion, ethyl	EPA 8141A/8141B	EPA 8141A/8141B	EPA 8141A/8141B
Parathion, methyl	EPA 8141A/8141B	EPA 8141A/8141B	EPA 8141A/8141B
Phorate	EPA 8141A/8141B	EPA 8141A/8141B	EPA 8141A/8141B
Ronnel	EPA 8141A/8141B	EPA 8141A/8141B	EPA 8141A/8141B
Stirophos	EPA 8141A/8141B	EPA 8141A/8141B	EPA 8141A/8141B
Purgeable Organics (Volatiles-VOC)			
1,1,1,2-Tetrachloroethane	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D
1,1,1-Trichloroethane	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D
1,1,2,2-Tetrachloroethane	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D
1,1,2-Trichloroethane	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D
1,1,2-Trichlorotrifluoroethane	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D
1,1-Dichloroethane	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D
1,1-Dichloroethene	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D
1,1-Dichloropropene	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D
1,2,3-Trichlorobenzene	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D
1,2,3-Trichloropropane	EPA 8260B/8260C/8260D EPA 8260B/8260C/8260D SIM	EPA 8260B/8260C/8260D EPA 8260B/8260C/8260D SIM	EPA 8260B/8260C/8260D EPA 8260B/8260C/8260D SIM
1,2,4-Trichlorobenzene	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D
1,2,4-Trimethylbenzene	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D
1,2-Dibromo-3-chloropropane	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D
1,2-Dibromoethane	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D
1,2-Dichlorobenzene	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D
1,2-Dichloroethane	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D
1,2-Dichloropropane	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D

Parameter/Analyte	Non-potable Water	Solid Hazardous Waste	
		Aqueous	Solid/Chemical
1,3,5-Trimethylbenzene	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D
1,3-Dichlorobenzene	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D
1,3-Dichloropropane	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D
1,4-Dichlorobenzene	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D
1,4-Dioxane	EPA 8260B/8260C/8260D/ EPA 8260B/8260C/8260D SIM	EPA 8260B/8260C/8260D/ EPA 8260B/8260C/8260D SIM	EPA 8260B/8260C/8260D/ EPA 8260B/8260C/8260D SIM
2,2-Dichloropropane	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D
2-Butanone (Methyl ethyl ketone)	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D
2-Chloroethyl vinyl ether	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D
2-Chlorotoluene	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D
2-Hexanone	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D
4-Chlorotoluene	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D
4-methyl-2-pentanone	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D
Acetone	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D
Acetonitrile	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D
Acrolein	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D
Acrylonitrile	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D
Benzene	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D
Bromobenzene	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D
Bromochloromethane	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D
Bromodichloromethane	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D
Bromoform	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D
Bromomethane	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D
Carbon disulfide	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D
Carbon tetrachloride	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D
Chlorobenzene	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D
Chloroethane	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D
Chloroform	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D
Chloromethane	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D
cis-1,2-Dichloroethene	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D
cis-1,3-Dichloropropene	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D
Cyclohexane	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D
Dibromochloromethane	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D
Dibromomethane	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D
Dichlorodifluoromethane	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D
Ethyl benzene	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D
Ethyl tert-butyl ether (ETBE)	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D
Hexachlorobutadiene	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D
Hexachloroethane	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D
Iodomethane	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D
Isopropyl ether (DIPE)	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D
Isopropylbenzene	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D
m+p-Xylene	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D
Methylacetate	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D
Methylcyclohexane	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D
Methyl tert-butyl ether (MTBE)	----------	----------	----------
Methylene chloride (Dichloromethane)	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D

Parameter/Analyte	Non-potable Water	Solid Hazardous Waste	
		Aqueous	Solid/Chemical
Naphthalene	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D
n-Butyl benzene	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D
n-Propylbenzene	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D
o-Xylene	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D
p-isopropyl toluene	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D
sec-Butyl benzene	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D
Styrene	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D
tert-Amyl methyl ether (TAME)	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D
tert-Butyl Alcohol (t-Butanol)	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D
tert-Butyl Benzene	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D
tert-Butyl Ethyl Ether (ETBE)	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D
Tetrachloroethene	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D
Toluene	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D
Total Xylenes	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D
trans-1,2-Dichloroethene	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D
trans-1,3-Dichloropropene	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D
Trichloroethene	EPA 8260B/8260C/8260D EPA 8260B/8260C/8260D SIM	EPA 8260B/8260C/8260D EPA 8260B/8260C/8260D SIM	EPA 8260B/8260C/8260D EPA 8260B/8260C/8260D SIM
Trichlorofluoromethane	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D
Vinyl Acetate	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D	EPA 8260B/8260C/8260D
Vinyl Chloride	EPA 8260B/8260C/8260D EPA 8260B/8260C/8260D SIM	EPA 8260B/8260C/8260D EPA 8260B/8260C/8260D SIM	EPA 8260B/8260C/8260D EPA 8260B/8260C/8260D SIM
Extractable Organics (Semivolatiles-SVOC)			
1,1'-Biphenyl	EPA 8270D/8270E	EPA 8270D/8270E	EPA 8270D/8270E
1-Methylnaphthalene	EPA 8270D/8270E SIM	EPA 8270D/8270E SIM	EPA 8270D/8270E SIM
1,2,4,5-Tetrachlorobenzene	EPA 8270D/8270E	EPA 8270D/8270E	EPA 8270D/8270E
1,2,4-Trichlorbenzene	EPA 8270D/8270E	EPA 8270D/8270E	EPA 8270D/8270E
1,2-Dichlorobenzene	EPA 8270D/8270E	EPA 8270D/8270E	EPA 8270D/8270E
1,3-Dichlorobenzene	EPA 8270D/8270E	EPA 8270D/8270E	EPA 8270D/8270E
1,4-Dichlorobenzene	EPA 8270D/8270E	EPA 8270D/8270E	EPA 8270D/8270E
1,4-Dioxane	EPA 8270D/8270E EPA 8270D/8270E SIM	EPA 8270D/8270E EPA 8270D/8270E SIM /8270E	EPA 8270D/8270E EPA 8270D/8270E SIM
2-Methylnaphthalene	EPA 8270D/8270E EPA 8270D/8270E SIM	EPA 8270D/8270E EPA 8270D/8270E SIM	EPA 8270D/8270E EPA 8270D/8270E SIM
2-(2-Methoxyethoxy)-ethanol	EPA 8270D/8270E	EPA 8270D/8270E	EPA 8270D/8270E
2,3,4,6-Tetrachlorophenol	EPA 8270D/8270E	EPA 8270D/8270E	EPA 8270D/8270E
2,4,5-Trichlorophenol	EPA 8270D/8270E	EPA 8270D/8270E	EPA 8270D/8270E
2,4,6-Trichlorophenol	EPA 8270D/8270E	EPA 8270D/8270E	EPA 8270D/8270E
2,4-Dichlorophenol	EPA 8270D/8270E	EPA 8270D/8270E	EPA 8270D/8270E
2,4-Dimethylphenol	EPA 8270D/8270E	EPA 8270D/8270E	EPA 8270D/8270E
2,4-Dinitrophenol	EPA 8270D/8270E	EPA 8270D/8270E	EPA 8270D/8270E
2,4-Dinitrotoluene (2,4-DNT)	EPA 8270D/8270E	EPA 8270D/8270E	EPA 8270D/8270E
2,6-Dichlorophenol	EPA 8270D/8270E	EPA 8270D/8270E	EPA 8270D/8270E
2,6-Dinitrotoluene (2,6-DNT)	EPA 8270D/8270E	EPA 8270D/8270E	EPA 8270D/8270E
2-Chloronaphthalene	EPA 8270D/8270E	EPA 8270D/8270E	EPA 8270D/8270E
2-Chlorophenol	EPA 8270D/8270E	EPA 8270D/8270E	EPA 8270D/8270E

Parameter/Analyte	Non-potable Water	Solid Hazardous Waste	
		Aqueous	Solid/Chemical
2-Methyl-4,6-Dinitrophenol	EPA 8270D/8270E	EPA 8270D/8270E	EPA 8270D/8270E
2-Methylnaphthalene	EPA 8270D/8270E	EPA 8270D/8270E	EPA 8270D/8270E
2-Methylphenol (o-Cresol)	EPA 8270D/8270E	EPA 8270D/8270E	EPA 8270D/8270E
2-Nitroaniline	EPA 8270D/8270E	EPA 8270D/8270E	EPA 8270D/8270E
2-Nitrophenol	EPA 8270D/8270E	EPA 8270D/8270E	EPA 8270D/8270E
3, 4-Methylphenol (m+p-Cresol)	EPA 8270D/8270E	EPA 8270D/8270E	EPA 8270D/8270E
3,3'-Dichlorobenzidine	EPA 8270D/8270E	EPA 8270D/8270E	EPA 8270D/8270E
3-Nitroaniline	EPA 8270D/8270E	EPA 8270D/8270E	EPA 8270D/8270E
4-Bromophenyl phenyl ether	EPA 8270D/8270E	EPA 8270D/8270E	EPA 8270D/8270E
4-Chloro-3-methylphenol	EPA 8270D/8270E	EPA 8270D/8270E	EPA 8270D/8270E
4-Chloroaniline	EPA 8270D/8270E	EPA 8270D/8270E	EPA 8270D/8270E
4-Chlorophenyl phenylether	EPA 8270D/8270E	EPA 8270D/8270E	EPA 8270D/8270E
4-Methylphenol (p-Cresol)	EPA 8270D/8270E	EPA 8270D/8270E	EPA 8270D/8270E
4-Nitroaniline	EPA 8270D/8270E	EPA 8270D/8270E	EPA 8270D/8270E
4-Nitrophenol	EPA 8270D/8270E	EPA 8270D/8270E	EPA 8270D/8270E
Acenaphthene	EPA 8270D/8270E EPA 8270D/8270E SIM	EPA 8270D/8270E EPA 8270D/8270E SIM	EPA 8270D/8270E EPA 8270D/8270E SIM
Acenaphthylene	EPA 8270D/8270E EPA 8270D/8270E SIM	EPA 8270D/8270E EPA 8270D/8270E SIM	EPA 8270D/8270E EPA 8270D/8270E SIM
Acetophenone	EPA 8270D/8270E	EPA 8270D/8270E	EPA 8270D/8270E
Aniline	EPA 8270D/8270E	EPA 8270D/8270E	EPA 8270D/8270E
Anthracene	EPA 8270D/8270E EPA 8270D/8270E SIM	EPA 8270D/8270E EPA 8270D/8270E SIM	EPA 8270D/8270E EPA 8270D/8270E SIM
Atrazine	EPA 8270D/8270E	EPA 8270D/8270E	EPA 8270D/8270E
Benzaldehyde	EPA 8270D/8270E	EPA 8270D/8270E	EPA 8270D/8270E
Benzidine	EPA 8270D/8270E	EPA 8270D/8270E	EPA 8270D/8270E
Benzo(a)anthracene	EPA 8270D/8270E EPA 8270D/8270E SIM	EPA 8270D/8270E EPA 8270D/8270E SIM	EPA 8270D/8270E EPA 8270D/8270E SIM
Benzo(a)pyrene	EPA 8270D/8270E EPA 8270D/8270E SIM	EPA 8270D/8270E EPA 8270D/8270E SIM	EPA 8270D/8270E EPA 8270D/8270E SIM
Benzo(b)fluoranthene	EPA 8270D/8270E EPA 8270D/8270E SIM	EPA 8270D/8270E EPA 8270D/8270E SIM	EPA 8270D/8270E EPA 8270D/8270E SIM
Benzo(b+k)fluoranthene	EPA 8270D/8270E SIM	EPA 8270D/8270E SIM	EPA 8270D/8270E SIM
Benzo(g,h,i)perylene	EPA 8270D/8270E EPA 8270D/8270E SIM	EPA 8270D/8270E EPA 8270D/8270E SIM	EPA 8270D/8270E EPA 8270D/8270E SIM
Benzo(k)fluoranthene	EPA 8270D/8270E EPA 8270D/8270E SIM	EPA 8270D/8270E EPA 8270D/8270E SIM	EPA 8270D/8270E EPA 8270D/8270E SIM
Benzoic acid	EPA 8270D/8270E	EPA 8270D/8270E	EPA 8270D/8270E
Benzyl alcohol	EPA 8270D/8270E	EPA 8270D/8270E	EPA 8270D/8270E
Benzyl butyl phthalate	EPA 8270D/8270E	EPA 8270D/8270E	EPA 8270D/8270E
Biphenyl	EPA 8270D/8270E	EPA 8270D/8270E	EPA 8270D/8270E
bis(2-Chloroethoxy) methane	EPA 8270D/8270E	EPA 8270D/8270E	EPA 8270D/8270E
bis(2-Chloroethyl) ether	EPA 8270D/8270E	EPA 8270D/8270E	EPA 8270D/8270E
bis(2-Chloroisopropyl) ether	EPA 8270D/8270E	EPA 8270D/8270E	EPA 8270D/8270E
bis(2-Ethylhexyl) phthalate (DEHP)	EPA 8270D/8270E	EPA 8270D/8270E	EPA 8270D/8270E
Butyl benzyl phthalate	EPA 8270D/8270E	EPA 8270D/8270E	EPA 8270D/8270E
Caprolactam	EPA 8270D/8270E	EPA 8270D/8270E	EPA 8270D/8270E
Carbazole	EPA 8270D/8270E	EPA 8270D/8270E	EPA 8270D/8270E
Chrysene	EPA 8270D/8270E	EPA 8270D/8270E	EPA 8270D/8270E

Parameter/Analyte	Non-potable Water	Solid Hazardous Waste	
		Aqueous	Solid/Chemical
	EPA 8270D/8270E SIM	EPA 8270D/8270E SIM	EPA 8270D/8270E SIM
Dibenz(a,h)anthracene	EPA 8270D/8270E EPA 8270D/8270E SIM	EPA 8270D/8270E EPA 8270D/8270E SIM	EPA 8270D/8270E EPA 8270D/8270E SIM
Dibenzofuran	EPA 8270D/8270E	EPA 8270D/8270E	EPA 8270D/8270E
Diethyl phthalate	EPA 8270D/8270E	EPA 8270D/8270E	EPA 8270D/8270E
Dimethyl phthalate	EPA 8270D/8270E	EPA 8270D/8270E	EPA 8270D/8270E
Di-n-butyl phthalate	EPA 8270D/8270E	EPA 8270D/8270E	EPA 8270D/8270E
Di-n-octyl phthalate	EPA 8270D/8270E	EPA 8270D/8270E	EPA 8270D/8270E
Fluoranthene	EPA 8270D/8270E EPA 8270D/8270E SIM	EPA 8270D/8270E EPA 8270D/8270E SIM	EPA 8270D/8270E EPA 8270D/8270E SIM
Fluorene	EPA 8270D/8270E EPA 8270D/8270E SIM	EPA 8270D/8270E EPA 8270D/8270E SIM	EPA 8270D/8270E EPA 8270D/8270E SIM
Hexachlorobenzene	EPA 8270D/8270E	EPA 8270D/8270E	EPA 8270D/8270E
Hexachlorobutadiene	EPA 8270D/8270E	EPA 8270D/8270E	EPA 8270D/8270E
Hexachlorocyclopentadiene	EPA 8270D/8270E	EPA 8270D/8270E	EPA 8270D/8270E
Hexachloroehane	EPA 8270D/8270E	EPA 8270D/8270E	EPA 8270D/8270E
Indeno(1,2,3-cd) pyrene	EPA 8270D/8270E EPA 8270D/8270E SIM	EPA 8270D/8270E EPA 8270D/8270E SIM	EPA 8270D/8270E EPA 8270D/8270E SIM
Isophorone	EPA 8270D/8270E	EPA 8270D/8270E	EPA 8270D/8270E
Naphthalene	EPA 8270D/8270E EPA 8270D/8270E SIM	EPA 8270D/8270E EPA 8270D/8270E SIM	EPA 8270D/8270E EPA 8270D/8270E SIM
Nitrobenzene	EPA 8270D/8270E	EPA 8270D/8270E	EPA 8270D/8270E
N-nitrosodimethylamine	EPA 8270D/8270E	EPA 8270D/8270E	EPA 8270D/8270E
N-nitrosodi-n-propylamine	EPA 8270D/8270E	EPA 8270D/8270E	EPA 8270D/8270E
N-nitrosodiphenylamine	EPA 8270D/8270E	EPA 8270D/8270E	EPA 8270D/8270E
Pentachlorophenol	EPA 8270D/8270E	EPA 8270D/8270E	EPA 8270D/8270E
Phenanthrene	EPA 8270D/8270E EPA 8270D/8270E SIM	EPA 8270D/8270E EPA 8270D/8270E SIM	EPA 8270D/8270E EPA 8270D/8270E SIM
Phenol	EPA 8270D/8270E	EPA 8270D/8270E	EPA 8270D/8270E
Pyrene	EPA 8270D/8270E EPA 8270D/8270E SIM	EPA 8270D/8270E EPA 8270D/8270E SIM	EPA 8270D/8270E EPA 8270D/8270E SIM
Pyridine	EPA 8270D/8270E	EPA 8270D/8270E	EPA 8270D/8270E
Dioxins/Furans			
1,2,3,4,6,7,8,9-OCDD	EPA 8290/8290A	EPA 8290/8290A	EPA 8290/8290A
1,2,3,4,6,7,8,9-OCDF	EPA 8290/8290A	EPA 8290/8290A	EPA 8290/8290A
1,2,3,4,6,7,8-Hpcdd	EPA 8290/8290A	EPA 8290/8290A	EPA 8290/8290A
1,2,3,4,6,7,8-Hpcdf	EPA 8290/8290A	EPA 8290/8290A	EPA 8290/8290A
1,2,3,4,7,8,9-Hpcdf	EPA 8290/8290A	EPA 8290/8290A	EPA 8290/8290A
1,2,3,4,7,8-Hxcdd	EPA 8290/8290A	EPA 8290/8290A	EPA 8290/8290A
1,2,3,4,7,8-Hxcdf	EPA 8290/8290A	EPA 8290/8290A	EPA 8290/8290A
1,2,3,6,7,8-Hxcdd	EPA 8290/8290A	EPA 8290/8290A	EPA 8290/8290A
1,2,3,6,7,8-Hxcdf	EPA 8290/8290A	EPA 8290/8290A	EPA 8290/8290A
1,2,3,7,8,9-Hxcdd	EPA 8290/8290A	EPA 8290/8290A	EPA 8290/8290A
1,2,3,7,8,9-Hxcdf	EPA 8290/8290A	EPA 8290/8290A	EPA 8290/8290A
1,2,3,7,8-Pecdd	EPA 8290/8290A	EPA 8290/8290A	EPA 8290/8290A
1,2,3,7,8-Pecdf	EPA 8290/8290A	EPA 8290/8290A	EPA 8290/8290A
2,3,4,6,7,8-Hxcdf	EPA 8290/8290A	EPA 8290/8290A	EPA 8290/8290A
2,3,4,7,8-Pecdf	EPA 8290/8290A	EPA 8290/8290A	EPA 8290/8290A
2,3,7,8-TCDD	EPA 8290/8290A	EPA 8290/8290A	EPA 8290/8290A

Parameter/Analyte	Non-potable Water	Solid Hazardous Waste	
		Aqueous	Solid/Chemical
2,3,7,8-TCDF	EPA 8290/8290A	EPA 8290/8290A	EPA 8290/8290A
Hpcdd, total	EPA 8290/8290A	EPA 8290/8290A	EPA 8290/8290A
Hpcdf, total	EPA 8290/8290A	EPA 8290/8290A	EPA 8290/8290A
Hxcdd, total	EPA 8290/8290A	EPA 8290/8290A	EPA 8290/8290A
Hxcdf, total	EPA 8290/8290A	EPA 8290/8290A	EPA 8290/8290A
PCDD + PCDF, total	EPA 8290/8290A	EPA 8290/8290A	EPA 8290/8290A
PCDD, total	EPA 8290/8290A	EPA 8290/8290A	EPA 8290/8290A
PCDF, total	EPA 8290/8290A	EPA 8290/8290A	EPA 8290/8290A
Pecdd, total	EPA 8290/8290A	EPA 8290/8290A	EPA 8290/8290A
Pecdf, total	EPA 8290/8290A	EPA 8290/8290A	EPA 8290/8290A
TCDD, total	EPA 8290/8290A	EPA 8290/8290A	EPA 8290/8290A
TCDF, total	EPA 8290/8290A	EPA 8290/8290A	EPA 8290/8290A

Parameter/Analyte	Non-potable Water	Solid Hazardous Waste		AFFF
		Aqueous	Solid/Chemical	
Per- & Polyfluoroalkyl Substances (PFAS)				
1H,1H, 2H, 2H-Perfluorohexane sulfonic acid FTS 4:2	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15
1H,1H, 2H, 2H-Perfluorooctane sulfonic acid FTS 6:2	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15
1H,1H, 2H, 2H-Perfluorodecane sulfonic acid FTS 8:2	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15
N-ethyl perfluorooctanesulfonamidoacetic acid N-EtFOSAA	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15
N-methyl perfluorooctanesulfonamidoacetic acid N-MeFOSAA	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15
Perfluorobutanoic acid PFBA	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15
Perfluorobutanesulfonic acid PFBS	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15
Perfluorodecanoic acid PFDA	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15

Parameter/Analyte	Non-potable Water	Solid Hazardous Waste		AFFF
		Aqueous	Solid/Chemical	
Perfluorododecanoic acid PFDoA	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15
Perfluorodecanesulfonic acid PFDS	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15
Perfluoroheptanoic acid PFHpA	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15
Perfluoroheptanesulfonic acid PFHpS	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15
Perfluorohexanoic acid PFHxA	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15
Perfluorohexanesulfonic acid PFHxS	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15
Perfluorononanoic acid PFNA	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15
Perfluorononanesulfonic acid PFNS	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15
Perfluorooctanoic acid PFOA	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15
Perfluorooctanesulfonic acid PFOS	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15
Perfluorooctanesulfonamide PFOSA	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15
Perfluoropentanoic acid PFPeA	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15
Perfluoropentansulfonic acid PFPeS	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15
Perfluorotetradecanoic acid PFTeDA	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15
Perfluorotridecanoic acid PFTrDA	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15
Perfluoroundecanoic acid PFUdA	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15
Hexafluoropropylene oxide dimer acid HFPO-DA	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15

Parameter/Analyte	Non-potable Water	Solid Hazardous Waste		AFFF
		Aqueous	Solid/Chemical	
9-Chlorohexadecafluoro-3-oxanonane-1-sulfonic acid 9-Cl-PF30NS	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15
11-Chloroeicosafluoro-3-oxaundecane-1-sulfonic acid 11-Cl-PF30UdS	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15
4,8-Dioxa-3H-perfluorononanoic acid ADONA	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15
N-ethyl perfluorooctanesulfonamidoethanol NEtFOSE	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15
N-ethyl perfluorooctanesulfonamide N-EtFOSA	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15
N-methyl perfluorooctanesulfonamidoethanol N-MeFOSE	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15
N-methyl perfluorooctanesulfonamide N-MeFOSA	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15
Perfluorododecanesulfonic acid PFDoS	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15
3-Perfluoropropyl propanoic acid 3:3 FTA	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15
2H,2H,3H,3H-Perfluorooctanoic acid 5:3 FTA	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15
3-Perfluoroheptyl propanoic acid 7:3 FTA	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15
1H,1H,2H,2H-Perfluorododecanesulphonic acid 10:2 FTS	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15
Perfluoro-3-methoxypropanoic acid PFMPA	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15
Perfluoro-4-methoxybutanoic acid PFMBA	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15

Parameter/Analyte	Non-potable Water	Solid Hazardous Waste		AFFF
		Aqueous	Solid/Chemical	
Nonafluoro-3,6-dioxaheptanoic acid NFDHA	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15
Perfluoro(2-ethoxyethane)sulfonic acid PFEESA	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15	PFAS by LCMSMS Compliant with DoD QSM 5.4 Table B-15

Parameter/Analyte	Non-potable Water	Solid Hazardous Waste	
		Aqueous	Solids
1H,1H, 2H, 2H-Perfluorohexane sulfonic acid 4:2 FTS	EPA DRAFT Method 1633 Rev 31633 Rev 3 Rev 3	EPA DRAFT Method 1633 Rev 3	EPA DRAFT Method 1633 Rev 3
1H,1H, 2H, 2H-Perfluorooctane sulfonic acid 6:2 FTS	EPA DRAFT Method 1633 Rev 3	EPA DRAFT Method 1633 Rev 3	EPA DRAFT Method 1633 Rev 3
1H,1H, 2H, 2H-Perfluorodecane sulfonic acid 8:2 FTS	EPA DRAFT Method 1633 Rev 3	EPA DRAFT Method 1633 Rev 3	EPA DRAFT Method 1633 Rev 3
N-methyl perfluorooctanesulfonamidoacetic acid NEtFOSAA	EPA DRAFT Method 1633 Rev 3	EPA DRAFT Method 1633 Rev 3	EPA DRAFT Method 1633 Rev 3
N-ethyl perfluorooctanesulfonamidoacetic acid NMeFOSAA	EPA DRAFT Method 1633 Rev 3	EPA DRAFT Method 1633 Rev 3	EPA DRAFT Method 1633 Rev 3
Perfluorobutanoic acid PFBA	EPA DRAFT Method 1633 Rev 3	EPA DRAFT Method 1633 Rev 3	EPA DRAFT Method 1633 Rev 3
Perfluorobutanesulfonic acid PFBS	EPA DRAFT Method 1633 Rev 3	EPA DRAFT Method 1633 Rev 3	EPA DRAFT Method 1633 Rev 3
Perfluorodecanoic acid PFDA	EPA DRAFT Method 1633 Rev 3	EPA DRAFT Method 1633 Rev 3	EPA DRAFT Method 1633 Rev 3
Perfluorododecanoic acid PFDoA	EPA DRAFT Method 1633 Rev 3	EPA DRAFT Method 1633 Rev 3	EPA DRAFT Method 1633 Rev 3
Perfluorodecanesulfonic acid PFDS	EPA DRAFT Method 1633 Rev 3	EPA DRAFT Method 1633 Rev 3	EPA DRAFT Method 1633 Rev 3
Perfluoroheptanoic acid PFHpA	EPA DRAFT Method 1633 Rev 3	EPA DRAFT Method 1633 Rev 3	EPA DRAFT Method 1633 Rev 3
Perfluoroheptanesulfonic acid PFHpS	EPA DRAFT Method 1633 Rev 3	EPA DRAFT Method 1633 Rev 3	EPA DRAFT Method 1633 Rev 3
Perfluorohexanoic acid PFHxA	EPA DRAFT Method 1633 Rev 3	EPA DRAFT Method 1633 Rev 3	EPA DRAFT Method 1633 Rev 3
Perfluorohexanesulfonic acid PFHxS	EPA DRAFT Method 1633 Rev 3	EPA DRAFT Method 1633 Rev 3	EPA DRAFT Method 1633 Rev 3

Parameter/Analyte	Non-potable Water	Solid Hazardous Waste	
		Aqueous	Solids
Perfluorononanoic acid PFNA	EPA DRAFT Method 1633 Rev 3	EPA DRAFT Method 1633 Rev 3	EPA DRAFT Method 1633 Rev 3
Perfluorononanesulfonic acid PFNS	EPA DRAFT Method 1633 Rev 3	EPA DRAFT Method 1633 Rev 3	EPA DRAFT Method 1633 Rev 3
Perfluorooctanoic acid PFOA	EPA DRAFT Method 1633 Rev 3	EPA DRAFT Method 1633 Rev 3	EPA DRAFT Method 1633 Rev 3
Perfluorooctanesulfonic acid PFOS	EPA DRAFT Method 1633 Rev 3	EPA DRAFT Method 1633 Rev 3	EPA DRAFT Method 1633 Rev 3
Perfluorooctanesulfonamide PFOSA	EPA DRAFT Method 1633 Rev 3	EPA DRAFT Method 1633 Rev 3	EPA DRAFT Method 1633 Rev 3
Perfluoropentanoic acid PFPeA	EPA DRAFT Method 1633 Rev 3	EPA DRAFT Method 1633 Rev 3	EPA DRAFT Method 1633 Rev 3
Perfluoropentansulfonic acid PFPeS	EPA DRAFT Method 1633 Rev 3	EPA DRAFT Method 1633 Rev 3	EPA DRAFT Method 1633 Rev 3
Perfluorotetradecanoic acid PFTeDA	EPA DRAFT Method 1633 Rev 3	EPA DRAFT Method 1633 Rev 3	EPA DRAFT Method 1633 Rev 3
Perfluorotridecanoic acid PFTrDA	EPA DRAFT Method 1633 Rev 3	EPA DRAFT Method 1633 Rev 3	EPA DRAFT Method 1633 Rev 3
Perfluoroundecanoic acid PFUnA	EPA DRAFT Method 1633 Rev 3	EPA DRAFT Method 1633 Rev 3	EPA DRAFT Method 1633 Rev 3
Hexafluoropropylene oxide dimer acid HFPO-DA	EPA DRAFT Method 1633 Rev 3	EPA DRAFT Method 1633 Rev 3	EPA DRAFT Method 1633 Rev 3
9-Chlorohexadecafluoro-3-oxanonane-1-sulfonic acid 9Cl-PF3ONS	EPA DRAFT Method 1633 Rev 3	EPA DRAFT Method 1633 Rev 3	EPA DRAFT Method 1633 Rev 3
11-Chloroeicosafluoro-3-oxaundecane-1-sulfonic acid 11Cl-PF3OUdS	EPA DRAFT Method 1633 Rev 3	EPA DRAFT Method 1633 Rev 3	EPA DRAFT Method 1633 Rev 3
4,8-Dioxa-3H-perfluorononanoic acid ADONA	EPA DRAFT Method 1633 Rev 3	EPA DRAFT Method 1633 Rev 3	EPA DRAFT Method 1633 Rev 3
N-ethyl perfluorooctanesulfonamidoethanol NEtFOSE	EPA DRAFT Method 1633 Rev 3	EPA DRAFT Method 1633 Rev 3	EPA DRAFT Method 1633 Rev 3
N-ethyl perfluorooctanesulfonamide NEtFOSA	EPA DRAFT Method 1633 Rev 3	EPA DRAFT Method 1633 Rev 3	EPA DRAFT Method 1633 Rev 3
N-methyl perfluorooctanesulfonamidoethanol NMeFOSE	EPA DRAFT Method 1633 Rev 3	EPA DRAFT Method 1633 Rev 3	EPA DRAFT Method 1633 Rev 3

Parameter/Analyte	Non-potable Water	Solid Hazardous Waste	
		Aqueous	Solids
N-methyl perfluorooctanesulfonamide NMeFOSA	EPA DRAFT Method 1633 Rev 3	EPA DRAFT Method 1633 Rev 3	EPA DRAFT Method 1633 Rev 3
Perfluorododecanesulfonic acid PFDoS	EPA DRAFT Method 1633 Rev 3	EPA DRAFT Method 1633 Rev 3	EPA DRAFT Method 1633 Rev 3
3-Perfluoropropyl propanoic acid 3:3 FTCA	EPA DRAFT Method 1633 Rev 3	EPA DRAFT Method 1633 Rev 3	EPA DRAFT Method 1633 Rev 3
2H,2H,3H,3H-Perfluorooctanoic acid 5:3 FTCA	EPA DRAFT Method 1633 Rev 3	EPA DRAFT Method 1633 Rev 3	EPA DRAFT Method 1633 Rev 3
3-Perfluoroheptyl propanoic acid 7:3 FTCA	EPA DRAFT Method 1633 Rev 3	EPA DRAFT Method 1633 Rev 3	EPA DRAFT Method 1633 Rev 3
Perfluoro-3-methoxypropanoic acid PFMPA	EPA DRAFT Method 1633 Rev 3	EPA DRAFT Method 1633 Rev 3	EPA DRAFT Method 1633 Rev 3
Perfluoro-4-methoxybutanoic acid PFMBA	EPA DRAFT Method 1633 Rev 3	EPA DRAFT Method 1633 Rev 3	EPA DRAFT Method 1633 Rev 3
Nonafluoro-3,6-dioxaheptanoic acid NFDHA	EPA DRAFT Method 1633 Rev 3	EPA DRAFT Method 1633 Rev 3	EPA DRAFT Method 1633 Rev 3
Perfluoro(2-ethoxyethane)sulfonic acid PFEESA	EPA DRAFT Method 1633 Rev 3	EPA DRAFT Method 1633 Rev 3	EPA DRAFT Method 1633 Rev 3
Perfluoro-4-ethylcyclohexanesulfonic Acid	EPA DRAFT Method 1633 Rev 3	EPA DRAFT Method 1633 Rev 3	EPA DRAFT Method 1633 Rev 3
Perfluorobutylsulfonamide	EPA DRAFT Method 1633 Rev 3	EPA DRAFT Method 1633 Rev 3	EPA DRAFT Method 1633 Rev 3
Perfluorohexanesulfonamide	EPA DRAFT Method 1633 Rev 3	EPA DRAFT Method 1633 Rev 3	EPA DRAFT Method 1633 Rev 3

Parameter/Analyte	Non-potable Water	Solid Hazardous Waste	
		Aqueous	Solid/Chemical
Energetics			
Nitroguanidine	EPA 8321A/8321B Mod.	EPA 8321A/8321B Mod.	EPA 8321A/8321B Mod.
Guanidine Nitrate	EPA 8321A/8321B Mod.	EPA 8321A/8321B Mod.	EPA 8321A/8321B Mod.
Perchlorate	EPA 6850	EPA 6850	EPA 6850
1,3,5-Trinitrobenzene	EPA 8330A/8330B	EPA 8330A/8330B	EPA 8330A/8330B
1,3-Dinitrobenzene	EPA 8330A/8330B	EPA 8330A/8330B	EPA 8330A/8330B
2,4,6-Trinitrotoluene	EPA 8330A/8330B	EPA 8330A/8330B	EPA 8330A/8330B
2,4-Dinitrotoluene	EPA 8330A/8330B	EPA 8330A/8330B	EPA 8330A/8330B
2,6-Dinitrotoluene	EPA 8330A/8330B	EPA 8330A/8330B	EPA 8330A/8330B
2-Amino-4,6-dinitrotoluene	EPA 8330A/8330B	EPA 8330A/8330B	EPA 8330A/8330B
2-Nitrotoluene	EPA 8330A/8330B	EPA 8330A/8330B	EPA 8330A/8330B
2-Amino-4,6-dinitrotoluene	EPA 8330A/8330B	EPA 8330A/8330B	EPA 8330A/8330B

Parameter/Analyte	Non-potable Water	Solid Hazardous Waste	
		Aqueous	Solid/Chemical
2-Nitrotoluene	EPA 8330A/8330B	EPA 8330A/8330B	EPA 8330A/8330B
3-Nitrotoluene	EPA 8330A/8330B	EPA 8330A/8330B	EPA 8330A/8330B
3,5 Dinitroaniline	EPA 8330A/8330B	EPA 8330A/8330B	EPA 8330A/8330B
4-Amino-2,6-dinitrotoluene	EPA 8330A/8330B	EPA 8330A/8330B	EPA 8330A/8330B
4-Nitrotoluene	EPA 8330A/8330B	EPA 8330A/8330B	EPA 8330A/8330B
HMX (Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine)	EPA 8330A/8330B	EPA 8330A/8330B	EPA 8330A/8330B
Nitrobenzene	EPA 8330A/8330B	EPA 8330A/8330B	EPA 8330A/8330B
Nitroglycerin	EPA 8330A/8330B	EPA 8330A/8330B	EPA 8330A/8330B
Pentaerythritoltetranitrate (PETN)	EPA 8330A/8330B	EPA 8330A/8330B	EPA 8330A/8330B
RDX (hexahydro-1,3,5-trinitro-1,3,5-triazine)	EPA 8330A/8330B	EPA 8330A/8330B	EPA 8330A/8330B
Tetryl (Methyl-2,4,6-trinitrophenylnitramine)	EPA 8330A/8330B	EPA 8330A/8330B	EPA 8330A/8330B
Picric Acid	EPA 8321A/8321B	EPA 8321A/8321B	EPA 8321A/8321B
Inorganics			
Ignitability	----------	----------	EPA 1030
pH / Corrosivity	EPA 9040C	EPA 9040C	EPA 9045C/D
Chromium VI	EPA 218.6/218.7	----------	----------
Chromium VI	EPA 7199	EPA 7199	EPA 7199
Chromium VI	----------	----------	EPA 7196A
Bromide	EPA 300.0	EPA 300.0	EPA 300.0
Chloride	EPA 300.0	EPA 300.0	EPA 300.0
Fluoride	EPA 300.0	EPA 300.0	EPA 300.0
Nitrate as N	EPA 300.0	EPA 300.0	EPA 300.0
Nitrite + Nitrate as N	EPA 300.0	EPA 300.0	EPA 300.0
Nitrite as N	EPA 300.0	EPA 300.0	EPA 300.0
Orthophosphate as P	----------	EPA 300.0	EPA 300.0
Phosphate and Orthophosphate - as P	----------	EPA 300.0	EPA 300.0
Sulfate	EPA 300.0	EPA 300.0	EPA 300.0
Bromide	EPA 9056/9056A	EPA 9056/9056A	EPA 9056/9056A
Chloride	EPA 9056/9056A	EPA 9056/9056A	EPA 9056/9056A
Fluoride	EPA 9056/9056A	EPA 9056/9056A	EPA 9056/9056A
Nitrate as N ($NO3^-$ as N)	EPA 9056/9056A	EPA 9056/9056A	EPA 9056/9056A
Nitrite + Nitrate as N	EPA 9056/9056A	EPA 9056/9056A	EPA 9056/9056A
Nitrite as N	EPA 9056/9056A	EPA 9056/9056A	EPA 9056/9056A
Sulfate	EPA 9056/9056A	EPA 9056/9056A	EPA 9056/9056A
Phosphate and Orthophosphate - as P	----------	EPA 9056/9056A	EPA 9056/9056A
Phosphate/Orthophosphate/Total Phosphorus	----------	SM 4500 PE	SM 4500 PE
Cyanide, Total	EPA 9014 SM 4500CN B,C,	EPA 9010C EPA 9014 SM 4500CN B,C,E,	EPA 9010C EPA 9014 SM 4500CN B,C,E,
Ammonia as N	EPA 350.1	EPA 350.1	EPA 350.1

Parameter/Analyte	Non-potable Water	Solid Hazardous Waste	
		Aqueous	Solid/Chemical
Total Kheldahl Nitrogen	EPA 351.2	EPA 351.2	EPA 351.2
Nitrate as N	EPA 353.2	EPA 353.2	EPA 353.2
Nitriate + Nitrate as N	EPA 353.2	EPA 353.2	EPA 353.2
Nitrite as N	EPA 353.2	EPA 353.2	EPA 353.2
Nitrocellulose	EPA 353.2 Mod	EPA 353.2 Mod	EPA 353.2 Mod
Bicarbonate	SM 2320B	SM 2320B	----------
Carbonate	SM 2320B	SM 2320B	----------
Hydroxide	SM 2320B	SM 2320B	----------
Total Alkalinity (CaCO3)	SM 2320B	SM 2320B	----------
Specific Conductance, Conductivity (25°C)	SM 2510B	SM 2510B	----------
Total Solids	SM 2540B	SM2540B	----------
Total Dissolved Solids (TDS)	EPA 160.1 SM 2540C	EPA 160.1 SM 2540C	----------
Non-Filterable Residue (TSS)	SM 2540D	SM 2540D	----------
Ferrous Iron	SM 3500-Fe Bc	SM 3500-Fe Bc	----------
Sulfide	SM 4500-S_2F	SM 4500-S_2F	SM 4500-S_2F
Silica	SM 4500-SiD	SM 4500-SiD	----------
Total Organic Carbon (TOC)	EPA 9060A SM 5310C	----------	WALKLEY-BLACK
Cation Exchange Capacity	----------	----------	EPA 9081/EPA 6010
Sample Preparation			
TCLP Extraction	----------	EPA 1311	EPA 1311
SPLP Extraction	----------	EPA 1312	EPA 1312
Acid Digestion for Metals Analysis	EPA 3010A	EPA 3010A	----------
Acid Digestion for Metals Analysis	----------	EPA 3050B	EPA 3050B
Alkaline Digestion for Hexavalent Chromium	----------	EPA 3060A	EPA 3060A
Separatory Funnel Extraction	EPA 3510C	EPA 3510C	----------
Microextraction	EPA 3511	EPA 3511	----------
Liquid-Liquid Extraction	EPA 3520C	EPA 3520C	----------
Soxhlet Extraction	----------	EPA 3540C	EPA 3540C
SPE Extraction for Explosives	EPA 3535A	EPA 3535A	----------
Ultrasonic Extraction	----------	EPA 3550B Mod.	EPA 3550B Mod.
Silica Gel Cleanup	EPA 3630C	EPA 3630C	EPA 3630C
Sulfur Cleanup	EPA 3660B	EPA 3660B	EPA 3660B
Sulfuric Acid - Permanganate Cleanup	EPA 3665A Mod.	EPA 3665A Mod.	EPA 3665A Mod.
Purge and Trap	EPA 5030B/5030C	EPA 5030B/5030C	EPA 5030B/5030C
Closed-System Purge and Trap Extraction	EPA 5035/5035A	EPA 5035/5035A	EPA 5035/5035A
Mercury Digestion	EPA 7470A	EPA 7470A	EPA 7471A/7471B
Incremental Sampling	----------	EPA 8330B, Appendix A	EPA 8330B, Appendix A
Waste Extraction Test (WET) (STLC)	----------	CCR Chapter 11, Article 5, Appendix II	CCR Chapter 11, Article 5, Appendix II

Parameter/Analyte	**Potable Water**
Metals	
Mercury	EPA 245.1
Inorganics	
Chromium VI	EPA 218.6/218.7
Bromide	EPA 300.0
Chloride	EPA 300.0
Fluoride	EPA 300.0
Nitrate as N	EPA 300.0
Nitrite + Nitrate as N	EPA 300.0
Nitrite as N	EPA 300.0
Orthophosphate as P	----------
Phosphate	EPA 300.0
Sulfate	EPA 300.0
Phosphate/Orthophosphate/Total Phosphorus	SM 4500 PE
Cyanide, Total	SM 4500CN B, C, E
Ammonia as N	EPA 350.1
Total Kheldahl Nitrogen	EPA 351.2
Nitrate as N	EPA 353.2
Nitriate + Nitrate as N	----------
Nitrite as N	EPA 353.2
Nitrocellulose	EPA 353.2 Mod.
Bicarbonate	SM 2320B
Carbonate	SM 2320B
Hydroxide	SM 2320B
Total Alkalinity (CaCO3)	SM 2320B
Specific Conductance, Conductivity (25C)	SM 2510B
Total Dissolved Solids (TDS)	EPA 160.1
Ferrous Iron	SM 3500-Fe Bc
Sulfide	SM 4500-S_2F
Total Organic Carbon (TOC)	SM 5310C
Dissolved Organic Carbon (DOC)	SM 5310C
Per- & Polyfluoroalkyl Substances (PFAS)	
N-ethyl perfluorooctanesulfonamidoacetic acid N-EtFOSAA	EPA 537.1
N-methyl perfluorooctanesulfonamidoacetic acid N-MeFOSAA	EPA 537.1
Perfluorobutanesulfonic acid PFBS	EPA 537.1
Perfluorodecanoic acid PFDA	EPA 537.1
Perfluorododecanoic acid PFDoA	EPA 537.1
Perfluoroheptanoic acid PFHpA	EPA 537.1
Perfluorohexanoic acid PFHxA	EPA 537.1
Perfluorohexanesulfonic acid	EPA 537.1

Parameter/Analyte	**Potable Water**
PFHxS	
Perfluorononanoic acid PFNA	EPA 537.1
Perfluorooctanoic acid PFOA	EPA 537.1
Perfluorooctanesulfonic acid PFOS	EPA 537.1
Perfluorotetradecanoic acid PFTeDA	EPA 537.1
Perfluorotridecanoic acid PFTrDA	EPA 537.1
Perfluoroundecanoic acid PFUdA	EPA 537.1
Hexafluoropropylene oxide dimer acid HFPO-DA	EPA 537.1
9-Chlorohexadecafluoro-3-oxanonane-1-sulfonic acid 9-Cl-PF30NS	EPA 537.1
11-Chloroeicosafluoro-3-oxaundecane-1-sulfonic acid 11-Cl-PF30UdS	EPA 537.1
4,8-Dioxa-3H-perfluorononanoic acid ADONA	EPA 537.1
Perfluorobutanoic acid PFBA	EPA 533
Perfluoropentanoic acid PFPeA	EPA 533
Perfluorohexanoic acid PFHxA	EPA 533
Perfluoroheptanoic acid PFHpA	EPA 533
Perfluorooctanoic acid PFOA	EPA 533
Perfluorononanoic acid PFNA	EPA 533
Perfluorodecanoic acid PFDA	EPA 533
Perfluoroundecanoic acid PFUnA	EPA 533
Perfluorododecanoic acid PFDoA	EPA 533
Perfluorobutanesulfonic acid PFBS	EPA 533
Perfluoropentansulfonic acid PFPeS	EPA 533
Perfluorohexanesulfonic acid PFHxS	EPA 533
Perfluoroheptanesulfonic acid PFHpS	EPA 533
Perfluorooctanesulfonic acid PFOS	EPA 533
1H,1H, 2H, 2H-Perfluorohexane sulfonic acid 4:2FTS	EPA 533
1H,1H, 2H, 2H-Perfluorooctane sulfonic acid	EPA 533

Parameter/Analyte	**Potable Water**
6:2FTS	
1H,1H, 2H, 2H-Perfluorodecane sulfonic acid 8:2FTS	EPA 533
Perfluoro-3-methoxypropanoic acid PFMPA	EPA 533
Perfluoro-4-methoxybutanoic acid PFMBA	EPA 533
Nonafluoro-3,6-dioxaheptanoic acid NFDHA	EPA 533
Hexafluoropropylene oxide dimer acid HFPO-DA	EPA 533
4,8-Dioxa-3H-perfluorononanoic acid ADONA	EPA 533
Perfluoro(2-ethoxyethane)sulfonic acid PFEESA	EPA 533
9-Chlorohexadecafluoro-3-oxanonane-1-sulfonic acid 9ClPF3ONS	EPA 533
11-Chloroeicosafluoro-3-oxaundecane-1-sulfonic acid 11 Cl-PF3OUdS	EPA 533
Sample Preparation	
Mercury digestion	EPA 245.1
PFAS SPE	EPA 537.1

Accredited Laboratory

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Clovis, CA

for technical competence in the field of

Environmental Testing

In recognition of the successful completion of the A2LA evaluation process that includes an assessment of the laboratory's compliance with ISO/IEC 17025:2017, the 2009 TNI Environmental Testing Laboratory Standard, and the requirements of the Department of Defense Environmental Laboratory Accreditation Program (DoD ELAP) as detailed in version 5.4 of the DoD/DOE Quality System Manual for Environmental Laboratories (QSM), accreditation is granted to this laboratory to perform recognized EPA methods as defined on the associated A2LA Environmental Scope of Accreditation. This accreditation demonstrates technical competence for this defined scope and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communiqué dated *April 2017*).

Presented this 24th day of July 2023.

Mr. Trace McInturff, Vice President, Accreditation Services
For the Accreditation Council
Certificate Number 4064.01
Valid to June 30, 2025

For the tests to which this accreditation applies, please refer to the laboratory's Environmental Scope of Accreditation.

Standard Operating Procedure

Instrumental Analysis of Per- and Polyfluoroalkyl Substances (PFAS)
BY LC-MS/MS (EPA Method 537.1, 533 and DoD QSM Table B-15)

1 STATEMENT OF PURPOSE

1.A This procedure describes the proper way analyze extracts from solid and liquid matrices for PFAS using liquid chromatography tandem mass spectrometry by EPA Method 537.1, 533, and in house DoD QSM complaint methods.

2 INSTRUCTIONS

3 Scope and Application

3.A This method describes instrumental analysis of PFAS in extracts from solid and aqueous matrices using liquid chromatography tandem mass spectrometry according to EPA 537.1 , EPA 533, and in compliance with DoD QSM Table B-15.

3.B This method is restricted to use by or under the supervision of personnel who have been trained according to this SOP as PFAS instrument analysts for the purpose of analyzing extracts from water and soil samples using LCMS-MS and interpreting and quantitating sample data using isotope dilution. Each analyst must demonstrate the ability to generate acceptable results with this method. If an individual project has its own QAPP with client specific requirements that are different than the SOP, the QAPP overrides the SOP. This information will be specified in the comment section of the ARF.

4 Method Summary

4.A Samples are spiked with isotopologues then extracted using SPE or SLE.

4.B The analytes are separated by liquid chromatography using a Gemini® 3 µm C18 110 Å column (or equivalent) and detected by MS/MS.

4.C An analyte is identified in a sample by comparing the RT to the standard retention time and the relative retention time to isotopologues. When appropriate, the analyte can be confirmed by comparing the secondary transition associated to that compound and compared to the standards' ion ratios.

4.D Quantitation is achieved based on a minimum five-point calibration curve using the appropriate quantification method for the requested method. EPA 537.1 required the internal standard method with extracted surrogate, EPA 533 required isotope dilution with all commercially available isotopologues and isotope performance standards. The QSM table B-15 requires internal standard or isotope dilution. Isotope dilution will be performed when isotopologues are commercially available.

5 Detection Limits

5.A See section 23 Tables.

6 Definitions

See SOP# DOC019-Definitions

7 Interferences and Potential Problems

7.A All glassware must be meticulously cleaned. Wash glassware with detergent and tap water, rinse with tap water, followed by a reagent water rinse. If the glassware is to be used for methanol, a final rinse with HPLC grade methanol is recommended. Nonvolumetric glassware can be heated in a muffle furnace at 400 °C for 2 h or solvent rinsed. Volumetric glassware should be solvent rinsed and not be heated in an oven above 120 °C. Store clean glassware inverted or capped. Do not cover with aluminum foil because PFAAs can be potentially transferred from the aluminum foil to the glassware.

7.B Method interferences may be caused by contaminants in solvents, reagents (including reagent water), sample bottles and caps, and other sample processing hardware that lead to discrete artifacts and/or elevated baselines in the chromatograms. The target analytes in this method can also be found in many common laboratory supplies and equipment, such as PTFE (polytetrafluoroethylene) products, LC solvent lines, methanol, aluminum foil, SPE sample transfer lines, etc. All items such as these must be routinely demonstrated to be free from interferences (less than 1/3 the MRL for each method analyte) under the conditions of the analysis by analyzing laboratory reagent blanks.

7.B.1 Potential lab contaminant peaks associated with glassware, instrument tubing, or reagents may be effectively separated from target analyte peaks by using the Luna® 5 µm C18(2) 100 Å column; or equivalent.

7.C Matrix interference may be caused by contaminants that are co-extracted from the sample. The extent of matrix interference 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.4-5 Total organic carbon (TOC) is a good indicator of humic content of the sample. Under the LC conditions used during method development, matrix effects due to total organic carbon (TOC) were not observed.

7.D Relatively large quantities of the preservative are added to sample bottles for EPA 537.1. The potential exists for trace-level organic contaminants in these reagents. Interference from these sources should be monitored by analysis of laboratory reagent blanks with each preparatory batch, particularly when new lots of reagents are acquired.

7.E SPE cartridges can be a source of interference. The analysis of field and laboratory reagent 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.

7.F NOTE: PFAA standards, extracts and samples should not come in contact with any glass containers or pipettes as these analytes can potentially adsorb to glass surfaces. PFAA analyte, IS (Internal Standards) and SUR (Surrogate) standards commercially purchased in glass ampules are acceptable; however, all subsequent transfers or dilutions performed by the analyst must be prepared and stored in polypropylene containers.

8 Health and Safety

8.A Lab coats, gloves, and safety glasses are to be used at all times.

9 Sample Preservation, Containers, Handling and Storage – See SOP PRE537

10 Quality Control

10.A Initial Demonstration of Capability (DOC):

10.B A DOC is completed according to SOP # QC006 when a new employee starts work and annually thereafter, using four replicate spikes at 1-4 times the LOQ.

10.C The acceptance criteria for all target analytes in the IDOC is 70-130% for accuracy and < 20%RPD for precision.

10.D For analytes that fail to meet acceptance criteria, repeat the IDOC before any sample analysis takes place.

10.E Method Detection Limits (MDL): Establish the limit of detection (LOD), limit of quantitation0 (LOQ), detection limit (DL), and method detection limit (MDL) according to SOP QC018.

10.F An MDL study must be analyzed at initial method setup and whenever there are major changes to the instrument.

10.F.1 The LODs and LOQs are confirmed quarterly. See QC018 Establishing MDL, LOD, LOQ for more information.

10.F.2 A retention time window study is performed at method set up and after every major instrument change such as a new column. Three injections of the standard or standards containing all analytes of interest including surrogates are made over the course of a 72-hour period. The retention time for each compound is recorded to three decimal places (e.g., 0.007). The width of the retention time window is defined as ± 3 times the standard deviation of the mean absolute retention time established during the 72-hour period. The retention time window position is set using the mid point of the ICAL standard. On days when an ICAL is not performed, the initial CCV is used to set the window position. It is acceptable to set the retention time window wider than the study indicates to ensure positive identification of all compounds. It is not permissible to set the window width less than the retention time window study.

10.G On-going Quality Control for sample extraction -

10.G.1 Sample quality control for preparation and analysis include the analysis of a method blank (BLK), a laboratory control spike (LCS), a matrix spike (MS), and a matrix duplicate (DUP) or matrix spike duplicate (MSD) in each analytical batch of 20 samples, and the addition of labeled internal standards and labeled C13 surrogates to each sample and QC sample.

10.G.2 The method blank must be shown to contain no analytes of interest >1/3 the LOQ for 537.1 and >½ LOQ for DoD (or >1/10th the amount in a sample or the regulatory method which ever is greater).

Corrective Action: If there is a detection >1/3 LOQ (or >½ LOQ for DoD) in the method blank the entire batch associated with the BLK will be re-extracted and reanalyzed. Sample data may not be reported if the method blank exceeds these minimum blank contamination requirements. If not enough sample volume exists for a re-extraction, the client will be notified for permission to report the sample as qualified with a 'B' flag for 'compound found in the associated blank. Samples associated with method blank concentrations <1/10 sample concentration or <1/10 regulatory limit do not require B-flags.

10.G.3 The laboratory control spike consists of an aliquot of control matrix similar to the sample matrix and of the sample weight or volume. The LCS is spiked with the same analytes at the same concentrations as the matrix spike/matrix spike duplicate. See section 23 Tables in this SOP for compounds and control limits.

Corrective Action: If the LCS does not meet acceptance criteria (70-130% true amount for medium, high, and DoD; 50-150% true amount for low concentration), the data must be considered invalid. The entire batch associated with the LCS will be re-extracted and reanalyzed. For DoD if not enough sample volume exists for a re-extraction, the sample will be qualified with a 'Q' for the analyte not meeting acceptance criteria with client instruction.

For DoD projects, an LCS/LCSD is required if there is insufficient volume for MS/MSD.

10.G.4 The matrix spike and matrix spike duplicate will be included with each sample batch as per client. The client is to determine which sample is designated with MS/MSD. The %RPD limit for the MS/MSD is ≤30%. If the criteria is not met notify the project manager who will examine the DQOs and contact the client. For DoD projects, an LCSD is required, if there is insufficient volume for MS/MSD.

Corrective Action: If the MS does not meet acceptance criteria (70-130% true amount for medium, high, and DoD; 50-150% true amount for low concentration) which indicates a potential problem due to the sample matrix itself, the LCS results are used to verify that the laboratory can perform the analysis in a clean matrix. For DoD, the sample will be qualified with a 'J' for the analyte not meeting acceptance criteria with client instruction.

10.G.5 For a matrix duplicate sample, any native hits associated in the sample and sample duplicate must have a %RPD limit of ≤30%.

10.G.6 All samples and quality control is fortified with labeled surrogates before being extracted. For 537.1, surrogates must recover between 70-130% of true amount. For DoD, surrogates must recover between 50-150% of true amount.

10.H On-going Quality Control for instrumentation –

10.H.1 A Calibration Curve is required at instrument set-up and after ICV or CCV failure, prior to sample analysis. Section 10 details how to prepare a calibration curve and Section 11 details how to analyze, quantitate, and evaluate a calibration curve, and Section 13 details the calculations used to evaluate the curve and subsequent calibration verifications.

Method-specific initial calibration criteria is discussed in more detail below for EPA 537.1 and DoD QSM Table B-15.

10.H.2 Initial Calibration Verification (ICV) – An ICV is a second source and must be analyzed after the calibration curve and prior to sample analysis. Analytes must recover within 70-130% of the true amount.

10.H.3 Continuing Calibration Verification (CCV) – A CCV must be analyzed at the beginning and the end of an analytical sequence, and after every tenth field sample during analysis.

For EPA 537.1, the CCV at the beginning of the sequence must be at or below the LOQ and must recover within 50-150% of the true amount; the subsequent CCVs are rotated between medium and high concentration calibration standards and must recover within 70-130% of the true amount.

For DoD, the CCV concentrations may range from the LOQ to the mid-level calibration range. The CCV must recover within 70-130% of the true amount. In addition, an LLCCV is prepared at the LOQ concentration and must recover within 70-130% of the true amount. The LLCCV is injected prior to analysis and at lease every 12 hours.

For DoD projects using QSM revision 5.1 (or later), if a CCV fails, the laboratory can immediately analyze two additional consecutive CCVs (immediately is defined as starting a consecutive pair within one hour; no samples can be run between the failed CCV and the two additional CCVs). This approach allows for spurious failures of analytes to be reported without reanalysis of samples. Any corrective actions that change the dynamics of the system (e.g., trap column, mobile phase preparation, run blanks) requires that all samples since the last acceptable CCV be reanalyzed. Both of these CCVs must meet acceptance criteria in order for the samples to be reported without reanalysis. If either of these two CCVs fail or if the laboratory cannot immediately analyze two CCVs, the associated samples cannot be reported and must be reanalyzed. Flagging of data for a failed CCV is only appropriate when the affected samples cannot be reanalyzed. The lab must notify the client prior to reporting data associated with a failed CCV.

Sample injection may continue for as long as all the calibration verification standard requirements listed above are met.

10.H.4 Instrument Blank (ICB/CCB) – An instrument blank must be analyzed immediately following the highest standard of the calibration curve and daily prior to sample analysis. The instrument blank must be shown to contain no analytes of interest >1/3 the LOQ for 537.1 and >½ LOQ for DoD.

10.H.5 All samples and quality control samples are spiked with labeled internal standards after extraction and before analysis. For 537.1, the internal standards must recover within 70-140% of the areas measured in the most recent CCV and within 50-150% of the average areas measured in the initial calibration. For DoD, the internal standards must recover within 50-150% of the daily initial CCV.

Note: All instrument quality control is fortified with labeled surrogates in addition to internal standards.

10.H.6 A second source (a spike source different from the calibration source) must be analyzed at least quarterly and when a new native intermediate is prepared. If a second vendor is not available, then a different lot of the standard should be used. The analytes must recover with 70-130% of the true amount.

10.I Quality control requirements specific to EPA 537.1 include:

10.I.1 Initial Demonstration of Peak Asymmetry Factor - the peak asymmetry factors must be calculated according to the formula in 13.0 for the first two eluting peaks using a mid-level calibration standard. The peak asymmetry factor must fall in the range of 0.8-1.5. The peak asymmetry factor must meet criteria every time a new calibration curve is generated. If it does not meet acceptance criteria, change the mobile phase conditions to higher aqueous content until the ratio for each peak is 0.8-1.5.The isotopically labeled compounds in this method may undergo suppression in the ESI source if the concentration of the co-eluting native analyte(s) is too high. The analyte concentration at which suppression may occur can vary depending on the instrument, LC conditions, ESI conditions, IS concentration, etc. See section 13 for the equation for calculating the %RPD between the high and low areas for each IS.

The %RPD calculated above must be <20% for each IS during calibration. If the calculated RPD is >20% for any IS, the analyst must recalibrate at lower analyte concentrations until the IS RPDs are <20%.

10.I.2 A field blank per every sample set. A sample set is composed of samples collected from the same sample site and at the same time.

10.I.3 The laboratory control spike must be rotated between low, medium, and high concentrations from batch to batch. The low spike concentration must be no more than two times the LOQ and must recover between 50-150% of the true amount. The high spike concentration must be near the high end of the calibration range. The medium and high spikes must recover between 70-130% of the true amount.

10.I.4 The matrix spike must be rotated between low, medium, and high concentrations from batch to batch. The low spike concentration must be no more than two times the LOQ and must recover between 50-150% of the true amount. The high spike concentration must be near the high end of the calibration range. The medium and high spikes must recover

10.J Quality control requirements specific to DoD QSM Table B-15 include:

10.J.1 The laboratory control spikes and matrix spikes must be spiked ≥ the LOQ and ≤ the mid-point of the calibration range and must recover between 70-130% of the true value.

10.J.2 An instrument sensitivity check (LLCCV) is required prior to sample analysis and once every 12 hrs. The LLCCV must be at the LOQ and recover within 70-130% of the true amount. The LLCCV can serve as the opening CCV for a sequence.

10.J.3 For any failures, check the following before moving forward with a corrective action:

10.J.4 Calculations to locate possible errors

10.J.5 Standard solutions for degradation

10.J.6 Contamination

10.J.7 Instrument performance

10.K Corrective Action: Errors, deficiencies, deviations, or laboratory events or data that fall outside of established acceptance criteria will be investigated. In some instances, corrective action may be needed to resolve the problem and restore proper functioning to the analytical system. The investigation of the problem and any subsequent corrective action taken is documented on a Nonconformance Work Report (NWR) and/or a Corrective Action Report (CAR).

10.L Deviations: Any activity not performed in accordance with laboratory procedures or Quality Assurance Project Plans is considered a deviation from plan. All deviations from plan will be documented as to the extent of, and reason for, the deviation.

11 Equipment/Apparatus

11.A Liquid chromatography (LC) / tandem mass spectrometer (MS/MS) with Data System

11.A.1 The TQ5500 LC MS/MS by SCIEX
11.A.2 Analyst® and MultiQuant™ Software by SCIEX
11.B LC Operational Settings:
11.B.1 Autosampler Temperature: 15 °C
11.B.2 Oven Temp: 40 °C
11.B.3 Injection Volumes: 10uL
11.C Mass Spec Operational Settings:
11.C.1 Scan Type: MRM (MRM)
11.C.2 Duration: 15 min
11.C.3 MRM Detection Window: 180 sec
11.C.4 Target Scan Time: 0.2 sec
11.D LC column
11.D.1 The suggested analytical column is a Cadenza CX-C18 VHP.
11.D.2 A second Cadenza Cx-C18 VHP column recommended for the removal of contamination introduced from instrument tubing and mobile phase reagents. The quality of this column is such that rejected analytical seperator columns may be used long after their normal lifespan in this position.
11.E Compressed nitrogen or nitrogen generator
11.F High Density Polyethylene (HDPE) bottles- 4mL and 10mL
11.G Centrifuge Tubes, 15 mL, polypropylene
11.H Injection vials with polyethylene caps:
11.I Polypropylene 300 µL vials
11.J Media 1 L Bottles
11.K Various Class A Glassware – not limited to volumetric flasks, graduated cylinders, and beakers.
11.L Adjustable Pipettes of various sizes

12 Reagents and Standards

12.A Reagent or pesticide grade chemicals shall be used in all tests. Other grades may be used, provided it is first ascertained that the reagent is of sufficiently high purity to permit its use without lessening the accuracy of the determination. All reagent and chemical lots will be documented properly for traceability. Certified reference Materials or stock standards must be purchased from a body that can provide ILAC-signatory (MRA) traceability and ISO/EC 9001, 17025, and 17034 certification.
12.A.1 Reagents:
12.A.2 Puchased Reagents:
All purchased reagents must be of high purity and demonstrated to be free of analytes and interferences.
TRIZMA® – Preset Crystals, pH 7.0 (Sigma cat# T-7193 or equivalent) –Reagent grade. A premixed blend of Tris [Tris(hydroxymethyl)aminomethane] and Tris HCL [Tris(hydroxymethyl)aminomethane hydrochloride. These blends are targeted to produce a pH near 7.0 at 25 °C in reagent water. Trizma® functions as a buffer, and removes free chlorine in chlorinated finished waters.
HPLC Grade Water – Purified water which does not contain any measurable quantities of any method analytes or interfering compounds greater than 1/3 the MRL for each method analyte of interest.
DI water from the laboratory system may be used in place of HPLC Grade water if it does not contain any measurable quantities of any method analytes or interfering compounds greater than 1/3 the MRL for each method analyte of interest. If DI water is to be used, 3 L must be flushed through the system prior to use.
Methanol HPLC Grade
Ammonium Acetate LCMS Grade
Glacial Acetic acid LCMS Grade
Ammonium Hydroxide LCMS Grade
12.A.3 Prepared Reagents:
Mobile Phase A: add 1.0mL of glacial acetic acid and 1.0mL ammonium hydroxide to 1L of HPLC Grade Water.
Mobile Phase B: add 1.0mL of glacial acetic acid and 1.0mL ammonium hydroxide 1 L of HPLC Grade Methanol
the standards above may be prepared in smaller and larger quantities as long as the ratios are kept the same.

12.B Standards:
12.B.1 All standards should be stored in polypropylene or HDPE containers at <4 °C to minimize being concentrated from the evaporation of methanol.
Note: When purchasing standards, the DoD requires the following when commercially available:
Both branched and linear isomers of the native compounds
Labeled analogs for each native analyte
12.B.2 Purchased Standards:
2000 ng/mL 24 Native Calibration Standard – Wellington, product number PFAC-24PAR; or equivalent.
Consists of 24 different PFAS compounds. Contains both branched and linear isomers for PFOS and PFHxS.
1000 ng/mL 24 Native Second Source – Absolute, product number 99207; or equivalent.
Consist of 24 different PFAS compounds. Contains both branched and linear isomers for PFOS and PFHxS.

1000-4000 ng/mL EPA 537.1 Surrogates – Wellington, product number EPA-537SS; or equivalent.
Consists of 3 different mass-labeled PFAS compounds. The isotopes used include ^{13}C and ^{2}H.
1000 ng/mL DOD 537 Surrogates – Wellington, product number MPFAC-24ES; or equivalent.
Consists of 19 different mass-labeled PFAS compounds. The isotopes used include ^{13}C and ^{2}H.
1000-4000 ng/mL EPA 537.1 Internal Standards – Wellington, product number EPA-537IS; or equivalent.
Consists of 3 different mass labeled PFAS compounds. The isotopes used include ^{13}C and ^{2}H.
2000 ng/mL DOD 537 Internal Standards – Wellington, product number MPFAC-C-IS; or equivalent.
Consists of 4 different mass labeled PFAS compounds. The isotope used is limited to ^{13}C.

12.B.3 Prepared Standards:
Note: When preparing standards…
All QSM TB-15 and 533 standards are to be prepared for a final methanol: water ratio of 80%:20%.
All 537.1 standards are to be prepared for a final methanol: water ratio of 96%:4%.
The stock solutions listed above are diluted into intermediates. The intermediates are then used to spike the calibration curve and all quality control samples. Refer to the standard prep log book, H:\Saphira\Standard Prep Log Book, for instructions on preparation of the intermediate standards.

12.B.4 The preparation of all standards is to be recorded and saved in H:\Saphira\Standard Prep Log Book.

12.B.5 The expiration date for analytical standards may be extended by following re-certification procedures below:
Contact the standard supplier and request an expiration date extension. If the supplier is not able to extend the date, then in-house re-certification may be performed as follows:
Analyze the expired standard and quantitate it against an unexpired standard from a different supplier or different lot # from same supplier.
For organic standards, the acceptance criteria is 20%D.
If the expired standard meets the above acceptance criteria, then extend the date by 3 months for organics.
The re-certification with extended expiration date is documented in the standard prep log book, along with the analysis date, instrument name, data file ID, and name of standard supplier with current unexpired lot number that was used to re-certify the expired standard.
Email this information to QAU.

13 Calibration and Standardization

13.A Prior to use and after major maintenance is performed, a mass calibration will be performed by a certified technician from SCIEX.

13.B Before Calibrating, perform a Tune Check by running a mid-point standard using the PFOS Tune Check method. See section 12.0 for details on how to inject. Verify that the mass of PFOS is ±0.5 amu of the true value (80 amu) by:

13.B.1 Opening the data for the tune check by double clicking the "Open Data File" Icon located underneath the Explore Icon on the left hand side of the Analyst® software.

13.B.2 Select the sample being used for the Tune Check and hit OK.

13.B.3 This will open a screen with peaks on it. Highlight the peaks then double click on the highlighted portion. This will zoom onto the PFOS peak. If the mass is within 79.5-80.5 amu, the tune check is acceptable.

13.B.4 If the Tune Check fails, SCIEX must be contacted and a certified technician will come out and perform an instrument tune. If the instrument tune does not resolve the problem, the SCIEX technician will perform a mass calibration.

13.C For details on how to prepare a calibration curve, reference section 10 and the most recent standard prep page located in H:\Saphira\Standard Prep Log Book.

13.D Once the calibration standards are prepared, analyze the standards and process the data according to the procedure in Section 12.0.

13.E The following applies to all calibration curves:

13.E.1 One of the concentrations will be at the quantitation limit. The analyst must refer to the incoming sample notice for the lab works code and look at the detection limits listed on the appropriate form 1 to determine the quantitation limit standard. The initial calibration curve is a reflection of the performance of the instrument at any given time. Compounds react to the changing dynamic of the instrument. Therefore it is sometimes necessary to delete levels for compounds in an initial calibration curve. When this occurs the following rules are followed to ensure integrity of the data:

13.E.2 A standard must be included in the curve for each compound, which is less than or equal to the reporting limit. If the responses of a sample peak exceed the calibration range of the system, dilute the extract and reanalyze.

13.E.3 The deletion of discrete points must never result in a calibration curve consisting of less than five points for each analyte of interest.

13.E.4 Points for an individual analyte in the middle of the curve may not be deleted, however unforeseen circumstances may occur such as a miss injection by the autosampler, a loose cap on an injection vial, etc. In this situation the entire level is deleted for all compounds and the reason for deletion is noted on the multilevel form. If this results in a calibration curve that consists of less than five points, another level may be run before the analysis of samples begin.

13.E.5 Points at the low end and high end of the curve may be deleted if it is determined the compound ceases to be linear at either end. Any positive findings in the samples will be analyzed so as to fall within the linear range of that particular compound.

13.F For a calibration curve to be considered acceptable for QSM TB-15 and meet DoD criteria, the following conditions must be met:

13.F.1 Note: secondary transitions do not need to meet acceptance criteria since they are only used to confirm the existence of the analyte and not the concentration. The only secondary transition requirement is the S/N ratio must be $\geq 3:1$ for analytes containing branched analytes in the standard. The ion ratio must be monitored and also documented using the instrument software for qualitative purposes. For a sample containing an analyte in the primary transition, it must be

documented on the multilevel (Table 5) that the secondary transition was also present in order for positive detection to be confirmed.

13.F.2 Calibrations must contain a minimum of 5 points for linear regression or 6 points for quadratic regression; weighting is allowed.

13.F.3 If a labeled analog is not commercially available, then the surrogate with the closest retention time is used for quantitation.

13.F.4 $r^2 \geq 0.99$ for each analyte.

13.F.5 All analytes must recover within 70-130% of their true amount.

13.F.6 The RSD% of the RFs for all analytes must be <20%. This is calculated using the Query described in section 12.0.

13.F.7 Internal standards must recover within 50-150% of the midpoint of the curve, and surrogates must recover within 50-150% of the true amount.

13.G For a calibration curve to be considered acceptable for EPA 537.1, the following conditions must be met:

13.G.1 Note: secondary transitions do not need to meet acceptance criteria since they are only used to confirm the existence of the analyte and not the concentration.

13.G.2 Peak Asymmetry Factor must fall in the range of 0.8-1.5 in the mid-level standard for the first two eluting peaks.

13.G.3 Calibrations must contain a minimum of 5 points spanning a 20-fold range.

13.G.4 Curves must always be forced through zero according to the EPA 537.1 method. Weighting is allowed.

13.G.5 All analytes must recover within 70-130% of their true amount; except the lowest point must recover with 50-150% of their true amount.

13.G.6 Internal standards must recover with 70-140% of the midpoint of the curve, surrogates must recover within 70-130% of the true amount.

13.G.7 The RPD for the mass-labeled internal standard area between the low and high calibration standard must be <20% for each internal standard. See section 13 for the calculation.

13.H An instrument blank, CCV, and ICV are to be injected after the completion of a curve. For more information and acceptance criteria, see section 8.

13.I Each sample analysis sequence must include an acceptable initial calibration; calibration verification standards. When a CCV or Resolution Check fails to meet the acceptance criteria, all samples that were injected after the last acceptable check must be re-injected.

14 Procedure

14.A See SOP PRE537 for the extraction procedure of aqueous and solid samples. The extracts will be analyzed according to the procedure listed below. The analyst is given a copy of the final extraction sheet from the extraction technician for each preparatory batch. The analyst uses the information on extraction sheet to enter sample weights and final volumes into the instrument software for quantitation purposes. In addition, the analyst uses the spike and surrogate information from the extraction sheet to calculate the spike and surrogate recoveries in the samples and associated QC samples. See section 13 of this SOP for calculations.

14.B Receipt of extracts:

14.B.1 Extracts are received and ensured they have been brought to the appropriate pH, final volume, and internal standards concentration. This is noted on the extraction sheet with a date and initial.

EPA 537.1 extracts require the 10µL/mL EPA537 IS solution

EPA 533 extracts require 10µL/mL IIS solution.

DoD/QSM Table B-15 samples do not require IS or IIS but can be spiked with 10µL/mL IIS solution to comply with legacy calculation methods. Extracts are sometimes received in alkaline conditions when ammonia fails to evaporate in the concentration step. These samples may be acidified with 20µL of acetic acid to ensure that PFBA and PFMBA do no split.

14.C Vialing

14.C.1 100µL of sample is transferred to a 300 µL conical injection vial and capped with a polyethylene cap.

Or 500µL of sample is transferred to a 1mL flat bottom injection vial and capped with a polyethylene cap.

14.C.2 For samples requiring small dilutions:

The injection volume may be modified to provide up to a 100x dilution factor (0.1µL/10µL) without any change in sample provide sufficient EIS sensitivity exists. S/N should aways be greater than 10 for EIS.

Due to difficulties with sulfur isotopes and compounds labeled M+2, some great bias may be seen when diluting this way for 4:2, 6:2, and 8:2 FTS. Due to this D4-13C2 isotoplologues are employed instead.

14.C.3 For samples requiring large dilutions (where the internal standard signal to noise cannot be maintained above 10)

Sample are diluted with a stock solution containing all relevant IS/EIS/IIS and no native present.

EPA 533 does not support dilutions in any way, instead re-extraction must be performed with a subsampled aliquot.

DoD/QSM Table B-15 samples are best reacquired as dilutions of the unextracted sample.

Samples prepared this way are required to be prepared and analyzed in duplicate and with PS samples every batch.

14.D Creating analysis batches and sequences and submitting them to the insturment.

14.D.1 Open the Analyst® software and connect to the mass spec by going to the Hardware Configuration Tab on the left side of the screen, double click to open. Select LCMS System and “Activate Profile.” This should result in an audible beep from the instrument and a green check mark indicating that the system has been connected to the computer.

14.D.2 If the system does not connect, power cycle the LC units, autosampler, and controller box and try to connect again.

14.D.3 Make sure the correct project folder is open, it should correlate to the date of the curve the samples are to be acquired under.

14.D.4 Under the navigation plane select acquire and create aquision batch.

14.D.5 Generate a set by typing the Date in the format YYYY-MM-DD in the set field and select create batch

14.D.6 Add samples to be the batch by selecting add samples
14.D.7 Name the samples relevantly to what you are injecting
14.D.8 Add the correct vial locations
14.D.9 Make sure they are being submitted under a data file of the format YYYY-MM-DD
14.D.10 Add the following information to the sample field in the following format
FA,units,IA,UCF,other
where:
FA= Final Amount with units
units= units being reported (ng/mL for CCV's , ng/L, ng/g, ug/L, or ng/mL for AFFF)
IA= Initial Amounts with units
UCF= Unit Conversion Factor (multiples of 1000)
14.D.11 Change to the submit tab and submit samples to the que in the correct order.
If the instrument is going from IDLE into the queue ensure that a MeOH cycle is run before analysis. The instrument uses the end of one injection to prepare for the next and the column oven needs to reach temperature before analysis can begin. A single cycle is sufficient to ensure this happens.
14.D.12 Press the ready button the bring the mass spectrometer online and press start queue to being the analysis.

14.E Analysis of data usning multiquant

14.E.1 Open the MultiQuant™ software in order to process the data. If a new calibration curve has been analyzed, go to file then "New Results Table." Select the data to be processed.
14.E.2 Hit "Next", choose an existing processing method (PFAS 537 for 537.1 or PFAS DOD for QSM TB-15) then hit "Finish." Save the file with the QCG name.
14.E.3 If the data will be processed from an existing calibration curve, go to file then "Open Results Table." Open the most recent ICAL file. Save the file with the QCG name for the samples that will be processed and continue to the steps below.
14.E.4 This will lead to screen where every analyte is listed for every sample. One analyte can be viewed by selecting it in the list on the left hand side of the screen.
14.E.5 The chromatograms and calibration curves can be viewed by selecting the appropriate symbols and the top of the screen.
14.E.6 The data set can then by processed using a Query which was developed, controlled, and provided by the manufacturer. This query calculate asymmetry factors, IS/surr recovery, and various other requirements. To process with the query, go to "Process" at the top of the screen, select Query. This lead to another screen. Select the correct query (PFAS_QUERY 2 for DOD/537M and PFAS_QUERY 537 for 537.1)
14.E.7 Click OK, fill out the acceptance criteria for the IS, the amount of sample added to the injection vial, the final volume in the injection vial, and the final volume of the extract. Click OK.
14.E.8 The Query will flag failures with a reason listed in the "Failure Reason" column. These failures include but are not limited to accuracy (CCV/linearity check failures), IS/Surr failures, potential problems with Ion ratio or signal/noise ratio. All of the flags should be thoroughly checked by the analyst and are not to be assumed as final until verified by the analyst.
14.E.9 Peaks may be manually integrated if the software did not properly integrate a specific peak, by using the mouse to accurately draw the baseline integration. Chromatographic noise peaks may be removed by setting the integration to "Not Found." For analytes with multiple peaks (branched and linear), all of the peaks associated with the analyte should be integrated and reported as the summation of the peaks for that particular analyte. This is applicable to the calibration standards as well as samples.
14.E.10 After any changes are made, save the file. To export or to pdf the data, go to file then Create Report select the correct report template: Sample Report APPL for PDF and printing data, ICAL Report 2 for PDF and printing a calibration curve, and CSV LIMS Report APPL for exporting the data. Save the PDF or export file into the HPLC Server by hitting the "Set… " button to the right of Generate report file. This will allow the data to be named by the QCG name and the data to be saved in the correct location.
14.E.11 Select the output format (PDF, word, csv) then hit ok.
14.E.12 The data is now ready to be uploaded into the LIMS System.

15 Data Analysis and Calculations

There exists many methods of quantification for PFAS analysis. EPA 8327, which is not explored within, relies on external standard quantification. EPA 537.1 and its sister methods rely on an internal standard approach. The QSM suggests Isotope dilution without Isotope performance standards, while EPA 533 requires isotope dilution with isotope performance standards. APPL takes great care in providing exactly as stated for all methods performed. The multiquant software employed by APPL is both powerful and versatile, but should not be used without caution. Anyone using the software is fully responsible to understand the math it's performing, the requirements of the methods performed, and to endure they are congruous.

15.B Multiquant generated equations

Mean response factor, Linear regressions and Quadratic regressions are generated by Multiqaunt software, may be unwighted, weighted $1/x$ or weighted $1/x^2$ as necessary.
They all take the form of $y = f(x)$
Where:

$$x = \frac{Concentration_{Analyte}}{Concentration_{InternalStandard}}, \quad y = \frac{Area_{Analyte}}{Area_{InternalStandard}}$$

The generation of these functions is not described herein, but their aplication is.

15.C Single-point external standard quantification (DoD/DoE QSM 5.3 – Table B-15 - Extracted Internal Standard)

"Extracted Internal Standard Analyte recoveries must be within 50% to 150% of ICAL midpoint standard area or area measured in the initial CCV on days when an ICAL is not performed."
-DoD/DoE QSM 5.3 Table B-15

In order to best represent the quoted requirement, multiquant is programmed to present EIS recoveries as a percentage of the most recent QC sample.

$$\%EIS = \frac{Area_{sample}}{Area_{CCV}} * 100$$

This forces two things, the concentration of EIS cannot vary between injections and the EIS may not be corrected by an Injected internal standard.

15.D Multi-point external standard quantification (EPA 8327)

Regression equations from 17.A are applied and the concentration and area of internal standards is assumed to be 1.

15.E Internal standard quantification (EPA 537.1)

Regression equations from 17.A are applied and the isotopologues added after the sample extract concentration step are used for the internal standards; in this way samples are correct for instrument variation and final volume variation.

15.F Isotope dilution quantification (EPA 533 and DoD/DoE QSM 5.3 – Table B-15)

Regression equations from 17.A are applied and the isotopologues added before the sample concentration concentration step are used as internal standards; in this way analytes are correct for extraction deficiencies, matrix effects, instrument variation and final volume variation.

15.G Isotope performance quantification (EPA 533 - extracted internal standard)

Regression equations from 17.A are applied and the isotopologues added before the sample concentration concentration step are treated as analytes and isotopoglues added after the sample concentration step are used as internal standards; in this way extracted isotopologues are correct for instrument variation and final volume variation.

15.H Conversion from in extract to in sample concentration

$$Concentration_{Sample} = Concentration_{Extract} * \frac{Volume_{Final}}{Amount_{Initial}} * UnitConversionFactor$$

15.I Correction of data to the protonated acid state.

All results are reported in the protonated acid form HA, where as some of our analytes come in stock solutions in the form KA or NaA. Correction of results is performed as such:

$$Concentration_{Acid} = Concentration_{Salt} * \frac{MolecularWeight_{Acid}}{MolecularWeight_{Salt}}$$

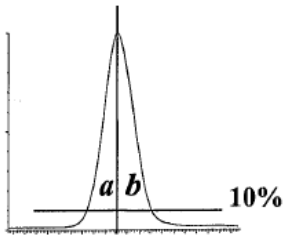
15.J Calibration standards, internal standards, surrogates, and spikes are prepared from dilutions of the purchased stock standards using the following equation:

$$C_1 * V_1 = C_2 * V_2$$

15.K Asymmetry Factor:

This calculation is performed by Multiquant and applies to the first two eluting peaks in EPA 537.1 which must be within 0.8-1.5.

$$A_s = \frac{b}{a}$$



where:

A_s = peak asymmetry factor

B = width of the back half of the peak measured (at 10% peak height) from the trailing edge of the peak to a line dropped perpendicularly from the peak apex

a = the width of the front half of the peak measured (at 10% peak height) from the leading edge of the peak to a line dropped perpendicularly from the apex.

15.L Manual integration: The MultiQuant™ software program is used for integration and quantitation of PFAS data. Manual integration of peaks should be consistent with the ICAL integrations for each standard level. If method acceptance criteria are not met for a particular analyte, then examine the software's integration for that analyte, and determine whether or not the integration is consistent with the ICAL integration at each level. If not, then perform the appropriate manual integration. It may be necessary to integrate other levels also to keep the integration consistent. If it is not possible to meet the criterion while maintaining the same baseline, make any adjustments necessary and recalibrate the instrument. If method acceptance criteria are met, but the software's integration for a peak is inconsistent with the ICAL integration at each level and performing a manual integration would not cause the ICAL to be unacceptable, do not manually integrate. It is the intent of the laboratory to minimize the amount of manual integrations performed by the chemist. Manual integrations should be signed and dated in the "Flag?" column such that they appear on the Raw Data. Manual integration review is performed at the time of final report review and the signature of such is included on the multilevel.

- 15.L.1 MI1) Integration does not follow baseline
- 15.L.2 MI2) Non-target peak interference
- 15.L.3 MI3) To split a peak that was integrated as one peak by the computer.
- 15.L.4 MI4) To integrate a split peak
- 15.L.5 MI5) The whole peak or part of the peak was not integrated.
- 15.L.6 MI6) Computer integrated wrong peak
- 15.L.7 MI7) Other – (See case narrative)

15.M After review by the section manager, the manager will date and initial. Upon client request, the integrations will be reviewed by the QAU or his/her designee initialed and dated. The hard copies will be filed with the raw data. See SOP QC044 Manual Integration for more information.

16 Data Assessment and Acceptance Criteria for QC

16.A The analyst first reviews data by checking the following against the acceptance criteria listed in section 8.0 Quality Control and section 11.0 Calibration. For DoD project acceptance criteria, consult the DoD QSM PFAS Table B-15, which is listed in this SOP as Table 4.

- 16.A.1 The initial calibration curve
- 16.A.2 The initial calibration verification and continuing calibration verification %D
- 16.A.3 The LLCCV recovery
- 16.A.4 The instrument (initial and continuing) blanks
- 16.A.5 The method blank
- 16.A.6 The lab spike recovery and precision
- 16.A.7 The matrix spike recovery and precision
- 16.A.8 Surrogate and Internal Standard %R
- 16.A.9 S/N Ratios
- 16.A.10 Asymmetry Factor
- 16.A.11 Ion Ratios

16.B The MultiQuant™ quantitation software automatically flags any data point that does not meet acceptance criteria, such as: ICAL, CCV, I.S., Surrogate, S/N Ratio, Isomer Ratios etc.

16.C The technical reason for flagging the data point will be listed under the "Failure Reason" column in the software.

16.D All software flags should be critically reviewed by the analyst to prevent errors resulting from inaccurate software integrations or determinations.

16.E The analyst reviews data and assembles the final report, in accordance with the Multilevel Quality Control Sign Off Worksheet, as discussed in APPL's SOP QC045 Data Integrity and Final Review. The analyst signs the MQCS sheet before secondary peer review. See Table 5 of this SOP for a copy of the PFAS MQCS.

16.F If at any point the review shows an out of control situation, complete an NWR form. See SOP QC033 Non-conforming Work Report. The analyst notifies the section manager, and the problem is investigated. The section manager notifies the project manager regarding any QC failures, so that the client is aware of any data integrity issues prior to receiving the final report.

16.G The corrective action for resolving QC issues may be one of several points considered; standard preparation, improper injection size, extraction technique, etc. The problem is potentially solved and reanalysis or re-extraction/reanalysis is performed if possible. If re-extraction is not possible due to limited volume etc, flag the reported data accordingly and notify the client.

16.H For DoD projects, consult Table 4 of this SOP for corrective actions and appropriate flagging criteria

16.I When QC parameters are exceeded, the following takes place:

- 16.I.1 For matrix spike criteria that are exceeded, contact the project manager who will contact the client as to additional measures to be taken. For the specific analyte(s) in the parent sample, apply appropriate flags if acceptance criteria are not met If the MS/MSD.
- 16.I.2 For Blank, LCS, IS, or Surrogate criteria that are exceeded, re-inject or re-extract as needed. Failing method blanks or LCS may require re-extraction of the entire sample batch, if the issue can not be resolved through re-injection or client approval, based on the project DQOs.
- 16.I.3 If the instrument calibration parameters are not met, the standards are re-prepared and re-analyzed. No sample analysis may take place with an out of compliance ICAL or ICV, based on the criteria listed in section 11 of this SOP.

16.J All pertinent information on the NWR and MQCS is included in the case narrative.

17 Corrective Actions and Contingencies for Out of Control Data or Unacceptable Data

18 In the event that an out of control situation occurs, the project manager will be notified immediately. The affect of the out of control situation will be assessed according to the project DQO. If sufficient sample remains, and the situation will significantly affect the quality of the results, the analysis will be repeated. If the situation does not significantly affect the quality of the data, the project manager will notify the client and instructions from the client will be followed. In the event no sample remains, the client will be notified immediately. All situations will be

documented on the multi level sheet and initialed by the project manager. All out of control situations will be brought to the attention of the QAU in the form of a NWR. The QAU has the final authority to approve the actions taken

19 Method Deviations

19.A This SOP was compared to EPA method 537.1. The following deviation were made:

19.A.1 EPA 537.1 requires that an initial demonstration of low background is performed whenever a new lot of cartridges, solvents, centrifuge tubes, pipettes, and injection vials are used.

APPL, Inc. procedure and justification: The lab will analyze a method blank with each preparatory batch in order to demonstrate that the procedure is free from contaminants. This will continuously monitor contamination within each new lot, rather than one IDOC study at the start of a new lot. All samples in the batch will be re-extracted if method blank contamination is present.

19.A.2 EPA 537.1 requires an initial demonstration of accuracy and precision to be performed using 4-7 lab control spikes spiked near the mid-point of the curve. The accuracy must be within 70-130% of the true amount and the RSD% less than 20%.

APPL, Inc. procedure and justification: The lab's standard practice incorporates accuracy and precision checks as a part of the initial demonstration of capability, which is done in accordance with DoD QSM Four spikes are used which are spiked at 1-4X the LOQ.

19.A.3 EPA 537.1 allows for an RPD between a sample and sample duplicate to be ≤50%, if the concentration of the detected analyte is below 2X the LOQ. For the low spiked MS/MSD, an RPD of ≤50% is acceptable.

APPL Inc procedure and justification: Due to limited LIMS capability for only one set of acceptance criteria, the %RPD will be flagged for any RPD >30%. This criteria is more stringent than the method requirement.

20 Pollution Prevention

20.A All hazardous materials that are generated during the testing of samples must be properly collected and stored. Drums are available in the storage room for the following types of wastes- acidic, basic and solvents.

21 Waste Management

21.A Spent sample extracts and standards / surrogates / spikes are disposed in the LC Waste Drum (Profile ID 312936 Acetonitrile/water/methanol).

21.B It is the laboratory's responsibility to comply with all federal, state, and local regulations governing waste management, particularly the hazardous waste identification rules and lands disposal restrictions. The laboratory has the responsibility to protect the environment by minimizing and controlling all releases from fume hoods and bench operations.

22 Method Performance

22.A Continuing method performance is monitored by analysis of LCS samples with each batch and control charting the results as per SOP# QC016.

22.B A method detection Limit (MDL) study is run to ensure the performance of the instrumentation is able to satisfy data quality objectives of the client by reaching the reporting limits necessary. An MDL study is performed for each matrix per instrument after major instrument changes take place, such as a column change and is performed in accordance with SOP# QC018.

22.C The method is not performed by any analyst until a Demonstration of Capability (DOC) is completed. Every analyst who performs this method has demonstrated acceptable accuracy and precision by passing a Demonstration of Capability study.

23 Equipment / Instrument Maintenance and Troubleshooting

23.A The LCMSMS is under service contract with SCIEX. For any major problems, it is best to allow certified technicians to work on the instrument. Technical Support Telephone 1-877-740-2129.

23.B If the Tune Check fails, SCIEX must be contacted and a certified technician will come out and perform an instrument tune. If the instrument tune does not resolve the problem, the SCIEX technician will perform a mass calibration. At a minimum the mass calibration is performed by the instrument manufacturer during the annual periodic maintenance schedule.

23.C More detailed maintenance and instructions for the software may be found at https://sciex.com/support/training or using the help menu in the instrument software.

23.D For reoccurring problems, the instrument Log Book located in H:\Saphira may be referenced for troubleshooting help.

23.E The pumps on the instrument must be purged of air bubbles whenever the mobile phases are changed out. To purge the pump, open the pump by twisting the knob on the door counter-clockwise. Select the purge option. This will purge for about 2 minutes. The knob can then be tightened.

23.F If there appears to be problems with the pump seals, the pumps can be purged with isopropyl alcohol and then purged with the mobile phases.

23.G The ion source, curtain plate, orifice plate on the mass spec may be wiped down gently with isopropyl while the system is under vacuum.

23.H For further cleaning of the mass spec, the vacuum must be released by holding the vent button on the side of the instrument down for 3 secs. Allow the system to vent for 15-20 mins.

23.I To pump back down, hold the reset button for 5 secs and allow the vacuum to run for about 30 mins.

23.J For any problems that are not resolved with the maintenance listed above need to be reported to SCIEX for further support.

24 Computer Hardware and Software

24.A Analyst®

24.A.1 This software is used in acquiring the data from the LCMSMS.

24.A.2 Most questions can be answered by accessing the 'Help' section of the software.

24.B MultiQuant™

24.B.1 This software is used in processing the data from the LCMSMS.

24.B.2 Most questions can be answered by accessing the 'Help' section of the software.

24.C The following Computer capabilities are needed to run the Analyst® and MultiQuant™ software are at minimum

25 References

25.A Method 537 Revision 1.11 Determination of Selected Perfluorinated Alkyl Acids in Drinking Water By Solid Phase Extraction and Liquid Chromatography/Tandem Mass Spectrometry, Version 1.1, 2009.
25.B Method 537.1 Version 1.0 November 2018, Determiniation of Selected PFAS substances in Drinking water by SPE and LCMS-MS
25.C Water quality – Determination of perfluorooctanesulfonate (PFOS) and perfluorooctanoate (PFOA) – Method for unfiltered samples using solid phase extraction and liquid chromatography/mass spectrometry, ISO25101, 1st Edition, 2009.
25.D DoD /DoE QSM, Version 5.3, May 2019
25.E ISO/IEC 17025:2017
25.F https://sciex.com/support/training
25.G www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/PFOA_PFOS.html

26 Tables, Diagrams, Flowcharts, Validation Data

Table 1: LOQ, LOD, MDL, CLs for 537.1 samples
Table 2: LOQ, LOD, MDL, CLs for QSM TB-15 water samples
Table 3: LOQ, LOD, MDL, CLs for QSM TB-15 solid samples
Table 4 : LCMSMS Transition list
Table 5: DoD QSM PFAS Table B-15

Section Manager Name: Hart Hedgpeth

Section Manager Signature:  Date: 08/31/23

QAU Director Name: Pamela Cooper



QAU Director Signature: Date: 08/31/23

Standard Operating Procedure

Given Short Name	Known Synonyms	Given long name	Cas	EPA 537.1	EPA 533	QSM 5.3 B-15
PFBA	HFBA, PFBuA	Perfluorobutanoic acid	375-22-4		IIS/EIS	EIS
PFPeA		Perfluoropentanoic acid	2706-90-3		EIS	EIS
PFHxA		Perfluorohexanoic acid	307-24-4	SUR	EIS	EIS
PFHpA		Perfluoroheptanoic acid	375-85-9	x	EIS	EIS
PFOA		Perfluorooctanoic acid	335-67-1	IS	IIS/EIS	EIS
PFNA		Perfluorononanoic acid	375-95-1	x	EIS	EIS
PFDA		Perfluorodecanoic acid	335-76-2	SUR	EIS	EIS
PFUnA	PFUA	Perfluoroundecanoic acid	2058-94-8	x	EIS	EIS
PFDoA	PFDoDA	Perfluorododecanoic acid	307-55-1	x	EIS	EIS
PFTrDA	PFTriDA	Perfluorotridecanoic acid	72629-94-8	x		x
PFTeDA	PFTA	Perfluorotetradecanoic acid	376-06-7	x		EIS
PFHxDA		Perfluorohexadecanoic acid	67905-19-5			x
PFODA		Perfluorooctadecanoic acid	16517-11-6			EIS
PFBS	PFBuS	Perfluorobutanesulfonic acid	375-73-5	x	EIS	EIS
PFPeS		Perfluoropentanesulfonic acid	2706-91-4		x	x
PFHxS		Perfluorohexanesulfonic acid	355-46-4	x	EIS	EIS
PFHpS		Perfluoroheptanesulfonic acid	375-92-8		x	x
PFOS		Perfluorooctanesulfonic acid	1763-23-1	IS	IIS/EIS	EIS
PFNS		Perfluorononanesulfonic acid	68259-12-1			x
PFDS		Perfluorodecanesulfonic acid	335-77-3			x
PFDoS	PFDoDS	Perfluorododecanesulfonic acid	79780-39-5			x
PFBSA	FBSA	Perfluorobutanesulfonamide	30334-69-1			x
PFHxSA	FHxSA	Perfluorohexanesulfonamide	41997-13-1			x
PFOSA	FOSA	Perfluorooctanesulfonamide	754-91-6			EIS
NMeFOSA		N-Methyl perfluorooctanesulfonamide	31506-32-8			EIS
NEtFOSA		N-Ethyl perfluorooctanesulfonamide	4151-50-2			EIS
NMeFOSAA		N-Methyl perfluorooctanesulfonamidoacetic acid	2355-31-9	IS		EIS
NEtFOSAA		N-Ethyl perfluorooctanesulfonamidoacetic acid	2991-50-6	SUR		EIS
NMeFOSE		N-Methyl perfluorooctanesulfonamidoethanol	24448-09-7			EIS
NEtFOSE		N-Ethyl perfluorooctanesulfonamidoethanol	1691-99-2			EIS
3:3FTcA	FPrPA; 33FTA; 3:3FTCA	2H,2H,3H,3H-Perfluorohexanoic acid	356-02-5			x
5:3FTcA	FPePA; 53FTA; 5:3FTCA	2H,2H,3H,3H-Perfluorooctanoic acid	914637-49-3			x
7:3FTcA	FHpPA; 73FTA; 8:3FTCA	2H,2H,3H,3H-Perflurodecanoic acid	812-70-4			x
4:2FTS	42FTSA	1H,1H,2H,2H-Perfluorohexanesulfonic acid	757124-72-4		EIS	EIS
6:2FTS	62FTSA	1H,1H,2H,2H-Perfluorooctanesulfonic acid	27619-97-2		EIS	EIS
8:2FTS	82FTSA	1H,1H,2H,2H-Perfluorodecanesulfonic acid	39108-34-4		EIS	EIS
10:2FTS	102FTSA	1H,1H,2H,2H-Perfluorododecanesulfonic acid	120226-60-0			EIS
PFMPA (533)	PF4OPeA	Perfluoro-3-methoxypropanoic acid	377-73-1		x	x
PFMBA (533)	PF5OHxA	Perfluoro-4-methoxybutanoic acid	863090-89-5		x	x
NFDHA (533)	PF3,6OHpA	Nonafluoro-3,6-dioxaheptanoic acid	151772-58-6		x	x
HFPO-DA		Hexafluoropropylene oxide dimer acid	13252-13-6	SUR	EIS	EIS
ADONA		4,8-dioxa-3H-perfluorononanoic acid	919005-14-4	x	x	x
PFEESA (533)	PF3OHxS	Perfluoro(2-ethoxyethane)sulfonic acid	113507-82-7		x	x
9Cl-PF3ONS		9-Chlorohexadecafluoro-3-oxanonane-1-sulfonic acid	756426-58-1	x	x	x
11Cl-PF3OUdS		11-Chloroeicosafluoro-3-oxaundecane-1-sulfonic acid	763051-92-9	x	x	x

Standard Operating Procedure

TABLE 1
LOQ, LOD, MDL, CLs for 537.1 samples (250mL)

Analyte	LOQ (ng/L)	LOD (ng/L)	MDL (ng/L)	CLs (%)
Perfluoro-n-hexanoic acid (PFHxA)[A]	2	1.2	0.46	70-130
Perfluoro-n-heptanoic acid (PFHpA)[A]	2	1.7	0.69	70-130
Perfluoro-n-octanoic acid (PFOA)[A]	2	1.2	0.47	70-130
Perfluoro-n-nonanoic acid (PFNA)[B]	2	1.5	0.59	70-130
Perfluoro-n-decanoic acid (PFDA)[B]	2	1	0.37	70-130
Perfluoro-n-undecanoic acid (PFUdA)[B]	2	1	0.38	70-130
Perfluoro-n-dodecanoic acid (PFDoA)[B]	2	1	0.23	70-130
Perfluoro-n-tridecanoic acid (PFTrDA)[B]	2	1	0.27	70-130
Perfluoro-n-tetradecanoic acid (PFTeDA)[B]	2	1	0.19	70-130
N-methylperfluoro-1-octanesulfonamidoacetic acid (N-MeFOSAA)[C]	2	1.1	0.43	70-130
N-ethylperfluoro-1-octanesulfonamidoacetic acid (N-EtFOSAA)[C]	2	1.2	0.46	70-130
Perfluoro-1-butanesulfonate (PFBS)[A]	2	1	0.27	70-130
Perfluorohexanesulfonate (PFHxS)[A]	2	1	0.29	70-130
Perfluorooctanesulfonate (PFOS)[B]	2	1	0.27	70-130
Hexafluoropropylene oxide dimer acid (HFPO-DA)	6	1	0.27	70-130
11-chlorocicosafluoro-3-oxaundecane-1-sulfonic acid(11-Cl-PF3OudS)	4	1	0.36	70-130
9-chlorohexadecafluoro-3-oxanone-1-sulfonic acid(9-Cl-PF3ONS)	4	1	0.35	70-130
4,8-Dioxa-3H-perfluorononanoic acid (NaDONA)	4	1.3	0.50	70-130
Surrogates				
13C2-PFHxA[D]	NA	NA	NA	70-130
13C2-PFDA[E]	NA	NA	NA	70-130
d5_EtFOSAA[E]	NA	NA	NA	70-130
Internal Standards				
13C2_PFOA	NA	NA	NA	Section 8
d3_MeFOSAA	NA	NA	NA	Section 8

A=the mass-labeled surrogate for these analytes is 13C2-PFHxA

B=the mass-labeled surrogate for these analytes is 13C2-PFDA

C=the mass-labeled surrogate for these analytes is d5_EtFOSAA

D=the mass-labeled internal standard for this surrogate is 13C2_PFOA

E=the mass-labeled internal standard for these surrogates is d3_MeFOSAA

TABLE 2
LOQ, LOD, MDL, CLs for QSM B-15 (537.1M) water samples (50mL)

Analyte	LOQ (ng/L)	LOD (ng/L)	MDL (ng/L)	CLs (%)
Perfluoro-n-butanoic acid (PFBA)	16	1	0.25	70-130
Perfluoro-n-pentanoic acid (PFPeA)	8	1	0.31	70-130
Perfluoro-n-hexanoic acid (PFHxA)	4	1	0.32	70-130
Perfluoro-n-heptanoic acid (PFHpA)	4	1	0.25	70-130
Perfluoro-n-octanoic acid (PFOA)	4	1	0.41	70-130
Perfluoro-n-nonanoic acid (PFNA)	4	1	0.25	70-130
Perfluoro-n-decanoic acid (PFDA)	4	1	0.25	70-130
Perfluoro-n-undecanoic acid (PFUdA)	4	1	0.40	70-130
Perfluoro-n-dodecanoic acid (PFDoA)	4	1	0.25	70-130
Perfluoro-n-tridecanoic acid (PFTrDA)[E]	4	1	0.29	70-130
Perfluoro-n-tetradecanoic acid (PFTeDA)	4	1	0.43	70-130
Perfluoro-1-octanesulfonamide (PFOSA)	16	1	0.25	70-130
N-methylperfluoro-1-octanesulfonamidoacetic acid (N-MeFOSAA)	16	10	4.9	70-130
N-ethylperfluoro-1-octanesulfonamidoacetic acid (N-EtFOSAA)	16	10	4.9	70-130
Perfluoro-1-butanesulfonate (PFBS)	4	1	0.25	70-130
Perfluoro-1-pentanesulfonate (PFPeS)[A]	4	1	0.29	70-130
Perfluorohexanesulfonate (PFHxS)	4	1	0.25	70-130
Perfluoro-1-heptanesulfonate (PFHpS)[B]	4	1	0.28	70-130
Perfluorooctanesulfonate (PFOS)	4	1	0.25	70-130
Perfluoro-1-nonanesulfonate (PFNS)[C]	4	2	1.2	70-130
Perfluoro-1-decanesulfonate (PFDS)[D]	4	1	0.32	70-130
4:2 Fluorotelomer sulfonate (4:2 FTS)	16	2	0.54	70-130
6:2 Fluorotelomer sulfonate (6:2 FTS)	16	1	0.45	70-130
8:2 Fluorotelomer sulfonate (8:2 FTS)	16	3	1	70-130
Hexafluoropropylene oxide dimer acid (HFPO-DA)	8	5	2.4	70-130
11-chloroeicosafluoro-3-oxaundecane-1-sulfonic acid(11-Cl-PF3OudS)	8	3	1.2	70-130
9-chlorohexadecafluoro-3-oxanone-1-sulfonic acid(9-Cl-PF3ONS)	8	3	1.2	70-130
1.3	8	3	1.3	70-130
Surrogates				
13C4_PFBA[F]	NA	NA	NA	50-150
13C5_PFPeA[F]	NA	NA	NA	50-150
13C3_PFBS[F]	NA	NA	NA	50-150
13C5_PFHxA[F]	NA	NA	NA	50-150
13C2_4:2 FTS[F]	NA	NA	NA	50-150
13C4_PFHpA[G]	NA	NA	NA	50-150
13C3_PFHxS[G]	NA	NA	NA	50-150
13C8_PFOA[G]	NA	NA	NA	50-150
13C2_6:2FTS[G]	NA	NA	NA	50-150
13C9_PFNA[G]	NA	NA	NA	50-150
13C8_PFOSA[G]	NA	NA	NA	50-150
13C8_PFOS[H]	NA	NA	NA	50-150

TABLE 2 - Continued
LOQ, LOD, MDL, CLs for QSM TB-15 water samples

Analyte	LOQ (ug/Kg)	LOD (ug/Kg)	MDL (ug/Kg)	CLs (%)
13C6_PFDA[J]	NA	NA	NA	50-150
13C2_8:2FTS[J]	NA	NA	NA	50-150
13C7_PFUdA[J]	NA	NA	NA	50-150
d3_MeFOSAA[J]	NA	NA	NA	50-150
d5_EtFOSAA[J]	NA	NA	NA	50-150
13C2_PFDoA[J]	NA	NA	NA	50-150
13C2_PFTeDA[J]	NA	NA	NA	50-150
Internal Standards				
13C3_PFBA	NA	NA	NA	Section 8
13C2_PFOA	NA	NA	NA	Section 8
13C4_PFOS	NA	NA	NA	Section 8
13C2_PFDA	NA	NA	NA	Section 8

A=the mass-labeled surrogate for this analyte is 13C2_4:2 FTS

B=the mass-labeled surrogate for this analyte is 13C2_6:2 FTS

C=the mass-labeled surrogate for this analyte is 13C2_8:2 FTS

D=the mass-labeled surrogate for this analyte is d5_EtFOSAA

E=the mass-labeled surrogate for this analyte is 13C2_PFTeDA

F=the mass-labeled internal standard for these surrogates is 13C3_PFBA

G=the mass-labeled internal standard for these surrogates is 13C2_PFOA

H=the mass-labeled internal standard for this surrogate is 13C4_PFOS

J=the mass-labeled internal standard for these surrogates is 13C2_PFDA

TABLE 3
LOQ, LOD, MDL, CLs for QSM B-15 soil samples (1g)

Analyte	LOQ (ug/Kg)	LOD (ug/Kg)	MDL (ug/Kg)	CLs (%)
Perfluoro-n-butanoic acid (PFBA)	1	0.4	0.1	70-130
Perfluoro-n-pentanoic acid (PFPeA)	1	0.4	0.15	70-130
Perfluoro-n-hexanoic acid (PFHxA)	1	0.4	0.1	70-130
Perfluoro-n-heptanoic acid (PFHpA)	1	0.4	0.1	70-130
Perfluoro-n-octanoic acid (PFOA)	1	0.4	0.15	70-130
Perfluoro-n-nonanoic acid (PFNA)	1	0.4	0.1	70-130
Perfluoro-n-decanoic acid (PFDA)	1	0.4	0.15	70-130
Perfluoro-n-undecanoic acid (PFUdA)	1	0.4	0.1	70-130
Perfluoro-n-dodecanoic acid (PFDoA)	1	0.4	0.15	70-130
Perfluoro-n-tridecanoic acid (PFTrDA)[E]	1	0.4	0.1	70-130
Perfluoro-n-tetradecanoic acid (PFTeDA)	1	0.4	0.2	70-130
Perfluoro-1-octanesulfonamide (PFOSA)	1	0.4	0.1	70-130
N-methylperfluoro-1-octanesulfonamidoacetic acid (N-MeFOSAA)	1	0.4	0.2	70-130
N-ethylperfluoro-1-octanesulfonamidoacetic acid (N-EtFOSAA)	1	0.4	0.2	70-130
Perfluoro-1-butanesulfonate (PFBS)	1	0.4	0.1	70-130
Perfluoro-1-pentanesulfonate (PFPeS)[A]	1	0.9	0.41	70-130
Perfluorohexanesulfonate (PFHxS)	1	0.4	0.15	70-130
Perfluoro-1-heptanesulfonate (PFHpS)[B]	1	0.4	0.15	70-130
Perfluorooctanesulfonate (PFOS)	1	0.4	0.1	70-130
Perfluoro-1-nonanesulfonate (PFNS)[C]	1	0.8	0.39	70-130
Perfluoro-1-decanesulfonate (PFDS)[D]	1	0.4	0.2	70-130
4:2 Fluorotelomer sulfonate (4:2 FTS)	1	0.4	0.2	70-130
6:2 Fluorotelomer sulfonate (6:2 FTS)	1	0.4	0.2	70-130
8:2 Fluorotelomer sulfonate (8:2 FTS)	1	0.4	0.15	70-130
Hexafluoropropylene oxide dimer acid (HFPO-DA)	1	0.4	0.2	70-130
11-chloroeicosafluoro-3-oxaundecane-1-sulfonic acid(11-Cl-PF3OudS)	1	0.4	0.2	70-130
9-chlorohexadecafluoro-3-oxanone-1-sulfonic acid(9-Cl-PF3ONS)	1	0.4	0.2	70-130
4,8-Dioxa-3H-perfluorononanoic acid (NaDONA)	1	0.4	0.2	70-130
Surrogates				
13C4_PFBA[F]	NA	NA	NA	50-150
13C5_PFPeA[F]	NA	NA	NA	50-150
13C3_PFBS[F]	NA	NA	NA	50-150
13C5_PFHxA[F]	NA	NA	NA	50-150
13C2_4:2 FTS[F]	NA	NA	NA	50-150
13C4_PFHpA[G]	NA	NA	NA	50-150
13C3_PFHxS[G]	NA	NA	NA	50-150
13C8_PFOA[G]	NA	NA	NA	50-150
13C2_6:2FTS[G]	NA	NA	NA	50-150
13C9_PFNA[G]	NA	NA	NA	50-150

TABLE 3 - Continued
LOQ, LOD, MDL, CLs for QSM B-15soil samples (1g)

Analyte	LOQ (ug/Kg)	LOD (ug/Kg)	MDL (ug/Kg)	CLs (%)
13C8_PFOSA[G]	NA	NA	NA	50-150
13C8_PFOS[H]	NA	NA	NA	50-150
13C6_PFDA[J]	NA	NA	NA	50-150
13C2_8:2FTS[J]	NA	NA	NA	50-150
13C7_PFUdA[J]	NA	NA	NA	50-150
d3_MeFOSAA[J]	NA	NA	NA	50-150
d5_EtFOSAA[J]	NA	NA	NA	50-150
13C2_PFDoA[J]	NA	NA	NA	50-150
13C2_PFTeDA[J]	NA	NA	NA	50-150
Internal Standards				
13C3_PFBA	NA	NA	NA	Section 8
13C2_PFOA	NA	NA	NA	Section 8
13C4_PFOS	NA	NA	NA	Section 8
13C2_PFDA	NA	NA	NA	Section 8

A=the mass-labeled surrogate for this analyte is 13C2_4:2 FTS

B=the mass-labeled surrogate for this analyte is 13C2_6:2 FTS

C=the mass-labeled surrogate for this analyte is 13C2_8:2 FTS

D=the mass-labeled surrogate for this analyte is d5_EtFOSAA

E=the mass-labeled surrogate for this analyte is 13C2_PFTeDA

F=the mass-labeled internal standard for these surrogates is 13C3_PFBA

G=the mass-labeled internal standard for these surrogates is 13C2_PFOA

H=the mass-labeled internal standard for this surrogate is 13C4_PFOS

J=the mass-labeled internal standard for these surrogates is 13C2_PFDA

Table 4 : LCMSMS Transition list

	Quant. Q1->Q3	Conf. Q1-Q3
PFBA	212.9->169	N/A
PFPeA	262.9->219	N/A
PFHxA	313->269	313->119
PFHpA	363->319	363->169
PFHpA	363->319	363->169
PFOA	413->369 [1]	413->169
PFNA	463->419	463->169
PFDA	513->469	513->169
PFUdA	563->519	563->169
PFDoA	613->569	613->169
PFTrDA	663->619	663->169
PFTeDA	713->669	713->169
PFHxDA	813->769	813->169
PFODA	913->869	913->169
3:3FTA	241->117	241->63
5:3FTA	341->236.7	341->217
7:3FTA	441->317	441->337
PFBS	298.9->80 [1,2]	298.9->99
PFPeS	349->80	349->99
PFHxS	399->80 [1,2]	399->99
PFHpS	449->80	449->99
PFOS	499->80 [1,2]	499->99
PFNS	549->80	549->99
PFDS	599->80	599->99
PFDoS	698.9->80	698.9->99
4:2 FTS	327->307 [1]	327->81
6:2 FTS	427->407 [1]	427->81
8:2 FTS	527->507 [1]	527->81
10:2FTS	628->608	628->81

[1]Quant transitions listed in the DoD QSM as required transitions. If they are not to be used, technical justification must be given (e.g. alternative transition was used due to observed interferences).
[2]These transitions must be used for EPA 537.1

	Quant. Q1->Q3	Conf. Q1-Q3
PFMPA	229->85	N/A
PFMBA	279->85	N/A
PFSBA	298->78	N/A
PFEESA	315->135	N/A
NFDHA	295->201	201->85
FHxSA	398->78	N/A
HFPO-DA	285->169	329->185
ADONA	377->85	377->251
9Cl-Pf3ONS	531->351	533->353
11Cl-PF3OUDS	631->451	633->453
PFOSA	498->78	N/A
N-MeFOSA	511.9->219	511.9->169
N-EtFOSA	526->219	526->169
N-MeFOSAA	570->419 [1]	570->483
N-EtFOSAA	584->419 [1]	584->526
N-MeFOSE	616.1->59	N/A
N-EtFOSE	630->59	N/A

[1]Quant transitions listed in the DoD QSM as required transitions. If they are not to be used, technical justification must be given (e.g. alternative transition was used due to observed interferences).

IS	Q1->Q3
13C3_PFBA_IIS	216->172
13C4_PFBA_EIS	217->172
13C5_PFPeA_EIS	267.9->223
13C3_PFBS_EIS	302->80
13C2_4:2 FTS_EIS	329->81
13C3_HFPODA_EIS	287->169
13C2_PFHxA_IIS	315.1->270
13C5_PFHxA_EIS	318->273
13C4_PFHpA_EIS	367->322
13C3_PFHxS_EIS	402->80
18O2_PFHxS_IIS	403->83.9
13C2_6:2FTS_EIS	429->81
13C2D4_6:2FTS_EIS	433->412
13C2_PFOA_IIS	415->370
13C8_PFOA_EIS	421->376
13C5_PFNA_IIS	468->423
13C9_PFNA_EIS	472->427
13C4_PFOS_IIS	502.8->79.9
13C8_PFOS_EIS	507->80
13C2_8:2FTS_EIS	529->81
13C2_PFDA_IIS	515.1->470.1
13C6_PFDA_EIS	519->474
13C8_PFOSA_EIS	506->78
D3_MeFOSAA_EIS	573->419
13C7_PFUdA_EIS	570->525
D5_EtFOSAA_EIS	589->419
13C2D4_10:2FTS_EIS	633->612
D7_NMeFOSE_EIS	623.2->58.9
D3_NMeFOSA_EIS	515->169
13C2_PFDoA_EIS	615->570
D9_NEtFOSE_EIS	639.2->58.9
D5_NEtFOSA_EIS	531.1->169
13C2_PFTeDA_EIS	715->670
13C2_PFHxDA	815->770

Standard Operating Procedure

TABLE 5

Table B-15. Per- and Polyfluoroalkyl Substances (PFAS) Using Liquid Chromatography Tandem Mass Spectrometry (LC/MS/MS) With Isotope Dilution or Internal Standard Quantification in Matrices Other Than Drinking Water

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action	Flagging Criteria	Comments
Aqueous Sample Preparation	Each sample and associated batch QC samples.	Solid Phase Extraction (SPE) must be used unless samples are known to contain high PFAS concentrations (e.g., Aqueous Film Forming Foam (AFFF) formulations). Inline SPE is acceptable. Entire sample plus bottle rinsate must be extracted using SPE. Known high PFAS concentration samples require serial dilution be performed in duplicate. Documented project approval is needed for samples prepared by serial dilution as opposed to SPE.	NA.	NA.	Samples with >1% solids may require centrifugation prior to SPE extraction. Pre-screening of separate aliquots of aqueous samples is recommended.
Solid Sample Preparation	Each sample and associated batch QC samples.	Entire sample received by the laboratory must be homogenized prior to subsampling.	NA.	NA.	NA.
Biota Sample Preparation	Each sample and associated batch QC samples.	Sample prepared as defined by the project (e.g., whole fish versus fileted fish).	NA.	NA.	NA.

TABLE 5, continued

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action	Flagging Criteria	Comments
AFFF and AFFF Mixture Samples, Preparation	Each sample and associated batch QC samples.	Each field sample must be prepared in duplicate (equivalent to matrix duplicate). Serial dilutions must be performed to achieve the lowest LOQ possible for each analyte.	NA.	NA.	Adsorption onto bottle is negligible compared to sample concentration so subsampling is allowed. Multiple dilutions will most likely have to be reported in order to achieve the lowest LOQ possible for each analyte.
Sample Cleanup Procedure	Each sample and associated batch QC samples. Not applicable to AFFF and AFFF Mixture Samples.	Removal of interferences from matrix. ENVI-CarbTM or equivalent must be used on each sample and batch QC sample.	NA.	Flagging is not appropriate.	Cleanup should reduce bias from matrix background.
Mass Calibration	Instrument must have a valid mass calibration prior to any sample analysis. Mass calibration is verified after each mass calibration, prior to initial calibration (ICAL).	Calibrate the mass scale of the MS with calibration compounds and procedures described by the manufacturer. Mass calibration range must bracket the ion masses of interest. The most recent mass calibration must be used for every acquisition in an analytical run. Mass calibration must be verified to be ±0.5 amu of the true value, by acquiring a full scan continuum mass spectrum of a PFAS stock standard.	If the mass calibration fails, then recalibrate. If it fails again, consult manufacturer instructions on corrective maintenance.	Flagging is not appropriate.	Problem must be corrected. No samples may be analyzed under a failing mass calibration. The mass calibration is updated on an as-needed basis (e.g., QC failures, ion masses fall outside of the ±0.5 amu of the true value, major instrument maintenance is performed, or the instrument is moved).

TABLE 5, continued

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action	Flagging Criteria	Comments
Mass Spectral Acquisition Rate	Each analyte, Extracted Internal Standard (EIS) Analyte.	A minimum of 10 spectra scans are acquired across each chromatographic peak.	NA.	Flagging is not appropriate.	NA.
Calibration, Calibration Verification, and Spiking Standards	All analytes.	Standards containing both branched and linear isomers must be used when commercially available. PFAS method analytes may consist of both branched and linear isomers, but quantitative standards that contain the linear and branched isomers do not exist for all method analytes. For PFAS that do not have a quantitative branched and linear standard, identify the branched isomers by analyzing a qualitative standard that includes both linear and branched isomers and determine retention times, transitions and transition ion ratios. Quantitate samples by integrating the total response (i.e., accounting for peaks that are identified as linear and branched isomers) and relying on the initial calibration that uses the linear isomer quantitative	NA.	Flagging is not appropriate.	Standards containing both branched and linear isomers are to be used during method validation and when reestablishing retention times, to ensure the total response is quantitated for that analyte. Technical grade standards cannot be used for quantitative analysis.

TABLE 5, continued

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action	Flagging Criteria	Comments
standard.					
Sample PFAS Identification	Identify all positive sample detections per method.	The chemical derivation of the ion transitions must be documented. A minimum of two ion transitions (Precursor → quant ion and precursor → confirmation ion) and the ion transitions ratio per analyte are required for confirmation. Exception is made for analytes where two transitions do not exist (PFBA and PFPeA). Documentation of the primary and confirmation transitions and the ion ratio is required. In-house acceptance criteria for evaluation of ion ratios must be used and must not exceed 50-150%. S/N ≥ 10:1 for all ions used for quantification and S/N ≥ 3:1 for all ions used for confirmation. Quant ion and confirmation ion must be present and must maximize simultaneously (±2 seconds).	NA.	PFAS identified, with Ion ratios that fail acceptance criteria, must be flagged. Any quantitation ion peak that does not meet the maximization criteria shall be included in the summed integration and the resulting data flagged as “estimated, biased high”.	For example: Ion Ratio = (quant ion abundance/ confirm ion abundance) Calculate the average ratio (A) and standard deviation (SD) using the ICAL standards. An acceptance range of ratio could be within A ±3SD for confirmation of detection.

TABLE 5, continued

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action	Flagging Criteria	Comments
Ion Transitions (Precursor-> Product)	Identify all positive sample detections per method.	In order to avoid biasing results high due to known interferences for some transitions, the following transitions must be used for the quantification of the following analytes: PFOA: 413 → 369 PFOS: 499 → 80 PFHxS: 399 → 80 PFBS: 299 → 80 4:2 FTS: 327 → 307 6:2 FTS: 427 → 407 8:2 FTS: 527 → 507 NEtFOSAA: 584 → 419 NMeFOSAA: 570 → 419 If these transitions are not used, the reason must be technically justified and documented (e.g., alternate transition was used due to observed interferences).	NA.	Flagging is not appropriate	NA.
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 if commercially available	Correct problem, then repeat ICAL.	Flagging is not appropriate.	No samples shall be analyzed until ICAL has passed. e.g., PFHxS and PFOS are not available as

TABLE 5, continued

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action	Flagging Criteria	Comments
		(Isotope Dilution Quantitation). Commercial PFAS standards available as salts, are acceptable, providing the measured mass is corrected to the neutral acid concentration. Results shall be reported as the neutral acid with appropriate CAS number. If a labeled analog is not commercially available, the Extracted Internal Standard Analyte with the closest retention time or chemical similarity to the analyte must be used for quantitation. (Internal Standard Quantitation) Option 1: The RSD of the RFs for all analytes must be ≤20%. Option 2: 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.			sulfonates but as their corresponding salts, such as Na+ and K+. Isotope Dilution is required for all analytes. External Calibration is not allowed. Calibration can be linear (minimum of 5 standards) or quadratic (minimum of 6 standards); weighting is allowed.
Retention Time Establishment	Once per ICAL and at the beginning of the analytical sequence.	Position shall be set using the midpoint standard of the ICAL curve when ICAL is performed. On days when ICAL is not performed, the initial CCV is used.	NA	NA	Calculated for each analyte and EIS

TABLE 5, continued

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action	Flagging Criteria	Comments
Retention Time	Every field sample, standard, blank, and QC sample.	RT of each analyte and EIS analyte must fall within 0.4 minutes of the predicted retention times from the daily calibration verification or on days when ICAL is performed, from the midpoint standard of the ICAL. Analytes must elute within 0.1 minutes of the associated EIS. This criterion applies only to analyte and labeled analog pairs.	Correct problem and reanalyze samples.	NA.	Calculated for each analyte and EIS.
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, rerun ISC. If problem persists, repeat ICAL.	Flagging is not appropriate.	No samples shall be analyzed until ISC has met acceptance criteria. ISC can serve as the initial daily CCV.
Initial Calibration Verification (ICV)	Once after each ICAL, analysis of a second source standard prior to sample analysis.	Analyte concentrations must be within ±30% of their true value.	Correct problem, rerun ICV. If problem persists, repeat ICAL.	Flagging is not appropriate.	No samples shall be analyzed until calibration has been verified.

TABLE 5, continued

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action	Flagging Criteria	Comments
Continuing Calibration Verification (CCV)	Prior to sample analysis, after every 10 field samples, and at the end of the analytical sequence.	Concentration of analytes must range from the LOQ to the mid-level calibration concentration. Analyte concentrations must be within ±30% of their true value.	Immediately analyze two additional consecutive CCVs. If both pass, samples may be reported without reanalysis. If either fails, or if two consecutive CCVs cannot be run, perform corrective action(s) and repeat CCV and all associated samples since last successful CCV. Alternately, recalibrate if necessary; then reanalyze all associated samples since the last acceptable CCV.	If reanalysis cannot be performed, data must be qualified and explained in the Case Narrative. Apply Q-flag to all results for the specific analyte(s) in all samples since the last acceptable calibration verification.	Results may not be reported without valid CCVs. Instrument Sensitivity Check (ISC) can serve as a bracketing CCV.
Instrument Blanks	Immediately following the highest standard analyzed and daily prior to sample analysis.	Concentration of each analyte must be ≤ ½ the LOQ. Instrument Blank must contain EIS to enable quantitation of contamination.	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 sample concentrations exceed the highest allowed standard and the sample(s) following exceed this acceptance criteria (>1/2 LOQ), they must be reanalyzed.	Flagging is only appropriate in cases when the sample cannot be reanalyzed and when there is no more sample left.	No samples shall be analyzed until instrument blank has met acceptance criteria. Note: Successful analysis following the highest standard analyzed determines the highest concentration that carryover does not occur. When the highest standard analyzed is not part of the calibration curve, it cannot be used to extend out the calibration range, it is used only to document a higher concentration at which carry over still does not occur.

TABLE 5, continued

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action	Flagging Criteria	Comments
Extracted Internal Standard Analytes (EIS)	Every field sample, standard, blank, and QC sample.	Added to solid sample prior to extraction. Added to aqueous samples, into the original container, prior to extraction. For aqueous samples prepared by serial dilution instead of SPE, added to final dilution of samples prior to analysis. Extracted Internal Standard Analyte recoveries must be within 50% to 150% of ICAL midpoint standard area or area measured in the initial CCV on days when an ICAL is not performed.	Correct problem. If required, re-extract and reanalyze associated field and QC samples. If recoveries are acceptable for QC samples, but not field samples, the field samples must be re-extracted and analyzed (greater dilution may be needed). Samples may be re-extracted and analyzed outside of hold times, as necessary for corrective action associated with QC failure.	Apply Q-flag and discuss in the Case Narrative only if reanalysis confirms failures in exactly the same manner.	Failing analytes shall be thoroughly documented in the Case Narrative. EIS should be 96% (or greater) purity. When the impurity consists of the unlabeled analyte, the EIS can result in a background artifact in every sample, standard and blank, if the EIS is fortified at excessive concentrations.
Method Blank (MB)	One per preparatory batch.	No analytes detected > ½ LOQ or > 1/10th the amount measured in any sample or 1/10th the regulatory limit, whichever is greater.	Correct problem. If required, re-extract and reanalyze MB and all QC samples and field samples processed with the contaminated blank. Samples may be re-extracted and analyzed outside of hold times, as necessary for corrective action associated with QC failure. Examine the project-specific requirements. Contact the client as to additional measures to be taken.	If reanalysis cannot be performed, data must be qualified and explained in the Case Narrative. Apply B-flag to all results for the specific analyte(s) in all samples in the associated preparatory batch.	Results may not be reported without a valid MB. Flagging is only appropriate in cases where the samples cannot be reanalyzed.

TABLE 5, continued

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action	Flagging Criteria	Comments
Laboratory Control Sample (LCS)	One per preparatory batch.	Blank spiked with all analytes at a concentration ≥ LOQ and ≤ the mid-level calibration concentration. A laboratory must use the DoD/DOE QSM Appendix C Limits for batch control if project limits are not specified. If the analyte(s) are not listed, use in-house LCS limits if project limits are not specified.	Correct problem, then re-extract and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes if sufficient sample material is available. Samples may be re-extracted and analyzed outside of hold times, as necessary for corrective action associated with QC failure. Examine the project-specific requirements. Contact the client as to additional measures to be taken.	If reanalysis cannot be performed, data must be qualified and explained in the Case Narrative. Apply Q-flag to specific analyte(s) in all samples in the associated preparatory batch.	Results may not be reported without a valid LCS. Flagging is only appropriate in cases where the samples cannot be reanalyzed.
Matrix Spike (MS)	One per preparatory batch. Not required for aqueous samples prepared by serial dilution instead of SPE.	Sample spiked with all analytes at a concentration ≥ LOQ and ≤ the mid-level calibration concentration. A laboratory must use the DoD/DOE QSM Appendix C Limits for batch control if project limits are not specified. If the analyte(s) are not listed, use in-house LCS limits if project limits are not specified.	Examine the project- specific requirements. Contact the client as to additional measures to be taken.	For the specific analyte(s) in the parent sample, apply J-flag if acceptance criteria are not met and explain in the Case Narrative.	For matrix evaluation only. If MS results are outside the limits, the data shall be evaluated to determine the source(s) of difference (i.e., matrix effect or analytical error).

TABLE5, continued

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action	Flagging Criteria	Comments
Matrix Spike Duplicate (MSD) or Matrix Duplicate (MD)	For MSD: One per preparatory batch. For MD: Each aqueous sample prepared by serial dilution instead of SPE.	For MSD: Sample spiked with all analytes at a concentration ≥ LOQ and ≤ the mid-level calibration concentration. A laboratory must use the DoD/DOE QSM Appendix C Limits for batch control if project limits are not specified. If the analyte(s) are not listed, use in-house LCS limits if project limits are not specified. RPD ≤ 30% (between MS and MSD or sample and MD).	Examine the project- specific requirements. Contact the client as to additional measures to be taken.	For the specific analyte(s) in the parent sample, apply J-flag if acceptance criteria are not met and explain in the Case Narrative.	The data shall be evaluated to determine the source of difference. For Sample/MD: RPD criteria only apply to analytes whose concentration in the saple is ≥LOQ. The MD is a second aliquot of the field sample that has been prepared by serial dilution.
Post Spike Sample	Only applies to aqueous samples prepared by serial dilution instead of SPE that have reported value of "<LOQ" for analyte(s).	Spike all analytes reported as "<LOQ" into the dilution that the result for that analyte is reported from. The spike must be at the LOQ concentration to be reported for this sample as "<LOQ". When analyte concentrations are calculated as "<LOQ," the post spike for that analyte must recover within 70-130% of its true value.	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.	Flagging is not appropriate.	When analyte concentrations are calculated as "<LOQ," results may not be reported without acceptable post spike recoveries.

CERTIFICATE OF ACCREDITATION

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Hereby attests that

Eurofins Sacramento
880 Riverside Parkway
West Sacramento, CA 95605

Fulfills the requirements of

ISO/IEC 17025:2017

and

U.S. Department of Defense (DoD) Quality Systems Manual for Environmental Laboratories (DoD QSM V5.4)

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Jason Stine, Vice President

Expiry Date: 20 January 2027

Certificate Number: L2468

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2017. 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).

SCOPE OF ACCREDITATION TO ISO/IEC 17025:2017

and

U.S. Department of Defense (DoD) Quality Systems Manual for Environmental Laboratories (DoD QSM V5.4)

Eurofins Sacramento
880 Riverside Parkway
West Sacramento, CA 95605
Robert Hrabak
916-374-4433

TESTING

Valid to: **January 20, 2027** Certificate Number: **L2468**

Environmental

Non-Potable Water		
Technology	**Method**	**Analyte**
Gravimetric	SM 2540B	Solids, Total (Residue, Total)
Gravimetric	SM 2540C	Solids, Total Dissolved (Residue, Filterable (TDS))
Gravimetric	SM 2540D	Solids, Total Suspended (Residue, Non-Filterable (TSS))
LC/MS/MS	EPA 6850	Perchlorate
GC/HRMS	EPA 8290/8290A/1613B	2,3,7,8-TeCDD
GC/HRMS	EPA 8290/8290A/1613B	1,2,3,7,8-PeCDD
GC/HRMS	EPA 8290/8290A/1613B	1,2,3,4,7,8-HxCDD
GC/HRMS	EPA 8290/8290A/1613B	1,2,3,6,7,8-HxCDD
GC/HRMS	EPA 8290/8290A/1613B	1,2,3,7,8,9-HxCDD
GC/HRMS	EPA 8290/8290A/1613B	1,2,3,4,6,7,8-HpCDD
GC/HRMS	EPA 8290/8290A/1613B	OCDD
GC/HRMS	EPA 8290/8290A/1613B	2,3,7,8-TeCDF
GC/HRMS	EPA 8290/8290A/1613B	1,2,3,7,8-PeCDF
GC/HRMS	EPA 8290/8290A/1613B	2,3,4,7,8-PeCDF
GC/HRMS	EPA 8290/8290A/1613B	1,2,3,4,7,8-HxCDF

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/HRMS	EPA 8290/8290A/1613B	1,2,3,6,7,8-HxCDF
GC/HRMS	EPA 8290/8290A/1613B	1,2,3,7,8,9-HxCDF
GC/HRMS	EPA 8290/8290A/1613B	2,3,4,6,7,8-HxCDF
GC/HRMS	EPA 8290/8290A/1613B	1,2,3,4,6,7,8-HpCDF
GC/HRMS	EPA 8290/8290A/1613B	1,2,3,4,7,8,9-HpCDF
GC/HRMS	EPA 8290/8290A/1613B	OCDF
GC/HRMS	EPA 8290/8290A/1613B	Total TCDD
GC/HRMS	EPA 8290/8290A/1613B	Total PeCDD
GC/HRMS	EPA 8290/8290A/1613B	Total HxCDD
GC/HRMS	EPA 8290/8290A/1613B	Total HpCDD
GC/HRMS	EPA 8290/8290A/1613B	Total TCDF
GC/HRMS	EPA 8290/8290A/1613B	Total PeCDF
GC/HRMS	EPA 8290/8290A/1613B	Total HxCDF
GC/HRMS	EPA 8290/8290A/1613B	Total HpCDF
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	6:2 Fluorotelomer sulfonic acid (1H,1H,2H,2H-perfluorooctane sulfonic acid) (6:2 FTS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	8:2 Fluorotelomer sulfonic acid (1H,1H,2H,2H-perfluorodecane sulfonic acid) (8:2 FTS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	N-Ethyl perfluorooctanesulfon amidoacetic acid (NEtFOSAA, EtFOSAA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	N-Methyl perfluorooctanesulfon amidoacetic acid (NMeFOSAA, MeFOSAA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	Perfluorooctanoic acid (PFOA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	Perfluorooctanesulfonic acid (PFOS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	Perfluorobutanoic acid (PFBA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	Perfluoropentanoic acid (PFPA)

Non-Potable Water		
Technology	**Method**	**Analyte**
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	Perfluorohexanoic acid (PFHxA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	Perfluoroheptanoic acid (PFHpA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	Perfluorononanoic acid (PFNA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	Perfluorodecanoic acid (PFDA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	Perfluoroundecanoic acid(PFUnA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	Perfluorododecanoic acid (PFDoA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	Perfluorotridecanoic acid(PFTrDA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	Perfluorotetradecanoic acid (PFTeDA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	Perfluorobutanesulfonic acid (PFBS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	Perfluorohexanesulfonic acid (PFHxS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	Perfluoroheptanesulfonic acid (PFHpS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	Perfluorodecanesulfonic acid (PFDS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	Perfluorooctanesulfonamide (PFOSA, FOSA)

Non-Potable Water		
Technology	**Method**	**Analyte**
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	4:2 Fluorotelomer sulfonic acid (1H, 1H,2H,2H-perfluorohexane sulfonic acid) (4:2 FTS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	10:2 Fluorotelomer sulfonic acid (1H, 1H,2H,2H-perfluorododecane sulfonic acid) (10:2 FTS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	Perfluorohexadecanoic acid (PFHxDA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	Perfluoropentanesulfonic acid (PFPeS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	Perfluorononanesulfonic acid (PFNS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	4,8-Dioxa-3H-perfluorononanoic acid (ADONA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	Hexafluoropropylene oxide dimer acid (HFPO-DA, GenX) (Perfluoro-2-propoxypropionic acid)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	9-Chlorohexadecafluoro-3-oxanonane-1-sulfonic acid (9Cl-PF3ONS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	11-Chloroeicosafluoro-3-oxaundecane-1-sulfonic acid (11C1-PF3OUdS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	Perfluorododecanesulfonic acid (PFDoS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	Perfluorooctadecanoic acid (PFODA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	Perfluoro-4-ethylcyclohexanesulfonic acid (PFecHS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	Perfluoro-1-propanesulfonic acid (PFPrS)

Non-Potable Water		
Technology	**Method**	**Analyte**
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	N-Ethylperfluorooctane sulfonamide (NEtFOSA, EtFOSA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	N-Methylperfluorooctane sulfonamide (NMeFOSA, MeFOSA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	N-Ethylperfluorooctane sulfonamido ethanol (NEtFOSE, EtFOSE)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	N-Methylperfluorooctane sulfonamido ethanol (NMeFOSe, MeFOSE)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	4,4,5,5,6,6,6-Heptafluorohexanoic acid (3-Perfluoropropyl propanoic acid) (3:3 FTCA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	2H,2H,3H,3H-Perfluorooctanoic acid (5:3 FTCA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	2H,2H,3H,3H-Perfluorodecanoic acid (3-Perfluoroheptyl propanoic acid) (7:3 FTCA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	2-Perfluorohexylethanoic acid (6:2 FTCA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	2-Perfluorooctylethanoic acid (8:2 FTCA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	2-Perfluorodecylethanoic acid (10:2 FTCA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	Perfluoropropionic acid (PPF Acid, PFPrA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	Perfluoro-3-methoxypropanoic acid (PFMPA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	Perfluoro-4-methoxybutanoic acid (PFMBA)

Non-Potable Water		
Technology	**Method**	**Analyte**
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	Nonafluoro-3,6-dioxaheptanoic acid (NFDHA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	Perfluoro(2-ethoxyethane) sulfonic acid (PFEESA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	Difluoro(perfluoromethoxy)acetic acid (PFMOAA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	Perfluoro-4-isopropoxybutanoic acid (PFECA G, PFPE-1)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	Perfluoro-3,5,7,9-butaoxadecanoic acid (PFO4DA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	Perfluoro-3,5,7-trioxaoctanoic acid (PFO3OA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	Perfluoro-3,5-dioxahexanoic acid (PFO2HXA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	Perfluoro-2-{[perfluoro-3-(perfluoroethoxy)-2-propanyl]oxy}ethanesulfonic acid (Hydro-PS Acid)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	Perfluoro-3,5,7,9,11-pentaoxadodecanoic acid (PFO5DoA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	Perfluoro-2-(perfluoromethoxy)propanoic acid (PMPA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	2,3,3,3-Tetrafluoro-2-(pentafluoroethoxy)propanoic acid (PEPA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	4-(2-carboxy-1,1,2,2-tetrafluoroethoxy)-2,2,3,3,4,5,5,5-octafluoro-pentanoic acid (R-EVE)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	1,1,2,2-Tetrafluoro-2-(1,2,2,2-tetrafluoroethoxy)ethane-1-sulfonic acid (NVHOS)

Non-Potable Water		
Technology	**Method**	**Analyte**
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	2,2,3,3-Tetrafluoro-3-{[1,1,1,2,3,3-hexafluoro-3-(1,2,2,2-tetrafluoroethoxy)propan-2-yl]oxy}propanoic acid (Hydro-EVE Acid)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	1,1,2,2-tetrafluoro-2-[1,2,2,3,3-pentafluoro-1-(trifluoromethyl)propoxy]ethanesulfonic acid (R-PSDCA)
LC/MS/MS	Draft EPA Method 1633 Rev 4	1*H*,1*H*, 2*H*, 2*H*-Perfluorooctane sulfonic acid (6:2FTS)
LC/MS/MS	Draft EPA Method 1633 Rev 4	1*H*,1*H*, 2*H*, 2*H*-Perfluorodecane sulfonic acid (8:2FTS)
LC/MS/MS	Draft EPA Method 1633 Rev 4	N-ethyl perfluorooctanesulfonamidoacetic acid (NEtFOSAA)
LC/MS/MS	Draft EPA Method 1633 Rev 4	N-methyl perfluorooctanesulfonamidoacetic acid (NMeFOSAA)
LC/MS/MS	Draft EPA Method 1633 Rev 4	Perfluorooctanoic acid (PFOA)
LC/MS/MS	Draft EPA Method 1633 Rev 4	Perfluorooctanesulfonic acid (PFOS)
LC/MS/MS	Draft EPA Method 1633 Rev 4	Perfluorobutanoic acid (PFBA)
LC/MS/MS	Draft EPA Method 1633 Rev 4	Perfluoropentanoic acid (PFPeA)
LC/MS/MS	Draft EPA Method 1633 Rev 4	Perfluorohexanoic acid (PFHxA)
LC/MS/MS	Draft EPA Method 1633 Rev 4	Perfluoroheptanoic acid (PFHpA)
LC/MS/MS	Draft EPA Method 1633 Rev 4	Perfluorononanoic acid (PFNA)
LC/MS/MS	Draft EPA Method 1633 Rev 4	Perfluorodecanoic acid (PFDA)
LC/MS/MS	Draft EPA Method 1633 Rev 4	Perfluoroundecanoic acid (PFUnA)
LC/MS/MS	Draft EPA Method 1633 Rev 4	Perfluorododecanoic acid (PFDoA)
LC/MS/MS	Draft EPA Method 1633 Rev 4	Perfluorotridecanoic acid (PFTrDA)
LC/MS/MS	Draft EPA Method 1633 Rev 4	Perfluorotetradecanoic acid (PFTeDA)
LC/MS/MS	Draft EPA Method 1633 Rev 4	Perfluorobutanesulfonic acid (PFBS)
LC/MS/MS	Draft EPA Method 1633 Rev 4	Perfluorohexanesulfonic acid (PFHxS)
LC/MS/MS	Draft EPA Method 1633 Rev 4	Perfluoroheptanesulfonic acid (PFHpS)
LC/MS/MS	Draft EPA Method 1633 Rev 4	Perfluorodecanesulfonic acid (PFDS)
LC/MS/MS	Draft EPA Method 1633 Rev 4	Perfluorooctanesulfonamide (PFOSA)
LC/MS/MS	Draft EPA Method 1633 Rev 4	1*H*,1*H*, 2*H*, 2*H*-Perfluorohexane sulfonic acid (4:2FTS)
LC/MS/MS	Draft EPA Method 1633 Rev 4	Perfluoropentanesulfonic acid (PFPeS)
LC/MS/MS	Draft EPA Method 1633 Rev 4	Perfluorononanesulfonic acid (PFNS)
LC/MS/MS	Draft EPA Method 1633 Rev 4	4,8-Dioxa-3*H*-perfluorononanoic acid (ADONA)
LC/MS/MS	Draft EPA Method 1633 Rev 4	Hexafluoropropylene oxide dimer acid (HFPO-DA)

Non-Potable Water		
Technology	**Method**	**Analyte**
LC/MS/MS	Draft EPA Method 1633 Rev 4	9-Chlorohexadecafluoro-3-oxanonane-1-sulfonic acid (9Cl-PF3ONS)
LC/MS/MS	Draft EPA Method 1633 Rev 4	11-Chloroeicosafluoro-3-oxaundecane-1-sulfonic acid (11C1-PF3OUdS)
LC/MS/MS	Draft EPA Method 1633 Rev 4	Perfluorododecanesulfonic acid (PFDoS)
LC/MS/MS	Draft EPA Method 1633 Rev 4	N-ethyl perfluorooctanesulfonamide (NEtFOSA)
LC/MS/MS	Draft EPA Method 1633 Rev 4	N-methyl perfluorooctanesulfonamide (NMeFOSA)
LC/MS/MS	Draft EPA Method 1633 Rev 4	N-ethyl perfluorooctanesulfonamidoethanol (NEtFOSE)
LC/MS/MS	Draft EPA Method 1633 Rev 4	N-methyl perfluorooctanesulfonamidoethanol (NMeFOSE)
LC/MS/MS	Draft EPA Method 1633 Rev 4	3-Perfluoropropyl propanoic acid (3:3FTCA)
LC/MS/MS	Draft EPA Method 1633 Rev 4	*2H,2H,3H,3H*-Perfluorooctanoic acid (5:3FTCA)
LC/MS/MS	Draft EPA Method 1633 Rev 4	3-Perfluoroheptyl propanoic acid (7:3FTCA)
LC/MS/MS	Draft EPA Method 1633 Rev 4	Perfluoro-3-methoxypropanoic acid (PFMPA)
LC/MS/MS	Draft EPA Method 1633 Rev 4	Perfluoro-4-methoxybutanoic acid (PFMBA)
LC/MS/MS	Draft EPA Method 1633 Rev 4	Nonafluoro-3,6-dioxaheptanoic acid (NFDHA)
LC/MS/MS	Draft EPA Method 1633 Rev 4	Perfluoro(2-ethoxyethane)sulfonic acid (PFEESA)
GC/HRMS	EPA 1668A/1668C	PCB 1
GC/HRMS	EPA 1668A/1668C	PCB 2
GC/HRMS	EPA 1668A/1668C	PCB 3
GC/HRMS	EPA 1668A/1668C	PCB 4
GC/HRMS	EPA 1668A/1668C	PCB 5
GC/HRMS	EPA 1668A/1668C	PCB 6
GC/HRMS	EPA 1668A/1668C	PCB 7
GC/HRMS	EPA 1668A/1668C	PCB 8
GC/HRMS	EPA 1668A/1668C	PCB 9
GC/HRMS	EPA 1668A/1668C	PCB 10
GC/HRMS	EPA 1668A/1668C	PCB 11
GC/HRMS	EPA 1668A/1668C	PCB 12
GC/HRMS	EPA 1668A/1668C	PCB 13
GC/HRMS	EPA 1668A/1668C	PCB 14
GC/HRMS	EPA 1668A/1668C	PCB 15
GC/HRMS	EPA 1668A/1668C	PCB 16
GC/HRMS	EPA 1668A/1668C	PCB 17

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/HRMS	EPA 1668A/1668C	PCB 18
GC/HRMS	EPA 1668A/1668C	PCB 19
GC/HRMS	EPA 1668A/1668C	PCB 20
GC/HRMS	EPA 1668A/1668C	PCB 21
GC/HRMS	EPA 1668A/1668C	PCB 22
GC/HRMS	EPA 1668A/1668C	PCB 23
GC/HRMS	EPA 1668A/1668C	PCB 24
GC/HRMS	EPA 1668A/1668C	PCB 25
GC/HRMS	EPA 1668A/1668C	PCB 26
GC/HRMS	EPA 1668A/1668C	PCB 27
GC/HRMS	EPA 1668A/1668C	PCB 28
GC/HRMS	EPA 1668A/1668C	PCB 29
GC/HRMS	EPA 1668A/1668C	PCB 30
GC/HRMS	EPA 1668A/1668C	PCB 32
GC/HRMS	EPA 1668A/1668C	PCB 31
GC/HRMS	EPA 1668A/1668C	PCB 33
GC/HRMS	EPA 1668A/1668C	PCB 34
GC/HRMS	EPA 1668A/1668C	PCB 35
GC/HRMS	EPA 1668A/1668C	PCB 36
GC/HRMS	EPA 1668A/1668C	PCB 37
GC/HRMS	EPA 1668A/1668C	PCB 38
GC/HRMS	EPA 1668A/1668C	PCB 39
GC/HRMS	EPA 1668A/1668C	PCB 40
GC/HRMS	EPA 1668A/1668C	PCB 41
GC/HRMS	EPA 1668A/1668C	PCB 42
GC/HRMS	EPA 1668A/1668C	PCB 43
GC/HRMS	EPA 1668A/1668C	PCB 44
GC/HRMS	EPA 1668A/1668C	PCB 45
GC/HRMS	EPA 1668A/1668C	PCB 46
GC/HRMS	EPA 1668A/1668C	PCB 47
GC/HRMS	EPA 1668A/1668C	PCB 48
GC/HRMS	EPA 1668A/1668C	PCB 49
GC/HRMS	EPA 1668A/1668C	PCB 50
GC/HRMS	EPA 1668A/1668C	PCB 51
GC/HRMS	EPA 1668A/1668C	PCB 52

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/HRMS	EPA 1668A/1668C	PCB 53
GC/HRMS	EPA 1668A/1668C	PCB 54
GC/HRMS	EPA 1668A/1668C	PCB 55
GC/HRMS	EPA 1668A/1668C	PCB 56
GC/HRMS	EPA 1668A/1668C	PCB 57
GC/HRMS	EPA 1668A/1668C	PCB 58
GC/HRMS	EPA 1668A/1668C	PCB 59
GC/HRMS	EPA 1668A/1668C	PCB 60
GC/HRMS	EPA 1668A/1668C	PCB 61
GC/HRMS	EPA 1668A/1668C	PCB 62
GC/HRMS	EPA 1668A/1668C	PCB 63
GC/HRMS	EPA 1668A/1668C	PCB 64
GC/HRMS	EPA 1668A/1668C	PCB 65
GC/HRMS	EPA 1668A/1668C	PCB 66
GC/HRMS	EPA 1668A/1668C	PCB 67
GC/HRMS	EPA 1668A/1668C	PCB 68
GC/HRMS	EPA 1668A/1668C	PCB 69
GC/HRMS	EPA 1668A/1668C	PCB 70
GC/HRMS	EPA 1668A/1668C	PCB 71
GC/HRMS	EPA 1668A/1668C	PCB 72
GC/HRMS	EPA 1668A/1668C	PCB 73
GC/HRMS	EPA 1668A/1668C	PCB 74
GC/HRMS	EPA 1668A/1668C	PCB 75
GC/HRMS	EPA 1668A/1668C	PCB 76
GC/HRMS	EPA 1668A/1668C	PCB 77
GC/HRMS	EPA 1668A/1668C	PCB 78
GC/HRMS	EPA 1668A/1668C	PCB 79
GC/HRMS	EPA 1668A/1668C	PCB 80
GC/HRMS	EPA 1668A/1668C	PCB 81
GC/HRMS	EPA 1668A/1668C	PCB 82
GC/HRMS	EPA 1668A/1668C	PCB 83
GC/HRMS	EPA 1668A/1668C	PCB 84
GC/HRMS	EPA 1668A/1668C	PCB 85
GC/HRMS	EPA 1668A/1668C	PCB 86
GC/HRMS	EPA 1668A/1668C	PCB 87

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/HRMS	EPA 1668A/1668C	PCB 88
GC/HRMS	EPA 1668A/1668C	PCB 89
GC/HRMS	EPA 1668A/1668C	PCB 90
GC/HRMS	EPA 1668A/1668C	PCB 91
GC/HRMS	EPA 1668A/1668C	PCB 92
GC/HRMS	EPA 1668A/1668C	PCB 93
GC/HRMS	EPA 1668A/1668C	PCB 94
GC/HRMS	EPA 1668A/1668C	PCB 95
GC/HRMS	EPA 1668A/1668C	PCB 96
GC/HRMS	EPA 1668A/1668C	PCB 97
GC/HRMS	EPA 1668A/1668C	PCB 98
GC/HRMS	EPA 1668A/1668C	PCB 99
GC/HRMS	EPA 1668A/1668C	PCB 100
GC/HRMS	EPA 1668A/1668C	PCB 101
GC/HRMS	EPA 1668A/1668C	PCB 102
GC/HRMS	EPA 1668A/1668C	PCB 103
GC/HRMS	EPA 1668A/1668C	PCB 104
GC/HRMS	EPA 1668A/1668C	PCB 105
GC/HRMS	EPA 1668A/1668C	PCB 106
GC/HRMS	EPA 1668A/1668C	PCB 107
GC/HRMS	EPA 1668A/1668C	PCB 108
GC/HRMS	EPA 1668A/1668C	PCB 109
GC/HRMS	EPA 1668A/1668C	PCB 110
GC/HRMS	EPA 1668A/1668C	PCB 111
GC/HRMS	EPA 1668A/1668C	PCB 112
GC/HRMS	EPA 1668A/1668C	PCB 113
GC/HRMS	EPA 1668A/1668C	PCB 114
GC/HRMS	EPA 1668A/1668C	PCB 115
GC/HRMS	EPA 1668A/1668C	PCB 116
GC/HRMS	EPA 1668A/1668C	PCB 117
GC/HRMS	EPA 1668A/1668C	PCB 118
GC/HRMS	EPA 1668A/1668C	PCB 119
GC/HRMS	EPA 1668A/1668C	PCB 120
GC/HRMS	EPA 1668A/1668C	PCB 121
GC/HRMS	EPA 1668A/1668C	PCB 122

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/HRMS	EPA 1668A/1668C	PCB 123
GC/HRMS	EPA 1668A/1668C	PCB 124
GC/HRMS	EPA 1668A/1668C	PCB 125
GC/HRMS	EPA 1668A/1668C	PCB 126
GC/HRMS	EPA 1668A/1668C	PCB 127
GC/HRMS	EPA 1668A/1668C	PCB 128
GC/HRMS	EPA 1668A/1668C	PCB 129
GC/HRMS	EPA 1668A/1668C	PCB 130
GC/HRMS	EPA 1668A/1668C	PCB 131
GC/HRMS	EPA 1668A/1668C	PCB 132
GC/HRMS	EPA 1668A/1668C	PCB 133
GC/HRMS	EPA 1668A/1668C	PCB 134
GC/HRMS	EPA 1668A/1668C	PCB 135
GC/HRMS	EPA 1668A/1668C	PCB 136
GC/HRMS	EPA 1668A/1668C	PCB 137
GC/HRMS	EPA 1668A/1668C	PCB 138
GC/HRMS	EPA 1668A/1668C	PCB 139
GC/HRMS	EPA 1668A/1668C	PCB 140
GC/HRMS	EPA 1668A/1668C	PCB 141
GC/HRMS	EPA 1668A/1668C	PCB 142
GC/HRMS	EPA 1668A/1668C	PCB 143
GC/HRMS	EPA 1668A/1668C	PCB 144
GC/HRMS	EPA 1668A/1668C	PCB 145
GC/HRMS	EPA 1668A/1668C	PCB 146
GC/HRMS	EPA 1668A/1668C	PCB 147
GC/HRMS	EPA 1668A/1668C	PCB 148
GC/HRMS	EPA 1668A/1668C	PCB 149
GC/HRMS	EPA 1668A/1668C	PCB 150
GC/HRMS	EPA 1668A/1668C	PCB 151
GC/HRMS	EPA 1668A/1668C	PCB 152
GC/HRMS	EPA 1668A/1668C	PCB 153
GC/HRMS	EPA 1668A/1668C	PCB 154
GC/HRMS	EPA 1668A/1668C	PCB 155
GC/HRMS	EPA 1668A/1668C	PCB 156
GC/HRMS	EPA 1668A/1668C	PCB 157

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/HRMS	EPA 1668A/1668C	PCB 158
GC/HRMS	EPA 1668A/1668C	PCB 159
GC/HRMS	EPA 1668A/1668C	PCB 160
GC/HRMS	EPA 1668A/1668C	PCB 161
GC/HRMS	EPA 1668A/1668C	PCB 162
GC/HRMS	EPA 1668A/1668C	PCB 163
GC/HRMS	EPA 1668A/1668C	PCB 164
GC/HRMS	EPA 1668A/1668C	PCB 165
GC/HRMS	EPA 1668A/1668C	PCB 166
GC/HRMS	EPA 1668A/1668C	PCB 167
GC/HRMS	EPA 1668A/1668C	PCB 168
GC/HRMS	EPA 1668A/1668C	PCB 169
GC/HRMS	EPA 1668A/1668C	PCB 170
GC/HRMS	EPA 1668A/1668C	PCB 171
GC/HRMS	EPA 1668A/1668C	PCB 172
GC/HRMS	EPA 1668A/1668C	PCB 173
GC/HRMS	EPA 1668A/1668C	PCB 174
GC/HRMS	EPA 1668A/1668C	PCB 175
GC/HRMS	EPA 1668A/1668C	PCB 176
GC/HRMS	EPA 1668A/1668C	PCB 177
GC/HRMS	EPA 1668A/1668C	PCB 178
GC/HRMS	EPA 1668A/1668C	PCB 179
GC/HRMS	EPA 1668A/1668C	PCB 180
GC/HRMS	EPA 1668A/1668C	PCB 181
GC/HRMS	EPA 1668A/1668C	PCB 182
GC/HRMS	EPA 1668A/1668C	PCB 183
GC/HRMS	EPA 1668A/1668C	PCB 184
GC/HRMS	EPA 1668A/1668C	PCB 185
GC/HRMS	EPA 1668A/1668C	PCB 186
GC/HRMS	EPA 1668A/1668C	PCB 187
GC/HRMS	EPA 1668A/1668C	PCB 188
GC/HRMS	EPA 1668A/1668C	PCB 189
GC/HRMS	EPA 1668A/1668C	PCB 190
GC/HRMS	EPA 1668A/1668C	PCB 191

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/HRMS	EPA 1668A/1668C	PCB 192
GC/HRMS	EPA 1668A/1668C	PCB 193
GC/HRMS	EPA 1668A/1668C	PCB 194
GC/HRMS	EPA 1668A/1668C	PCB 195
GC/HRMS	EPA 1668A/1668C	PCB 196
GC/HRMS	EPA 1668A/1668C	PCB 197
GC/HRMS	EPA 1668A/1668C	PCB 198
GC/HRMS	EPA 1668A/1668C	PCB 199
GC/HRMS	EPA 1668A/1668C	PCB 200
GC/HRMS	EPA 1668A/1668C	PCB 201
GC/HRMS	EPA 1668A/1668C	PCB 202
GC/HRMS	EPA 1668A/1668C	PCB 203
GC/HRMS	EPA 1668A/1668C	PCB 204
GC/HRMS	EPA 1668A/1668C	PCB 205
GC/HRMS	EPA 1668A/1668C	PCB 206
GC/HRMS	EPA 1668A/1668C	PCB 207
GC/HRMS	EPA 1668A/1668C	PCB 208
GC/HRMS	EPA 1668A/1668C	PCB 209
Preparation	**Method**	**Type**
Separatory Funnel Liquid-Liquid Extraction	EPA 3510C	Semivolatile and Non-Volatile Organics
Solid Phase Extraction	EPA 3535A	Semivolatile and Non-Volatile Organics

Drinking Water		
Technology	**Method**	**Analyte**
LC/MS/MS	EPA 537	Perfluorobutanesulfonic acid (PFBS)
LC/MS/MS	EPA 537	Perfluorohexanesulfonic acid (PFHxS)
LC/MS/MS	EPA 537	Perfluorohexane Sulfonic Acid (PFHxS)
LC/MS/MS	EPA 537	Perfluorononanoic acid (PFNA)
LC/MS/MS	EPA 537	Perfluorooctanoic acid (PFOA)
LC/MS/MS	EPA 537	Perfluorooctanesulfonic acid (PFOS)
LC/MS/MS	EPA 537	Perfluorodecanoic acid (PFDA)
LC/MS/MS	EPA 537	Perfluorododecanoic acid (PFDoA)

Drinking Water		
Technology	**Method**	**Analyte**
LC/MS/MS	EPA 537	Perfluorohexanoic acid (PFHxA)
LC/MS/MS	EPA 537	Perfluorotetradecanoic acid (PFTeDA)
LC/MS/MS	EPA 537	Perfluorotridecanoic acid (PFTrDA)
LC/MS/MS	EPA 537	Perfluoroundecanoic acid (PFUnA)
LC/MS/MS	EPA 537	N-Ethyl perfluorooctanesulfon amidoacetic acid (NEtFOSAA, EtFOSAA)
LC/MS/MS	EPA 537	N-Methyl perfluorooctanesulfon amidoacetic acid (NMeFOSAA, MeFOSAA)
LC/MS/MS	EPA 537.1	Perfluorodecanoic acid (PFDA)
LC/MS/MS	EPA 537.1	Perfluorododecanoic acid (PFDoA)
LC/MS/MS	EPA 537.1	Perfluorohexanoic acid (PFHxA)
LC/MS/MS	EPA 537.1	Perfluorotetradecanoic acid (PFTeDA)
LC/MS/MS	EPA 537.1	Perfluorotridecanoic acid (PFTrDA)
LC/MS/MS	EPA 537.1	Perfluoroundecanoic acid (PFUnA)
LC/MS/MS	EPA 537.1	N-Ethyl perfluorooctanesulfon amidoacetic acid (NEtFOSAA, EtFOSAA)
LC/MS/MS	EPA 537.1	N-Methyl perfluorooctanesulfon amidoacetic acid (NMeFOSAA, MeFOSAA)
LC/MS/MS	EPA 537.1	Perfluoroheptanoic acid (PFHpA)
LC/MS/MS	EPA 537.1	Perfluorooctanoic acid (PFOA)
LC/MS/MS	EPA 537.1	Perfluorononanoic acid (PFNA)
LC/MS/MS	EPA 537.1	Perfluorobutanesulfonic acid (PFBS)
LC/MS/MS	EPA 537.1	Perfluorohexanesulfonic acid (PFHxS)
LC/MS/MS	EPA 537.1	Perfluorooctanesulfonic acid (PFOS)
LC/MS/MS	EPA 537.1	Hexafluoropropylene Oxide Dimer Acid (HFPO-DA)
LC/MS/MS	EPA 537.1	9-Chlorohexadecafluoro-3-oxanonane-1-sulfonic acid (9Cl-PF3ONS)
LC/MS/MS	EPA 537.1	11-Chloroeicosafluoro-3-oxaundecane-1-sulfonic acid (11C1-PF3OUdS)
LC/MS/MS	EPA 537.1	4,8-Dioxa-3H-perfluorononanoic Acid (ADONA)
LC/MS/MS	EPA 533	11-Chloroeicosafluoro-3-oxaundecane-1-sulfonic acid (11C1-PF3OUdS)
LC/MS/MS	EPA 533	8:2 Fluorotelomer sulfonic acid (1H,1H,2H,2H-perfluorodecane sulfonic acid) (8:2 FTS)

Drinking Water		
Technology	**Method**	**Analyte**
LC/MS/MS	EPA 533	4:2 Fluorotelomer sulfonic acid (1H, 1H,2H,2H-perfluorohexane sulfonic acid) (4:2 FTS)
LC/MS/MS	EPA 533	6:2 Fluorotelomer sulfonic acid (1H,1H,2H,2H-perfluorooctane sulfonic acid) (6:2 FTS)
LC/MS/MS	EPA 533	4,8-Dioxa-3H-perfluorononanoic acid (DONA)
LC/MS/MS	EPA 533	9-Chlorohexadecafluoro-3-oxanonane-1-sulfonic acid (9Cl-PF3ONS)
LC/MS/MS	EPA 533	Hexafluoropropylene oxide dimer acid (HFPO-DA, GenX) (Perfluoro-2-propoxypropionic acid)
LC/MS/MS	EPA 533	Nonafluoro-3,6-dioxaheptanoic acid (NFDHA)
LC/MS/MS	EPA 533	Perfluoro (2-ethoxyethane) sulfonic acid (PFEESA)
LC/MS/MS	EPA 533	Perfluoro-3-methoxypropanoic acid (PFMPA)
LC/MS/MS	EPA 533	Perfluoro-4-methoxybutanoic acid (PFMBA)
LC/MS/MS	EPA 533	Perfluorobutanesulfonic acid (PFBS)
LC/MS/MS	EPA 533	Perfluorobutanoic acid (PFBA)
LC/MS/MS	EPA 533	Perfluorodecanoic acid (PFDA)
LC/MS/MS	EPA 533	Perfluorododecanoic acid (PFDoA)
LC/MS/MS	EPA 533	Perfluoroheptanesulfonic acid (PFHpS)
LC/MS/MS	EPA 533	Perfluoroheptanoic acid (PFHpA)
LC/MS/MS	EPA 533	Perfluorohexanesulfonic acid (PFHxS)
LC/MS/MS	EPA 533	Perfluorohexanoic acid (PFHxA)
LC/MS/MS	EPA 533	Perfluorononanoic acid (PFNA)
LC/MS/MS	EPA 533	Perfluorooctanesulfonic acid (PFOS)
LC/MS/MS	EPA 533	Perfluorooctanoic acid (PFOA)
LC/MS/MS	EPA 533	Perfluoropentanesulfonic acid (PFPeS)
LC/MS/MS	EPA 533	Perfluoropentanoic acid (PFPeA)
LC/MS/MS	EPA 533	Perfluoroundecanoic acid (PFUnA)
Preparation	**Method**	**Type**
Solid Phase Extraction	EPA 537/537.1/533	Perfluoro compounds in Drinking Water

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
LC/MS/MS	EPA 6850	Perchlorate
Gravimetric	ASTM D2216	%Moisture
GC/HRMS	EPA 8290/ 8290A/1613B	2,3,7,8-TeCDD
GC/HRMS	EPA 8290/ 8290A/1613B	1,2,3,7,8-PeCDD
GC/HRMS	EPA 8290/ 8290A/1613B	1,2,3,4,7,8-HxCDD
GC/HRMS	EPA 8290/ 8290A/1613B	1,2,3,6,7,8-HxCDD
GC/HRMS	EPA 8290/ 8290A/1613B	1,2,3,7,8,9-HxCDD
GC/HRMS	EPA 8290/ 8290A/1613B	1,2,3,4,6,7,8-HpCDD
GC/HRMS	EPA 8290/ 8290A/1613B	OCDD
GC/HRMS	EPA 8290/ 8290A/1613B	2,3,7,8-TeCDF
GC/HRMS	EPA 8290/ 8290A/1613B	1,2,3,7,8-PeCDF
GC/HRMS	EPA 8290/ 8290A/1613B	2,3,4,7,8-PeCDF
GC/HRMS	EPA 8290/ 8290A/1613B	1,2,3,4,7,8-HxCDF
GC/HRMS	EPA 8290/ 8290A/1613B	1,2,3,6,7,8-HxCDF
GC/HRMS	EPA 8290/ 8290A/1613B	1,2,3,7,8,9-HxCDF
GC/HRMS	EPA 8290/ 8290A/1613B	2,3,4,6,7,8-HxCDF
GC/HRMS	EPA 8290/ 8290A/1613B	1,2,3,4,6,7,8-HpCDF
GC/HRMS	EPA 8290/ 8290A/1613B	1,2,3,4,7,8,9-HpCDF
GC/HRMS	EPA 8290/ 8290A/1613B	OCDF
GC/HRMS	EPA 8290/ 8290A/1613B	Total TCDD
GC/HRMS	EPA 8290/ 8290A/1613B	Total PeCDD
GC/HRMS	EPA 8290/ 8290A/1613B	Total HxCDD
GC/HRMS	EPA 8290/ 8290A/1613B	Total HpCDD
GC/HRMS	EPA 8290/ 8290A/1613B	Total TCDF
GC/HRMS	EPA 8290/ 8290A/1613B	Total PeCDF
GC/HRMS	EPA 8290/ 8290A/1613B	Total HxCDF
GC/HRMS	EPA 8290/ 8290A/1613B	Total HpCDF
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	6:2 Fluorotelomer sulfonic acid (1H,1H,2H,2H-perfluorooctane sulfonic acid) (6:2 FTS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	8:2 Fluorotelomer sulfonic acid (1H,1H,2H,2H-perfluorodecane sulfonic acid) (8:2 FTS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	N-Ethyl perfluorooctanesulfon amidoacetic acid (NEtFOSAA, EtFOSAA)

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	N-Methyl perfluorooctanesulfon amidoacetic acid (NMeFOSAA, MeFOSAA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	Perfluorooctanoic acid (PFOA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	Perfluorooctanesulfonic acid (PFOS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	Perfluorobutanoic acid (PFBA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	Perfluoropentanoic acid (PFPA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	Perfluorohexanoic acid (PFHxA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	Perfluoroheptanoic acid (PFHpA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	Perfluorononanoic acid (PFNA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	Perfluorodecanoic acid (PFDA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	Perfluoroundecanoic acid (PFUnA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	Perfluorododecanoic acid (PFDoA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	Perfluorotridecanoic acid (PFTrDA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	Perfluorotetradecanoic acid (PFTeDA)

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	Perfluorobutanesulfonic acid (PFBS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	Perfluorohexanesulfonic acid (PFHxS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	Perfluoroheptanesulfonic acid (PFHpS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	Perfluorodecanesulfonic acid (PFDS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	Perfluorooctanesulfonamide (PFOSA, FOSA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	4:2 Fluorotelomer sulfonic acid (1H, 1H,2H,2H-perfluorohexane sulfonic acid) (4:2 FTS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	10:2 Fluorotelomer sulfonic acid (1H, 1H,2H,2H-perfluorododecane sulfonic acid) (10:2 FTS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	Perfluorohexadecanoic acid (PFHxDA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	Perfluoropentanesulfonic acid (PFPeS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	Perfluorononanesulfonic acid (PFNS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	4,8-Dioxa-3H-perfluorononanoic acid (ADONA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	Hexafluoropropylene oxide dimer acid (HFPO-DA, GenX) (Perfluoro-2-propoxypropionic acid)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	9-Chlorohexadecafluoro-3-oxanonane-1-sulfonic acid (9Cl-PF3ONS)

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	11-Chloroeicosafluoro-3-oxaundecane-1-sulfonic acid (11C1-PF3OUdS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	Perfluorododecanesulfonic acid (PFDoS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	Perfluorooctadecanoic acid (PFODA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	Perfluoro-4-ethylcyclohexanesulfonic acid (PFecHS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	Perfluoro-1-propanesulfonic acid (PFPrS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	N-Ethylperfluorooctane sulfonamide (NEtFOSA ,EtFOSA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	N-Methylperfluorooctane sulfonamide (NMeFOSA, MeFOSA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	N-Ethylperfluorooctane sulfonamido ethanol (NEtFOSE EtFOSE)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	N-Methylperfluorooctane sulfonamido ethanol (NMeFOSe, MeFOSE)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	4,4,5,5,6,6,6-Heptafluorohexanoic acid (3-Perfluoropropyl propanoic acid) (3:3 FTCA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	2H,2H,3H,3H-Perfluorooctanoic acid (5:3 FTCA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	2H,2H,3H,3H-Perfluorodecanoic acid (3-Perfluoroheptyl propanoic acid) (7:3 FTCA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	2-Perfluorohexylethanoic acid (6:2 FTCA)

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	2-Perfluorooctylethanoic acid (8:2 FTCA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	2-Perfluorodecylethanoic acid (10:2 FTCA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	Perfluoropropionic acid (PPF Acid, PFPrA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	Perfluoro-3-methoxypropanoic acid (PFMPA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	Perfluoro-4-methoxybutanoic acid (PFMBA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	Nonafluoro-3,6-dioxaheptanoic acid (NFDHA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	Perfluoro(2-ethoxyethane) sulfonic acid (PFEESA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	Difluoro(perfluoromethoxy)acetic acid (PFMOAA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	Perfluoro-4-isopropoxybutanoic acid (PFECA G, PFPE-1)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	Perfluoro-3,5,7,9-butaoxadecanoic acid (PFO4DA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	Perfluoro-3,5,7-trioxaoctanoic acid (PFO3OA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	Perfluoro-3,5-dioxahexanoic acid (PFO2HXA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	Perfluoro-2-{[perfluoro-3-(perfluoroethoxy)-2-propanyl]oxy}ethanesulfonic acid (Hydro-PS Acid)

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	Perfluoro-3,5,7,9,11-pentaoxadodecanoic acid (PFO5DoA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	Perfluoro-2-(perfluoromethoxy)propanoic acid (PMPA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	2,3,3,3-Tetrafluoro-2-(pentafluoroethoxy)propanoic acid (PEPA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	4-(2-carboxy-1,1,2,2-tetrafluoroethoxy)-2,2,3,3,4,5,5,5-octafluoro-pentanoic acid (R-EVE)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	1,1,2,2-Tetrafluoro-2-(1,2,2,2-tetrafluoroethoxy)ethane-1-sulfonic acid (NVHOS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	2,2,3,3-Tetrafluoro-3-{[1,1,1,2,3,3-hexafluoro-3-(1,2,2,2-tetrafluoroethoxy)propan-2-yl]oxy}propanoic acid (Hydro-EVE Acid)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	1,1,2,2-tetrafluoro-2-[1,2,2,3,3-pentafluoro-1-(trifluoromethyl)propoxy]ethanesulfonic acid (R-PSDCA)
LC/MS/MS	Draft EPA Method 1633 Rev 4	1*H*,1*H*, 2*H*, 2*H*-Perfluorooctane sulfonic acid (6:2FTS)
LC/MS/MS	Draft EPA Method 1633 Rev 4	1*H*,1*H*, 2*H*, 2*H*-Perfluorodecane sulfonic acid (8:2FTS)
LC/MS/MS	Draft EPA Method 1633 Rev 4	N-ethyl perfluorooctanesulfonamidoacetic acid (NEtFOSAA)
LC/MS/MS	Draft EPA Method 1633 Rev 4	N-methyl perfluorooctanesulfonamidoacetic acid (NMeFOSAA)
LC/MS/MS	Draft EPA Method 1633 Rev 4	Perfluorooctanoic acid (PFOA)
LC/MS/MS	Draft EPA Method 1633 Rev 4	Perfluorooctanesulfonic acid (PFOS)
LC/MS/MS	Draft EPA Method 1633 Rev 4	Perfluorobutanoic acid (PFBA)
LC/MS/MS	Draft EPA Method 1633 Rev 4	Perfluoropentanoic acid (PFPeA)
LC/MS/MS	Draft EPA Method 1633 Rev 4	Perfluorohexanoic acid (PFHxA)
LC/MS/MS	Draft EPA Method 1633 Rev 4	Perfluoroheptanoic acid (PFHpA)
LC/MS/MS	Draft EPA Method 1633 Rev 4	Perfluorononanoic acid (PFNA)
LC/MS/MS	Draft EPA Method 1633 Rev 4	Perfluorodecanoic acid (PFDA)
LC/MS/MS	Draft EPA Method 1633 Rev 4	Perfluoroundecanoic acid (PFUnA)
LC/MS/MS	Draft EPA Method 1633 Rev 4	Perfluorododecanoic acid (PFDoA)

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
LC/MS/MS	Draft EPA Method 1633 Rev 4	Perfluorotridecanoic acid (PFTrDA)
LC/MS/MS	Draft EPA Method 1633 Rev 4	Perfluorotetradecanoic acid (PFTeDA)
LC/MS/MS	Draft EPA Method 1633 Rev 4	Perfluorobutanesulfonic acid (PFBS)
LC/MS/MS	Draft EPA Method 1633 Rev 4	Perfluorohexanesulfonic acid (PFHxS)
LC/MS/MS	Draft EPA Method 1633 Rev 4	Perfluoroheptanesulfonic acid (PFHpS)
LC/MS/MS	Draft EPA Method 1633 Rev 4	Perfluorodecanesulfonic acid (PFDS)
LC/MS/MS	Draft EPA Method 1633 Rev 4	Perfluorooctanesulfonamide (PFOSA)
LC/MS/MS	Draft EPA Method 1633 Rev 4	1*H*,1*H*, 2*H*, 2*H*-Perfluorohexane sulfonic acid (4:2FTS)
LC/MS/MS	Draft EPA Method 1633 Rev 4	Perfluoropentanesulfonic acid (PFPeS)
LC/MS/MS	Draft EPA Method 1633 Rev 4	Perfluorononanesulfonic acid (PFNS)
LC/MS/MS	Draft EPA Method 1633 Rev 4	4,8-Dioxa-3*H*-perfluorononanoic acid (ADONA)
LC/MS/MS	Draft EPA Method 1633 Rev 4	Hexafluoropropylene oxide dimer acid (HFPO-DA)
LC/MS/MS	Draft EPA Method 1633 Rev 4	9-Chlorohexadecafluoro-3-oxanonane-1-sulfonic acid (9Cl-PF3ONS)
LC/MS/MS	Draft EPA Method 1633 Rev 4	11-Chloroeicosafluoro-3-oxaundecane-1-sulfonic acid (11C1-PF3OUdS)
LC/MS/MS	Draft EPA Method 1633 Rev 4	Perfluorododecanesulfonic acid (PFDoS)
LC/MS/MS	Draft EPA Method 1633 Rev 4	N-ethyl perfluorooctanesulfonamide (NEtFOSA)
LC/MS/MS	Draft EPA Method 1633 Rev 4	N-methyl perfluorooctanesulfonamide (NMeFOSA)
LC/MS/MS	Draft EPA Method 1633 Rev 4	N-ethyl perfluorooctanesulfonamidoethanol (NEtFOSE)
LC/MS/MS	Draft EPA Method 1633 Rev 4	N-methyl perfluorooctanesulfonamidoethanol (NMeFOSE)
LC/MS/MS	Draft EPA Method 1633 Rev 4	3-Perfluoropropyl propanoic acid (3:3FTCA)
LC/MS/MS	Draft EPA Method 1633 Rev 4	2*H*,2*H*,3*H*,3*H*-Perfluorooctanoic acid (5:3FTCA)
LC/MS/MS	Draft EPA Method 1633 Rev 4	3-Perfluoroheptyl propanoic acid (7:3FTCA)
LC/MS/MS	Draft EPA Method 1633 Rev 4	Perfluoro-3-methoxypropanoic acid (PFMPA)
LC/MS/MS	Draft EPA Method 1633 Rev 4	Perfluoro-4-methoxybutanoic acid (PFMBA)
LC/MS/MS	Draft EPA Method 1633 Rev 4	Nonafluoro-3,6-dioxaheptanoic acid (NFDHA)
LC/MS/MS	Draft EPA Method 1633 Rev 4	Perfluoro(2-ethoxyethane)sulfonic acid (PFEESA)
GC/HRMS	EPA 1668A/1668C	PCB 1
GC/HRMS	EPA 1668A/1668C	PCB 2
GC/HRMS	EPA 1668A/1668C	PCB 3

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/HRMS	EPA 1668A/1668C	PCB 4
GC/HRMS	EPA 1668A/1668C	PCB 5
GC/HRMS	EPA 1668A/1668C	PCB 6
GC/HRMS	EPA 1668A/1668C	PCB 7
GC/HRMS	EPA 1668A/1668C	PCB 8
GC/HRMS	EPA 1668A/1668C	PCB 9
GC/HRMS	EPA 1668A/1668C	PCB 10
GC/HRMS	EPA 1668A/1668C	PCB 11
GC/HRMS	EPA 1668A/1668C	PCB 12
GC/HRMS	EPA 1668A/1668C	PCB 13
GC/HRMS	EPA 1668A/1668C	PCB 14
GC/HRMS	EPA 1668A/1668C	PCB 15
GC/HRMS	EPA 1668A/1668C	PCB 16
GC/HRMS	EPA 1668A/1668C	PCB 17
GC/HRMS	EPA 1668A/1668C	PCB 18
GC/HRMS	EPA 1668A/1668C	PCB 19
GC/HRMS	EPA 1668A/1668C	PCB 20
GC/HRMS	EPA 1668A/1668C	PCB 21
GC/HRMS	EPA 1668A/1668C	PCB 22
GC/HRMS	EPA 1668A/1668C	PCB 23
GC/HRMS	EPA 1668A/1668C	PCB 24
GC/HRMS	EPA 1668A/1668C	PCB 25
GC/HRMS	EPA 1668A/1668C	PCB 26
GC/HRMS	EPA 1668A/1668C	PCB 27
GC/HRMS	EPA 1668A/1668C	PCB 28
GC/HRMS	EPA 1668A/1668C	PCB 29
GC/HRMS	EPA 1668A/1668C	PCB 30
GC/HRMS	EPA 1668A/1668C	PCB 32
GC/HRMS	EPA 1668A/1668C	PCB 31
GC/HRMS	EPA 1668A/1668C	PCB 33
GC/HRMS	EPA 1668A/1668C	PCB 34
GC/HRMS	EPA 1668A/1668C	PCB 35
GC/HRMS	EPA 1668A/1668C	PCB 36
GC/HRMS	EPA 1668A/1668C	PCB 37
GC/HRMS	EPA 1668A/1668C	PCB 38

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/HRMS	EPA 1668A/1668C	PCB 39
GC/HRMS	EPA 1668A/1668C	PCB 40
GC/HRMS	EPA 1668A/1668C	PCB 41
GC/HRMS	EPA 1668A/1668C	PCB 42
GC/HRMS	EPA 1668A/1668C	PCB 43
GC/HRMS	EPA 1668A/1668C	PCB 44
GC/HRMS	EPA 1668A/1668C	PCB 45
GC/HRMS	EPA 1668A/1668C	PCB 46
GC/HRMS	EPA 1668A/1668C	PCB 47
GC/HRMS	EPA 1668A/1668C	PCB 48
GC/HRMS	EPA 1668A/1668C	PCB 49
GC/HRMS	EPA 1668A/1668C	PCB 50
GC/HRMS	EPA 1668A/1668C	PCB 51
GC/HRMS	EPA 1668A/1668C	PCB 52
GC/HRMS	EPA 1668A/1668C	PCB 53
GC/HRMS	EPA 1668A/1668C	PCB 54
GC/HRMS	EPA 1668A/1668C	PCB 55
GC/HRMS	EPA 1668A/1668C	PCB 56
GC/HRMS	EPA 1668A/1668C	PCB 57
GC/HRMS	EPA 1668A/1668C	PCB 58
GC/HRMS	EPA 1668A/1668C	PCB 59
GC/HRMS	EPA 1668A/1668C	PCB 60
GC/HRMS	EPA 1668A/1668C	PCB 61
GC/HRMS	EPA 1668A/1668C	PCB 62
GC/HRMS	EPA 1668A/1668C	PCB 63
GC/HRMS	EPA 1668A/1668C	PCB 64
GC/HRMS	EPA 1668A/1668C	PCB 65
GC/HRMS	EPA 1668A/1668C	PCB 66
GC/HRMS	EPA 1668A/1668C	PCB 67
GC/HRMS	EPA 1668A/1668C	PCB 68
GC/HRMS	EPA 1668A/1668C	PCB 69
GC/HRMS	EPA 1668A/1668C	PCB 70
GC/HRMS	EPA 1668A/1668C	PCB 71
GC/HRMS	EPA 1668A/1668C	PCB 72
GC/HRMS	EPA 1668A/1668C	PCB 73

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/HRMS	EPA 1668A/1668C	PCB 74
GC/HRMS	EPA 1668A/1668C	PCB 75
GC/HRMS	EPA 1668A/1668C	PCB 76
GC/HRMS	EPA 1668A/1668C	PCB 77
GC/HRMS	EPA 1668A/1668C	PCB 78
GC/HRMS	EPA 1668A/1668C	PCB 79
GC/HRMS	EPA 1668A/1668C	PCB 80
GC/HRMS	EPA 1668A/1668C	PCB 81
GC/HRMS	EPA 1668A/1668C	PCB 82
GC/HRMS	EPA 1668A/1668C	PCB 83
GC/HRMS	EPA 1668A/1668C	PCB 84
GC/HRMS	EPA 1668A/1668C	PCB 85
GC/HRMS	EPA 1668A/1668C	PCB 86
GC/HRMS	EPA 1668A/1668C	PCB 87
GC/HRMS	EPA 1668A/1668C	PCB 88
GC/HRMS	EPA 1668A/1668C	PCB 89
GC/HRMS	EPA 1668A/1668C	PCB 90
GC/HRMS	EPA 1668A/1668C	PCB 91
GC/HRMS	EPA 1668A/1668C	PCB 92
GC/HRMS	EPA 1668A/1668C	PCB 93
GC/HRMS	EPA 1668A/1668C	PCB 94
GC/HRMS	EPA 1668A/1668C	PCB 95
GC/HRMS	EPA 1668A/1668C	PCB 96
GC/HRMS	EPA 1668A/1668C	PCB 97
GC/HRMS	EPA 1668A/1668C	PCB 98
GC/HRMS	EPA 1668A/1668C	PCB 99
GC/HRMS	EPA 1668A/1668C	PCB 100
GC/HRMS	EPA 1668A/1668C	PCB 101
GC/HRMS	EPA 1668A/1668C	PCB 102
GC/HRMS	EPA 1668A/1668C	PCB 103
GC/HRMS	EPA 1668A/1668C	PCB 104
GC/HRMS	EPA 1668A/1668C	PCB 105
GC/HRMS	EPA 1668A/1668C	PCB 106
GC/HRMS	EPA 1668A/1668C	PCB 107
GC/HRMS	EPA 1668A/1668C	PCB 108

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/HRMS	EPA 1668A/1668C	PCB 109
GC/HRMS	EPA 1668A/1668C	PCB 110
GC/HRMS	EPA 1668A/1668C	PCB 111
GC/HRMS	EPA 1668A/1668C	PCB 112
GC/HRMS	EPA 1668A/1668C	PCB 113
GC/HRMS	EPA 1668A/1668C	PCB 114
GC/HRMS	EPA 1668A/1668C	PCB 115
GC/HRMS	EPA 1668A/1668C	PCB 116
GC/HRMS	EPA 1668A/1668C	PCB 117
GC/HRMS	EPA 1668A/1668C	PCB 118
GC/HRMS	EPA 1668A/1668C	PCB 119
GC/HRMS	EPA 1668A/1668C	PCB 120
GC/HRMS	EPA 1668A/1668C	PCB 121
GC/HRMS	EPA 1668A/1668C	PCB 122
GC/HRMS	EPA 1668A/1668C	PCB 123
GC/HRMS	EPA 1668A/1668C	PCB 124
GC/HRMS	EPA 1668A/1668C	PCB 125
GC/HRMS	EPA 1668A/1668C	PCB 126
GC/HRMS	EPA 1668A/1668C	PCB 127
GC/HRMS	EPA 1668A/1668C	PCB 128
GC/HRMS	EPA 1668A/1668C	PCB 129
GC/HRMS	EPA 1668A/1668C	PCB 130
GC/HRMS	EPA 1668A/1668C	PCB 131
GC/HRMS	EPA 1668A/1668C	PCB 132
GC/HRMS	EPA 1668A/1668C	PCB 133
GC/HRMS	EPA 1668A/1668C	PCB 134
GC/HRMS	EPA 1668A/1668C	PCB 135
GC/HRMS	EPA 1668A/1668C	PCB 136
GC/HRMS	EPA 1668A/1668C	PCB 137
GC/HRMS	EPA 1668A/1668C	PCB 138
GC/HRMS	EPA 1668A/1668C	PCB 139
GC/HRMS	EPA 1668A/1668C	PCB 140
GC/HRMS	EPA 1668A/1668C	PCB 141
GC/HRMS	EPA 1668A/1668C	PCB 142
GC/HRMS	EPA 1668A/1668C	PCB 143

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/HRMS	EPA 1668A/1668C	PCB 144
GC/HRMS	EPA 1668A/1668C	PCB 145
GC/HRMS	EPA 1668A/1668C	PCB 146
GC/HRMS	EPA 1668A/1668C	PCB 147
GC/HRMS	EPA 1668A/1668C	PCB 148
GC/HRMS	EPA 1668A/1668C	PCB 149
GC/HRMS	EPA 1668A/1668C	PCB 150
GC/HRMS	EPA 1668A/1668C	PCB 151
GC/HRMS	EPA 1668A/1668C	PCB 152
GC/HRMS	EPA 1668A/1668C	PCB 153
GC/HRMS	EPA 1668A/1668C	PCB 154
GC/HRMS	EPA 1668A/1668C	PCB 155
GC/HRMS	EPA 1668A/1668C	PCB 156
GC/HRMS	EPA 1668A/1668C	PCB 157
GC/HRMS	EPA 1668A/1668C	PCB 158
GC/HRMS	EPA 1668A/1668C	PCB 159
GC/HRMS	EPA 1668A/1668C	PCB 160
GC/HRMS	EPA 1668A/1668C	PCB 161
GC/HRMS	EPA 1668A/1668C	PCB 162
GC/HRMS	EPA 1668A/1668C	PCB 163
GC/HRMS	EPA 1668A/1668C	PCB 164
GC/HRMS	EPA 1668A/1668C	PCB 165
GC/HRMS	EPA 1668A/1668C	PCB 166
GC/HRMS	EPA 1668A/1668C	PCB 167
GC/HRMS	EPA 1668A/1668C	PCB 168
GC/HRMS	EPA 1668A/1668C	PCB 169
GC/HRMS	EPA 1668A/1668C	PCB 170
GC/HRMS	EPA 1668A/1668C	PCB 171
GC/HRMS	EPA 1668A/1668C	PCB 172
GC/HRMS	EPA 1668A/1668C	PCB 173
GC/HRMS	EPA 1668A/1668C	PCB 174
GC/HRMS	EPA 1668A/1668C	PCB 175
GC/HRMS	EPA 1668A/1668C	PCB 176
GC/HRMS	EPA 1668A/1668C	PCB 177
GC/HRMS	EPA 1668A/1668C	PCB 178

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/HRMS	EPA 1668A/1668C	PCB 179
GC/HRMS	EPA 1668A/1668C	PCB 180
GC/HRMS	EPA 1668A/1668C	PCB 181
GC/HRMS	EPA 1668A/1668C	PCB 182
GC/HRMS	EPA 1668A/1668C	PCB 183
GC/HRMS	EPA 1668A/1668C	PCB 184
GC/HRMS	EPA 1668A/1668C	PCB 185
GC/HRMS	EPA 1668A/1668C	PCB 186
GC/HRMS	EPA 1668A/1668C	PCB 187
GC/HRMS	EPA 1668A/1668C	PCB 188
GC/HRMS	EPA 1668A/1668C	PCB 189
GC/HRMS	EPA 1668A/1668C	PCB 190
GC/HRMS	EPA 1668A/1668C	PCB 191
GC/HRMS	EPA 1668A/1668C	PCB 192
GC/HRMS	EPA 1668A/1668C	PCB 193
GC/HRMS	EPA 1668A/1668C	PCB 194
GC/HRMS	EPA 1668A/1668C	PCB 195
GC/HRMS	EPA 1668A/1668C	PCB 196
GC/HRMS	EPA 1668A/1668C	PCB 197
GC/HRMS	EPA 1668A/1668C	PCB 198
GC/HRMS	EPA 1668A/1668C	PCB 199
GC/HRMS	EPA 1668A/1668C	PCB 200
GC/HRMS	EPA 1668A/1668C	PCB 201
GC/HRMS	EPA 1668A/1668C	PCB 202
GC/HRMS	EPA 1668A/1668C	PCB 203
GC/HRMS	EPA 1668A/1668C	PCB 204
GC/HRMS	EPA 1668A/1668C	PCB 205
GC/HRMS	EPA 1668A/1668C	PCB 206
GC/HRMS	EPA 1668A/1668C	PCB 207
GC/HRMS	EPA 1668A/1668C	PCB 208
GC/HRMS	EPA 1668A/1668C	PCB 209
Preparation	**Method**	**Type**
Separatory Funnel Liquid-Liquid Extraction	EPA 3510C	Semivolatile and Non-Volatile Organics

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
Solvent Dilution	EPA 3580A	Semivolatile and Non-Volatile Organics
TCLP Extraction	EPA 1311	Toxicity Characteristic Leaching Procedure
SPLP Extraction	EPA 1312	Synthetic Precipitation Leaching Procedure
STLC Extraction	CA-WET	California Waste Extraction Test

Biological Tissue		
Technology	**Method**	**Analyte**
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	6:2 Fluorotelomer sulfonic acid (1H,1H,2H,2H-perfluorooctane sulfonic acid) (6:2 FTS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	8:2 Fluorotelomer sulfonic acid (1H,1H,2H,2H-perfluorodecane sulfonic acid) (8:2 FTS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	N-Ethyl perfluorooctanesulfon amidoacetic acid (NEtFOSAA, EtFOSAA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	N-Methyl perfluorooctanesulfon amidoacetic acid (NMeFOSAA, MeFOSAA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	Perfluorooctanoic acid (PFOA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	Perfluorooctanesulfonic acid (PFOS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	Perfluorobutanoic acid (PFBA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	Perfluoropentanoic acid (PFPA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	Perfluorohexanoic acid (PFHxA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	Perfluoroheptanoic acid (PFHpA)

Biological Tissue		
Technology	**Method**	**Analyte**
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	Perfluorononanoic acid (PFNA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	Perfluorodecanoic acid (PFDA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	Perfluoroundecanoic acid (PFUnA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	Perfluorododecanoic acid (PFDoA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	Perfluorotridecanoic acid (PFTrDA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	Perfluorotetradecanoic acid (PFTeDA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.34 Table B-15 WS-LC-0025	Perfluorobutanesulfonic acid (PFBS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.34 Table B-15 WS-LC-0025	Perfluorohexanesulfonic acid (PFHxS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	Perfluorooctanesulfonamide (PFOSA, FOSA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	4:2 Fluorotelomer sulfonic acid (1H, 1H,2H,2H-perfluorohexane sulfonic acid) (4:2 FTS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	10:2 Fluorotelomer sulfonic acid (1H, 1H,2H,2H-perfluorododecane sulfonic acid) (10:2 FTS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	Perfluorohexadecanoic acid (PFHxDA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	Perfluoropentanesulfonic acid (PFPeS)

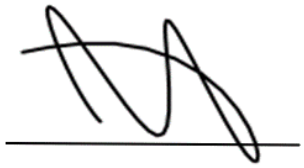
Biological Tissue		
Technology	**Method**	**Analyte**
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	Perfluorononanesulfonic acid (PFNS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	4,8-Dioxa-3H-perfluorononanoic acid (ADONA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	Hexafluoropropylene oxide dimer acid (HFPO-DA, GenX) (Perfluoro-2-propoxypropionic acid)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	9-Chlorohexadecafluoro-3-oxanonane-1-sulfonic acid (9Cl-PF3ONS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	11-Chloroeicosafluoro-3-oxaundecane-1-sulfonic acid (11C1-PF3OUdS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	Perfluorododecanesulfonic acid (PFDoS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	Perfluorooctadecanoic acid (PFODA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	N-Ethylperfluorooctane sulfonamide (NEtFOSA, EtFOSA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	N-Methylperfluorooctane sulfonamide (NMeFOSA, MeFOSA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	N-Ethylperfluorooctane sulfonamido ethanol (NEtFOSE, EtFOSE)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	N-Methylperfluorooctane sulfonamido ethanol (NMeFOSe, MeFOSE)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	Perfluoroheptanesulfonic acid (PFHpS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	Perfluorodecanesulfonic acid (PFDS)

Biological Tissue		
Technology	**Method**	**Analyte**
LC/MS/MS	Draft EPA Method 1633 Rev 4	1*H*,1*H*, 2*H*, 2*H*-Perfluorooctane sulfonic acid (6:2FTS)
LC/MS/MS	Draft EPA Method 1633 Rev 4	1*H*,1*H*, 2*H*, 2*H*-Perfluorodecane sulfonic acid (8:2FTS)
LC/MS/MS	Draft EPA Method 1633 Rev 4	N-ethyl perfluorooctanesulfonamidoacetic acid (NEtFOSAA)
LC/MS/MS	Draft EPA Method 1633 Rev 4	N-methyl perfluorooctanesulfonamidoacetic acid (NMeFOSAA)
LC/MS/MS	Draft EPA Method 1633 Rev 4	Perfluorooctanoic acid (PFOA)
LC/MS/MS	Draft EPA Method 1633 Rev 4	Perfluorooctanesulfonic acid (PFOS)
LC/MS/MS	Draft EPA Method 1633 Rev 4	Perfluorobutanoic acid (PFBA)
LC/MS/MS	Draft EPA Method 1633 Rev 4	Perfluoropentanoic acid (PFPeA)
LC/MS/MS	Draft EPA Method 1633 Rev 4	Perfluorohexanoic acid (PFHxA)
LC/MS/MS	Draft EPA Method 1633 Rev 4	Perfluoroheptanoic acid (PFHpA)
LC/MS/MS	Draft EPA Method 1633 Rev 4	Perfluorononanoic acid (PFNA)
LC/MS/MS	Draft EPA Method 1633 Rev 4	Perfluorodecanoic acid (PFDA)
LC/MS/MS	Draft EPA Method 1633 Rev 4	Perfluoroundecanoic acid (PFUnA)
LC/MS/MS	Draft EPA Method 1633 Rev 4	Perfluorododecanoic acid (PFDoA)
LC/MS/MS	Draft EPA Method 1633 Rev 4	Perfluorotridecanoic acid (PFTrDA)
LC/MS/MS	Draft EPA Method 1633 Rev 4	Perfluorotetradecanoic acid (PFTeDA)
LC/MS/MS	Draft EPA Method 1633 Rev 4	Perfluorobutanesulfonic acid (PFBS)
LC/MS/MS	Draft EPA Method 1633 Rev 4	Perfluorohexanesulfonic acid (PFHxS)
LC/MS/MS	Draft EPA Method 1633 Rev 4	Perfluoroheptanesulfonic acid (PFHpS)
LC/MS/MS	Draft EPA Method 1633 Rev 4	Perfluorodecanesulfonic acid (PFDS)
LC/MS/MS	Draft EPA Method 1633 Rev 4	Perfluorooctanesulfonamide (PFOSA)
LC/MS/MS	Draft EPA Method 1633 Rev 4	1*H*,1*H*, 2*H*, 2*H*-Perfluorohexane sulfonic acid (4:2FTS)
LC/MS/MS	Draft EPA Method 1633 Rev 4	Perfluoropentanesulfonic acid (PFPeS)
LC/MS/MS	Draft EPA Method 1633 Rev 4	Perfluorononanesulfonic acid (PFNS)
LC/MS/MS	Draft EPA Method 1633 Rev 4	4,8-Dioxa-3*H*-perfluorononanoic acid (ADONA)
LC/MS/MS	Draft EPA Method 1633 Rev 4	Hexafluoropropylene oxide dimer acid (HFPO-DA)
LC/MS/MS	Draft EPA Method 1633 Rev 4	9-Chlorohexadecafluoro-3-oxanonane-1-sulfonic acid (9Cl-PF3ONS)
LC/MS/MS	Draft EPA Method 1633 Rev 4	11-Chloroeicosafluoro-3-oxaundecane-1-sulfonic acid (11C1-PF3OUdS)

Biological Tissue		
Technology	**Method**	**Analyte**
LC/MS/MS	Draft EPA Method 1633 Rev 4	Perfluorododecanesulfonic acid (PFDoS)
LC/MS/MS	Draft EPA Method 1633 Rev 4	N-ethyl perfluorooctanesulfonamide (NEtFOSA)
LC/MS/MS	Draft EPA Method 1633 Rev 4	N-methyl perfluorooctanesulfonamide (NMeFOSA)
LC/MS/MS	Draft EPA Method 1633 Rev 4	N-ethyl perfluorooctanesulfonamidoethanol (NEtFOSE)
LC/MS/MS	Draft EPA Method 1633 Rev 4	N-methyl perfluorooctanesulfonamidoethanol (NMeFOSE)
LC/MS/MS	Draft EPA Method 1633 Rev 4	3-Perfluoropropyl propanoic acid (3:3FTCA)
LC/MS/MS	Draft EPA Method 1633 Rev 4	2*H*,2*H*,3*H*,3*H*-Perfluorooctanoic acid (5:3FTCA)
LC/MS/MS	Draft EPA Method 1633 Rev 4	3-Perfluoroheptyl propanoic acid (7:3FTCA)
LC/MS/MS	Draft EPA Method 1633 Rev 4	Perfluoro-3-methoxypropanoic acid (PFMPA)
LC/MS/MS	Draft EPA Method 1633 Rev 4	Perfluoro-4-methoxybutanoic acid (PFMBA)
LC/MS/MS	Draft EPA Method 1633 Rev 4	Nonafluoro-3,6-dioxaheptanoic acid (NFDHA)
LC/MS/MS	Draft EPA Method 1633 Rev 4	Perfluoro(2-ethoxyethane)sulfonic acid (PFEESA)
Preparation	**Method**	**Type**
Tissue Extraction for PFAS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	Sonication/Solvent Shake with SPE cleanup

Note:

1. This scope is formatted as part of a single document including Certificate of Accreditation No. L2468.
2. Eurofins Sacramento is a laboratory within Eurofins Environment Testing Northern California, LLC, a company within the Eurofins Environment Testing Group of Companies.



Jason Stine, Vice President

Title: Per- and Polyfluorinated Alkyl Substances (PFAS) in Water, Soils, Sediments and Tissue

[Method 537 (Modified), Method PFAS by LCMSMS Compliant with QSM Table B-15, Revision 5.3 and higher]

Approvals (Signature/Date):

Robert Hrabak — 01/27/2021 Technical Manager	Joe Schairer — 01/27/2021 Health & Safety Manager / Coordinator
Lisa Stafford — 01/27/2021 Quality Assurance Manager	Chris Williams — 01/27/2021 Laboratory Manager

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1. SCOPE AND APPLICATION

1.1. This procedure describes the analysis of water, soil, sediment, and tissue samples for the following compounds using liquid chromatography / tandem mass spectrometry (LC/MS/MS).

Table 1.1
PFAS Supported

Compound Name	Abbreviations	CAS #
Perfluoroalkylcarboxylic acids (PFCAs)		
Perfluoro-n-butanoic acid	PFBA	375-22-4
Perfluoro-n-pentanoic acid	PFPeA	2706-90-3
Perfluoro-n-hexanoic acid	PFHxA	307-24-4
Perfluoro-n-heptanoic acid	PFHpA	375-85-9
Perfluoro-n-octanoic acid	PFOA	335-67-1
Perfluoro-n-nonanoic acid	PFNA	375-95-1
Perfluoro-n-decanoic acid	PFDA	335-76-2
Perfluoro-n-undecanoic acid	PFUdA, PFUnA	2058-94-8
Perfluoro-n-dodecanoic acid	PFDoA	307-55-1
Perfluoro-n-tridecanoic acid	PFTrDA	72629-94-8
Perfluoro-n-tetradecanoic acid	PFTeDA, PFTA	376-06-7
Perfluorinated sulfonic acids (PFSAs)		
Perfluoro-1-butanesulfonic acid	PFBS	375-73-5
Perfluoro-1-pentanesulfonic acid	PFPeS	2706-91-4
Perfluoro-1-hexanesulfonic acid	PFHxS	355-46-4
Perfluoro-1-heptanesulfonic acid	PFHpS	375-92-8
Perfluoro-1-octanesulfonic acid	PFOS	1763-23-1
Perfluoro-nonanesulfonic acid	PFNS	68259-12-1
Perfluoro-1-decanesulfonic acid	PFDS	335-77-3
Perfluoro-1-dodecansulfonic acid	PFDoS	79780-39-5
Perfluorinated sulfonamides (FOSA)		
Perfluoro-1-octanesulfonamide	PFOSA, FOSA	754-91-6
N-ethylperfluoro-1-octanesulfonamide	Et-FOSA, N-Et-FOSA	4151-50-2
N-methylperfluoro-1-octanesulfonamide	Me-FOSA, N-Me-FOSA	31506-32-8
Perfluorinated sulfonamide ethanols (FOSE)		
2-(N-ethylperfluoro-1-octanesulfonamido) ethanol	Et-FOSE, N-Et-FOSE	1691-99-2
2-(N-methylperfluoro-1-octanesulfonamido) ethanol	Me-FOSE, N-Me-FOSE	24448-09-7
Perfluorinated sulfonamidoacetic acids (FOSAA)		
N-ethylperfluoro-1-octanesulfonamidoacetic acid	EtFOSAA	2991-50-6

Table 1.1 PFAS Supported		
Compound Name	**Abbreviations**	**CAS #**
	N-EtFOSAA	
N-methylperfluoro-1-octanesulfonamidoacetic acid	MeFOSAA, N-MeFOSAA	2355-31-9
Fluorotelomer sulfonates (FTS)		
1H,1H,2H,2H-perfluorohexane sulfonic acid *(4:2)*	4:2 FTS	757124-72-4
1H,1H,2H,2H-perfluorooctane sulfonic acid *(6:2)*	6:2 FTS	27619-97-2
1H,1H,2H,2H-perfluorodecane sulfonic acid *(8:2)*	8:2 FTS	39108-34-4
1H,1H,2H,2H-perfluorododecane sulfonic acid *(10:2)*	10:2 FTS	120226-60-0
Fluorinated Replacement Chemicals		
4,8-dioxa-3H-perfluorononanoic acid	DONA, ADONA(1)	919005-14-4
Perfluoro(2-propoxypropanoic) acid or Hexafluoropropylene oxide dimer acid	HFPO-DA, GenX	13252-13-6
F53B (reported as the summation of the following)	F53B	NA
9-Chlorohexadecafluoro-3-oxanonane-1-sulfonic acid	F53B major, 9Cl-PF3ONS	756426-58-1
11-Chloroeicosafluoro-3-oxaundecane-1-sulfonic acid	F5B minor, 11Cl-PF3OUdS	763051-92-9

***Note**: Abbreviations in parenthesis are the abbreviations listed in Method 537/537.1, where they differ from the abbreviation used by the laboratory's LIMS.*

(1) In some literature, the acronym ADONA refers to the ammonium salt, CAS 958445-44-8, and DONA refers to the parent acid. In Method 537.1, ADONA refers to the parent acid. DONA is the acronym present on the laboratory raw data.

1.2. Additional analytes supported by this method: The following analytes can be supported by this method under special request.

Table 1.2 Additional Compounds		
Compound Name	**Abbreviation**	**CAS #**
Perfluoroalkylcarboxylic acids (PFCAs)		
Perfluoro-n-hexadecanoic acid	PFHxDA	67905-19-5
Perfluoro-n-octadecanoic acid	PFODA	16517-11-6
Perfluorinated sulfonic acids (PFSAs)		
Perfluoro-4-ethylcyclohexanesulfonic acid	PFECHS	133201-07-7
Perfluoropropanesulfonic acid	PFPrS	423-41-6
Fluorotelomer carboxylic acids (FTCA)		
3-Perfluoropropylpropanoic acid	3:3 FTCA	356-02-5
3-Perfluoropentylpropanoic acid	5:3 FTCA	914637-49-3
3-Perfluoroheptylpropanoic acid	7:3 FTCA	812-70-4
2-Perfluorohexylethanoic acid	6:2 FTCA	53826-12-3
2-Perfluorooctylethanoic acid	8:2 FTCA, FOEA	27854-31-5

Table 1.2 Additional Compounds		
Compound Name	**Abbreviation**	**CAS #**
2-Perfluorodecylethanoic acid	10:2 FTCA	53826-13-4
Fluorotelomer unsaturated carboxylic acids (FTUCA)		
2H-Perfluoro-2-octenoic acid	6:2 FTUCA	70887-88-6
2H-Perfluoro-2-decenoic acid	8:2 FTUCA	70887-84-2
2H-Perfluoro-2-dodecenoic acid	10:2 FTUCA	70887-94-4
Short Chain		
Perfluoropropionic acid (PPF Acid)	PFPrA, PPF Acid	422-64-0
Perfluoro-3-methoxypropanoic acid (PFMPA)	PFECA F, PFMPA, PFMOPrA	377-73-1
Perfluoro-4-methoxybutanoic acid (PFMBA)	PFECA A, PFMBA, PFMOBA	863090-89-5
Nonafluoro-3,6-dioxaheptanoic acid (NFDHA)	PFECA B, NFDHA	151772-58-6
Perfluoro(2-ethoxyethane) sulfonic acid (PFEESA)	PES, PFEESA	113507-82-7
Difluoro(perfluoromethoxy)acetic acid	PFMOAA	674-13-5
Perfluoro-4-isopropoxybutanoic acid	PFECA G, PFPE-1	801212-59-9
Perfluoro-3,5,7,9-butaoxadecanoic acid	PFO4DA	39492-90-5
Perfluoro-3,5,7-trioxaoctanoic acid	PFO3OA	39492-89-2
Perfluoro-3,5-dioxahexanoic acid	PFO2HxA	39492-88-1
Perfluoro-3,6-dioxa-4-methyl-7-octene-1-sulfonic acid	PFESA BP 1 PS Acid	29311-67-9
Perfluoro-2-{[perfluoro-3-(perfluoroethoxy)-2-propanyl]oxy}ethanesulfonic acid	PFESA BP 2 Hydro-PS Acid	749836-20-2
Perfluoro-3,5,7,9,11-pentaoxadodecanoic acid	PFO5DA, PFO5DoA, TAF	39492-91-6
Perfluoro-2-(perfluoromethoxy)propanoic acid	PMPA	13140-29-9
2,3,3,3-Tetrafluoro-2-(pentafluoroethoxy)propanoic acid	PEPA	267239-61-2
3-(Methoxy)tetrafluoropropionic acid	MTP	93449-21-9
4-(2-carboxy-1,1,2,2-tetrafluoroethoxy)-2,2,3,3,4,5,5,5-octafluoro-pentanoic acid	R-EVE	2416366-22-6
2,2,3,3-Tetrafluoro-3-{[1,1,1,2,3,3-hexafluoro-3-(1,2,2-trifluoroethenoxy)propan-2-yl]oxy}propanoic acid	EVE Acid	69087-46-3
1,1,2,2,4,5,5,5-heptafluoro-3-oxapentanesulfonic acid	NVHOS	1132933-86-8(2)
2,2,3,3-Tetrafluoro-3-{[1,1,1,2,3,3-hexafluoro-3-(1,2,2,2-tetrafluoroethoxy)propan-2-yl]oxy}propanoic acid	Hydro-EVE Acid	773804-62-9
Ethanesulfonic acid, 1,1,2,2-tetrafluoro-2-[1,2,2,3,3-pentafluoro-1-(trifluoromethyl)propoxy]-	Byproduct 6, R-PDSCA	2416366-21-5

(2) The CAS Number listed for NVHOS is for the sodium salt. As of this writing, there isn't a CAS number for the parent acid. The laboratory performs analysis for the sulfonic acid.

1.3. The working range of the method is listed below. The linear range can be extended by diluting the extracts.

Table 1.3
Reporting Limits and Working Range

Matrix	Nominal Sample Size	Reporting Limit	Working Range
Water	250 mL	2.0 ng/L – 20 ng/L	2.0 ng/L - 800 ng/L
Soil/Sediment	5 g	0.2 µg/kg – 1.0 µg/kg	0.2 µg/kg - 50 µg/kg
Tissue	1 g	0.4 µg/kg – 2.0 µg/kg	0.4 µg/kg – 100 µg/kg

1.4. This procedure also includes direction for preparing samples to determine "Total Oxidizable Precursors", which may assist in improving understanding of potential PFAS environmental risk.

1.5. When undertaking projects for the Department of Defense (DoD) and/or the Department of Energy (DOE) the relevant criteria in QA Policy WS-PQA-021, "Federal Program Requirements" must be checked and incorporated.

1.6. Many jurisdictions have additional requirements for PFAS analysis, such as different holding times, preservation, or calibration criteria. These are detailed in the document WS-WI-0066, "Agency Specific Criteria for PFAS in Matrices Other Than Drinking Water".

2. SUMMARY OF METHOD

2.1. Water samples are extracted using a solid phase extraction (SPE) cartridge. PFAS are eluted from the cartridge with an [redacted] solution.

2.2. Soil/sediment/tissue samples are extracted with a KOH/methanol solution using sonication for 1 hour. The mixture is centrifuged and the solvent filtered.

2.3. The final 80:20 methanol:water extracts are analyzed by LC/MS/MS. PFAS are separated from other components on a C18 column with a solvent gradient program using [redacted] The mass spectrometer detector is operated in the electrospray (ESI) negative ion mode for the analysis of PFAS.

2.4. An isotope dilution technique is employed with this method for the compounds of interest. The isotope dilution analytes (IDA) consist of carbon-13 labeled analogs, oxygen-18 labeled analogs, or deuterated analogs of the compounds of interest, and they are fortified into the samples at the time of extraction. This technique allows for the correction for analytical bias encountered when analyzing more chemically complex environmental samples. The isotopically labeled compounds are chemically similar to the compounds of concern and are therefore affected by sample-related

interferences to the same extent as the compounds of concern. Compounds that do not have an identically labeled analog are quantitated by the IDA method using a closely related labeled analog.

2.5. Quantitation by the internal standard method is employed for the IDA analytes/recoveries. Peak response is measured as the area of the peak.

2.6. Samples for the "Total Oxidizable Precursor" assay (TOP) are analyzed in two phases – an aliquot is prepared and analyzed as a normal sample, and a second aliquot is subjected to [redacted] prior to solid phase extraction and analysis. The total perfluorocarboxylic acid value is determined for each aliquot, and the difference calculated.

3. DEFINITIONS

3.1. PFCAs: Perfluorocarboxylic acids

3.2. PFSAs: Perfluorinated sulfonic acids

3.3. FOSA: Perfluorinated sulfonamide

3.4. PFOA: Perfluorooctanoic acid

3.5. PFOS: Perfluorooctane sulfonic acid

3.6. PTFE: Polytetrafluoroethylene (e.g. Teflon®)

3.7. SPE: Solid phase extraction

3.8. PP: Polypropylene

3.9. PE: Polyethylene

3.10. HDPE: High density polyethylene

3.11. AFFF: Aqueous Film Forming Foam

3.12. IDA: Isotope dilution analyte

3.13. Further definitions of terms used in this SOP may be found in the glossary of the Laboratory Quality Assurance Manual (QAM).

4. INTERFERENCES

4.1. PFAS have been used in a wide variety of manufacturing processes, and laboratory supplies should be considered potentially contaminated until they have been tested and shown to be otherwise. The materials and supplies used during the method validation process have been tested and shown to be clean. These items are listed below in Section 6.

4.2. To avoid contamination of samples, standards are prepared in a ventilation hood in an area separate from where samples are extracted.

4.3. PTFE products can be a source of PFOA contamination. The use of PTFE in the procedure should be avoided or at least thoroughly tested before use. Polypropylene (PP) or polyethylene (PE, HDPE) products may be used in place of PTFE products to minimize PFOA contamination.

4.3.1. Standards and samples are injected from polypropylene autosampler vials with polypropylene screw caps once. Multiple injections may be performed on Primers when conditioning the instrument for analysis.

4.3.2. Random evaporation losses have been observed with the polypropylene caps causing high IDA recovery after the vial was punctured and sample re-injected. For this reason, it is best to inject standards and samples once in the analytical sequence.

4.3.3. Teflon-lined screw caps have detected PFAS at low concentrations. Repeated injection from the same Teflon-lined screw cap have detected PFNA at increasing concentration as each repeated injection was performed, therefore, it is best to use polypropylene screw caps.

4.4. Volumetric glassware and syringes are difficult to clean after being used for solutions containing high levels of PFOA. These items should be labeled for use only with similarly concentrated solutions or verified clean prior to re-use. To the extent possible, disposable labware is used.

4.5. Both branched and linear PFAS isomers can potentially be found in the environment. Linear and branched isomers are known to exist for PFOS, PFOA, PFHxS, PFBS, Et-FOSAA, and Me-FOSAA based upon the scientific literature. If multiple isomers are present for one of these PFAS they might be adjacent peaks that completely resolve or not, but usually with a deflection point resolved during peak integration. The later of these peaks matches the retention time of its labeled linear analog. In general, earlier peaks are the branched isomers and are not the result of peak splitting.

As of this writing, only PFOS, PFOA, PFHxS, Et-FOSAA and Me-FOSAA are commercially available as technical mixtures. These reference standards of the technical mixtures for these specific PFAS are used to ensure that all appropriate peaks are included during peak integration.

4.6. In an attempt to reduce PFOS bias, it is required that m/z 499>80 transition be used as the quantitation transition.

4.7. Per the Certificate of Analysis for labeled perfluorohexadecanoic acid ($13C_2$-PFHxDA) produced by Wellington Laboratories, the stock standard contains roughly 0.3% of native perfluorohexadecanoic acid. This equates to roughly 0.15 ng/L or 0.0075 ug/kg of perfluorohexadecanoic acid expected in all samples and blanks.

4.8. Aluminum foil should not be used for this analysis due to the potential interferences from the PFAS used as release agents.

5. SAFETY

Employees must abide by the policies and procedures in the Corporate Safety Manual, Sacramento Supplement to the CSM, and this document. All work must be stopped in the event of a known or potential compromise to the health or safety of an associate. The situation must be reported **immediately** to a supervisor, the EH&S Staff, or a senior manager.

5.1. Specific Safety Concerns

5.1.1. Preliminary toxicity studies indicate that PFAS could have significant toxic effects. In the interest of keeping exposure levels as low as reasonably achievable, PFAS and PFAS samples must be handled in the laboratory as hazardous and toxic chemicals.

5.1.2. Exercise caution when using syringes with attached filter disc assemblies. Application of excessive force has, upon occasion, caused a filter disc to burst during the process.

5.1.3. Laboratory procedures such as repetitive use of pipets, repetitive transferring of extracts and manipulation of filled separatory funnels and other glassware represent a significant potential for repetitive motion or other ergonomic injuries. Laboratory associates performing these procedures are in the best position to realize when they are at risk for these types of injuries. Whenever a situation is found in which an employee is performing the same repetitive motion, the employee shall immediately bring this to the attention of their supervisor, manager, or the EH&S staff. The task will be analyzed to determine a better means of accomplishing it.

5.1.4. Eye protection that satisfies ANSI Z87.1 (as per the Eurofins TestAmerica Safety Manual), laboratory coat, and nitrile gloves must be worn while handling samples, standards, solvents, and reagents. Disposable gloves that have been contaminated will be removed and discarded; other gloves will be cleaned immediately.

5.1.5. Perfluorocarboxylic acids are acids and are not compatible with strong bases.

5.1.6. The use of vacuum systems presents the risk of imploding glassware. All glassware used during vacuum operations must be thoroughly inspected prior to each use. Glass that is chipped, scratched, cracked, rubbed, or marred in any manner must not be used under vacuum. It must be removed from service and replaced.

5.1.7. Glass containers are not to be used for "tumbling" soil samples.

5.2. Primary Materials Used

The following is a list of the materials used in this method, which have a serious or significant hazard rating. NOTE: This list does not include all materials used in the method. The table contains a summary of the primary hazards listed in the SDS for each of the materials listed in the table. A complete list of materials used in the method can be found in the reagents and materials section. Employees must review the information in the SDS for each material before using it for the first time or when there are major changes to the SDS.

Material[1]	**Hazards**	**Exposure Limit[2]**	**Signs and Symptoms of Exposure**
Acetic Acid (3-2-1)	Corrosive Poison Flammable	10 ppm-TWA 15 ppm-STEL	Contact with concentrated solution may cause serious damage to the skin and eyes. Inhalation of concentrated vapors may cause serious damage to the lining of the nose, throat, and lungs. Breathing difficulties may occur.
[redacted] (3-1-0)	Corrosive Poison	50 ppm-TWA	Severe irritant. Effects from inhalation of dust or mist vary from mild irritation to serious damage to the upper respiratory tract. Symptoms may include sneezing, sore throat or runny nose. Contact with skin can cause irritation or severe burns and scarring with greater exposures. Causes irritation of eyes, and with greater exposures it can cause burns that may result in permanent damage, including blindness. Brief exposure to 5000 PPM can be fatal.
Hexane (3-3-1)	Flammable Irritant	50 ppm PEL	Inhalation of vapors irritates the respiratory tract. Overexposure may cause lightheadedness, nausea, headache, and blurred vision. Vapors may cause irritation to the skin and eyes.

Material[1]	Hazards	Exposure Limit[2]	Signs and Symptoms of Exposure
Hydrochloric Acid (3-0-1)	Corrosive Poison	5 ppm (Ceiling)	Can cause pain and severe burns upon inhalation, ingestion, eye or skin contact. Exposure to concentrated solutions may cause deep ulcerations to skin, permanent eye damage, circulatory failure and swallowing may be fatal.
Methanol (2-3-0)	Flammable Poison Irritant	200 ppm PEL 250 ppm STEL	A slight irritant to the mucous membranes. Toxic effects exerted upon nervous system, particularly the optic nerve. Symptoms of overexposure may include headache, drowsiness and dizziness. Methyl alcohol is a defatting agent and may cause skin to become dry and cracked. Skin absorption can occur; symptoms may parallel inhalation exposure. Irritant to the eyes.
Potassium Hydroxide (3-0-1)	Corrosive Poison	2 mg/m^3 (Ceiling)	Severe irritant. Can cause severe burns upon inhalation, ingestion, eye or skin contact. Exposure to concentrated solutions may cause severe scarring of tissue, blindness, and may be fatal if swallowed.
[redacted] (2-0-1-OX)	Oxidizer	None	Causes irritation to the respiratory tract. Symptoms may include coughing, shortness of breath. Causes irritation to skin and eyes. Symptoms include redness, itching, and pain. May cause dermatitis, burns, and moderate skin necrosis.
Sodium Hydroxide (3-0-1)	Corrosive Poison	2 mg/m^3 (Ceiling)	Severe irritant. Can cause severe burns upon inhalation, ingestion, eye or skin contact. Exposure to concentrated solutions may cause severe scarring of tissue, blindness, and may be fatal if swallowed.

(1) Always add acid to water to prevent violent reactions.
(2) Exposure limit refers to the OSHA regulatory exposure limit.

6. EQUIPMENT AND SUPPLIES

Due to the ubiquitous nature of PFAS, all disposable equipment (including, but not limited to vials, pipet tips, and SPE manifold parts) that directly contacts a sample or extract is subject to QC checks on a by-lot basis prior to use. At a minimum, the QC checks include either a rinse with DI water or an extraction with basic methanol to mimic the usage encountered during sample preparation. QC check data is kept on file for reference as needed

6.1. 15 mL polypropylene test tubes with polypropylene screw caps.

6.2. 50 mL graduated plastic centrifuge tubes.

6.3. 125 mL HDPE bottles with HDPE screw caps.

6.4. 250 mL HDPE bottles with HDPE screw caps. The average weight of the HDPE bottles with HDPE screw caps are calibrated once per year. The calibration is

performed by weighing 10 bottles with caps and dividing by 10 to get the average weight. The average weight is used in section (11.3.5.1 Step 4).

6.5. Analytical balance capable of accurately weighing to the nearest 0.0001g, and checked for accuracy each day it is used in accordance with WS-QA-0041.

6.6. Extract concentrator or nitrogen manifold with water bath heating to 65°C.

6.7. Syringe filter, Millipore Millex-HV 0.45 um, or equivalent. Do not use PTFE type filters.

6.8. 300 µL autosampler vials, polypropylene, with polypropylene screw caps, Waters PN 1860004112, or equivalent.

6.9. SPE columns

6.9.1. [redacted] or equivalent for the TOP assay.

6.9.2. [redacted] or equivalent. This cartridge incorporates a graphitized carbon.

6.10. Graphitized carbon (Envi-Carb™ or equivalent).

6.11. Vacuum manifold for Solid Phase Extraction (SPE).

6.12. Miscellaneous laboratory apparatus (beakers, test tubes, volumetric flasks, pipettes, etc.). These should be disposable where possible, or marked and segregated for high-level versus low-level use.

6.13. Water bath: Heated with concentric ring cover capable of temperature control (±5°C) up to 95°C. The bath must be used in a fume hood.

6.14. Plastic tub for an ice bath, AKRO-N.S.T. part No. 35-180 or equivalent.

6.15. pH indicator paper, wide range.

6.16. Bottle rotating apparatus for soil extractions.

6.17. Glass fiber filter, Whatman GF/F, catalog number 1825 090 or equivalent. Filters, if used, are QC checked by lot by extraction with basic methanol. The filters must be clean to less than ½ RL before they can be used, and the data kept on file.

6.18. Liquid Chromatography/Tandem Mass Spectrometer (LC/MS/MS) –The instrument described below, or equivalent, may be used for this method. The HPLC is equipped

with a refrigerated autosampler, an injection valve, and a pump capable of variable flow rate. The use of a column heater is required to maintain a stable temperature throughout the analytical run. Data is processed using Chrom Peak Review, version 2.3 or equivalent. The MS/MS is capable of running in the NI-ESI mode at the recommended flow rate with a minimum of 10 scans per peak.

6.18.1. [redacted] LC/MS/MS

This system consists of a Shimadzu HPLC interfaced with a [redacted] Triple Quad MS, or equivalent. The instrument control and data acquisition software is [redacted] version 1.6.3 or equivalent.

6.18.1.1. [redacted] HPLC equipped with [redacted] pumps and one DGU-20 degassing unit or equivalent.

6.18.1.2. [redacted]

6.18.1.3. PFAS Isolator column, [redacted] This is plumbed between the UPLC pumps and autosampler valve to minimize PFAS background from the UPLC solvent lines and filters.

6.19. Preventive and routine maintenance is described in the table below

Table 6.19
HPLC/MS/MS Preventative Maintenance

As Needed:	**Daily (When in use)**
Change pump seals. Change in-line filters in autosampler (HPLC). Check/replace in-line frit if excessive pressure or poor performance. Replace column if no change following in-line frit change. Clean corona needle. Replace sample inlet tube in APCI (10.1 cm). Replace fused silica tube in ESI interface. Clean lenses. Clean skimmer. Ballast rough pump 30 minutes. Create all eluents in Reagent module, label eluent containers with TALS label and place 2nd label into maintenance log when put into use.	Check solvent reservoirs for sufficient level of solvent. Verify that pump is primed, operating pulse free. Check needle wash reservoir for sufficient solvent. Verify capillary heater temperature functioning. Verify vaporizer heater temperature. Verify rough pump oil levels. Verify turbo-pump functioning. Verify nitrogen pressure for auxiliary and sheath gasses. Verify that corona and multiplier are functioning.
Semi-Annually	**Annually**

Table 6.19 HPLC/MS/MS Preventative Maintenance	
Replace rough-pump oil (4-6 months). Replace oil mist and odor elements. Replace activated alumina filter if applicable	Vacuum system components including fans and fan covers. Clean/replace fan filters, if applicable.

7. REAGENTS AND STANDARDS

7.1. Reagent grade chemicals shall be used in all tests whenever available. Unless otherwise indicated, it is intended that all reagents shall conform to the specifications of the Committee on the Analytical Reagents of the American Chemical Society, where such specifications are available. Other grades may be used, provided it is first ascertained that the reagent is of sufficiently high purity to permit its use without lessening the accuracy of the determination.

7.1.1. Acetic acid, glacial

7.1.2. [redacted] This solution has volatile components, thus it should be replaced every 7 days or sooner.

7.1.3. Ammonium hydroxide (NH4OH), 0.3% in methanol: Prepared by diluting 12 mL of ammonium hydroxide into 4L of methanol.

7.1.4. Hexane

7.1.5. Hydrochloric acid (HCl), 2.0 M solution in water

7.1.6. Hydrochloric acid (HCl), concentrated, reagent grade

7.1.7. Methanol

7.1.8. [redacted]

7.1.9. [redacted], reagent grade

7.1.10. Ottawa Sand (blank matrix for solid samples)

7.1.11. Vegetable Oil, Crisco® brand (blank matrix for tissue samples) – replace within one year of opening.

7.1.12. Sodium hydroxide (NaOH), 0.1 N, in water: Prepared by diluting 400 mL of 1N NaOH into 3.6L of water for a total volume of 4 L.

7.1.13. Sodium hydroxide (NaOH), 10 N, reagent grade

7.1.14. Water, Nanopure or Millipore, must be free of interference and target analytes.

7.1.15. Nitrogen, Ultra High Purity, used for the ESI interface, collision cell, and concentration of extracts.

7.1.16. Air, Ultra-Pure, used for vacuum and source gas.

7.1.17. 30:70 methanol:water (v/v), prepared by diluting 30 mL methanol with 70 mL HPLC reagent water or equivalent volume in respect to the ratio.

7.2. Standards

7.2.1. PFAS are purchased as high purity solids (96% or greater) or as certified solutions. Standard materials are verified compared to a second source material at the time of initial calibration. The solid stock material is stored at room temperature or as specified by the manufacturer or vendor.

7.2.1.1. Per the Certificate of Analysis for labeled perfluorohexadecanoic acid ($13C_2$-PFHxDA) produced by Wellington Laboratories, the stock standard contains roughly 0.3% of native perfluorohexadecanoic acid. This equates to roughly 0.15 ng/L or 0.0075 µg/kg of perfluorohexadecanoic acid expected in all samples and blanks.

7.2.2. As of this writing, only PFOS, PFOA, PFHxS, Et-FOSAA and Me-FOSAA are commercially available as technical mixtures. These reference standards of the technical mixtures for these specific PFAS are used to ensure that all appropriate peaks are included during peak integration.

7.2.3. If solid material is used for preparing a standard, stock standard solutions are prepared from the solids and are stored at 0 - 6°C. Stock standard solutions should be brought to room temperature before using. Standards are monitored for signs of degradation or evaporation. Standard solutions must be replaced at least annually from the date of preparation.

7.2.4. PFBS, PFHxS, PFHpS, PFOS, PFDS, and many other PFAS are not available in the acid form, but rather as their corresponding salts, such as sodium or potassium. The standards are prepared and corrected for their salt content according to the equation below.

$$Mass_{acid} = Measured\ Mass_{salt} \times MW_{acid} / MW_{salt}$$

Where: MW_{acid} is the molecular weight of PFAA

MW_{salt} is the molecular weight of the purchased salt.

For example, the molecular weight of PFOS is 500.1295 and the molecular weight of NaPFOS is 523.1193. Therefore, the amount of NaPFOS used must be adjusted by a factor of 0.956.

7.2.5. For the primary source calibration solutions, individual solutions for each PFAS (both native and isotopically labelled) are purchased from Wellington Laboratories, or other reputable vendors, and are predominantly at a concentration of 50 ug/mL in basic methanol. In the case of the sulfonic compounds, the concentration is 50ug/mL of the alkali (potassium or sodium) salt. The laboratory uses the concentration of the acid form when determining the concentration of individual sulfonic acids in solution (See Section 7.2.4 above).

7.2.6. While PFAS standards commercially purchased are supplied in glass ampoules, all subsequent transfers or dilutions performed by the analyst must be prepared and stored in polypropylene or HDPE containers. Vortex all standard solutions prior to removing aliquots.

7.3. PFC IM/LCS (LCS/Matrix PFC Spike Solution), 20 ng/mL

250 ml of a mixed stock solution at a nominal concentration of 0.02 ug/mL in methanol (see note above) is prepared from the individual solutions, using 100 uL of each individual solution. This mixed stock is used as the spiking solution during sample preparation, as well an intermediate for the calibration curve, using the recipe below:

Table 7.3
PFC IM/LCS Solution Recipe
The solutions below are combined and diluted to 250 mL in methanol

Analyte	Stock Conc. (µg/mL)	Aliquot (mL)	PFC IM/LCS Conc. (µg/mL)	Analyte	Stock Conc. (µg/mL)	Aliquot (mL)	PFC IM/LCS Conc. (µg/mL)
PFBA	50	0.1	0.02	EtFOSAA	50	0.1	0.02
PFPeA	50	0.1	0.02	MeFOSAA	50	0.1	0.02
PFHxA	50	0.1	0.02	4:2 FTS	46.7	0.1	0.01868
PFHpA	50	0.1	0.02	6:2 FTS	47.4	0.1	0.01896
PFOA	50	0.1	0.02	8:2 FTS	47.9	0.1	0.01916
PFNA	50	0.1	0.02	10:2 FTS	48.2	0.1	0.01928
PFDA	50	0.1	0.02	HFPO-DA	50	0.1	0.02
PFUdA	50	0.1	0.02	9CI-PF3ONS	46.6	0.1	0.01864
PFDoA	50	0.1	0.02	11CI-PF3OUdS	47.1	0.1	0.01884
PFTrDA	50	0.1	0.02	4,8-dioxa-3H-PFNA (DONA)	47.1	0.1	0.01884

Table 7.3
PFC IM/LCS Solution Recipe
The solutions below are combined and diluted to 250 mL in methanol

Analyte	Stock Conc. (µg/mL)	Aliquot (mL)	PFC IM/LCS Conc. (µg/mL)	Analyte	Stock Conc. (µg/mL)	Aliquot (mL)	PFC IM/LCS Conc. (µg/mL)
PFTeDA	50	0.1	0.02	3:3 FTCA	50	0.1	0.02
PFHxDA	50	0.1	0.02	5:3 FTCA	50	0.1	0.02
PFODA	50	0.1	0.02	7:3 FTCA	50	0.1	0.02
PFBS	44.2	0.1	0.01768	6:2 FTCA	50	0.1	0.02
PFPeS	46.9	0.1	0.01876	8:2 FTCA	50	0.1	0.02
PFHxS	45.5	0.1	0.0182	10:2 FTCA	50	0.1	0.02
PFHpS	47.6	0.1	0.01904	6:2 FTUCA	50	0.1	0.02
PFOS	46.2	0.1	0.01856	8:2 FTUCA	50	0.1	0.02
PFNS	48	0.1	0.0192	10:2 FTUCA	50	0.1	0.02
PFDS	48.2	0.1	0.01928	PFECHS	46.1	0.1	0.01844
PFDoS	48.4	0.1	0.01936	PFPrA	48.5	0.1	0.0194
FOSA	50	0.1	0.02	PFPrS	45.8	0.1	0.01832
Et-FOSA	50	0.1	0.02	PFECA F	50	0.1	0.02
Me-FOSA	50	0.1	0.02	PFECA A	50	0.1	0.02
Et-FOSE	50	0.1	0.02	PFECA B	50	0.1	0.02
Me-FOSE	50	0.1	0.02	PES	44.5	0.1	0.0178

7.4. PFC Expanded Analyte Intermediate (PFC3SP IM)

250 ml of a mixed stock solution at a nominal concentration of 0.5 ug/mL in methanol (see note above) is prepared from the individual solutions, using 50 uL of each individual solution, as denoted in the recipe below. This mixed stock is used as an intermediate for the calibration curve and for the PFC Expanded Analyte LCS (Section 7.4.1).

Table 7.4
PFC Expanded Analyte IM Solution Recipe
The solutions below are combined and diluted to 250 mL in methanol

Analyte	Stock Conc. (µg/mL)	Aliquot (mL)	PFC3SP IM Conc. (µg/mL)	Analyte	Stock Conc. (µg/mL)	Aliquot (mL)	PFC3SP IM Conc. (µg/mL)
Hydro-EVE Acid	1000	0.05	0.5	PFO3OA	1000	0.05	0.5
Hydro-PS Acid	1000	0.05	0.5	PFO4DA	1000	0.05	0.5
MTP	1000	0.05	0.5	PMPA	1000	0.05	0.5
NVHOS	1000	0.05	0.5	PS Acid	1000	0.05	0.5
PEPA	1000	0.05	0.5	R-EVE	1000	0.05	0.5
PFECA G	1000	0.05	0.5	R-PSDCA	1000	0.05	0.5

Table 7.4
PFC Expanded Analyte IM Solution Recipe
The solutions below are combined and diluted to 250 mL in methanol

Analyte	Stock Conc. (µg/mL)	Aliquot (mL)	PFC3SP IM Conc. (µg/mL)	Analyte	Stock Conc. (µg/mL)	Aliquot (mL)	PFC3SP IM Conc. (µg/mL)
PFMOAA	1000	0.05	0.5	TAF (PFO5DoA)	1000	0.05	0.5
PFO2HxA	1000	0.05	0.5	EVE Acid	1000	0.05	0.5

7.4.1. PFC Expanded Analyte IM/LCS Solution (PFC3SP)

The expanded analyte spike solution is made by diluting 10 mL of the Expanded Analyte Intermediate (Section 7.4, above) to 250 mL in methanol:

Table 7.4.1
PFC Expanded Analyte Spiking Solution Composition
(following dilution of 10 mL IM to 250 mL MeOH)

Analyte	PFC3SP (ug/mL)	Analyte	PFC3SP (ug/mL)
Hydro-EVE Acid	0.02	PFO3OA	0.02
Hydro-PS Acid	0.02	PFO4DA	0.02
MTP	0.02	PMPA	0.02
NVHOS	0.02	PS Acid	0.02
PEPA	0.02	R-EVE	0.02
PFECA G	0.02	R-PSDCA	0.02
PFMOAA	0.02	TAF (PFO5DoA)	0.02
PFO2HxA	0.02	EVE Acid	0.02

7.5. PFC Isotope Dilution Analyte Solution (Extracted Internal Standards), 25 ng/mL

The PFC-IDA solution is added to all samples prior to extraction and used as an intermediate solution for preparation of the instrument calibration standards. 200 mL of the solution at a nominal concentration of 0.025 ug/mL (25 ng/mL) is prepared from the individual solutions described in Section 7.2.5. using the recipe below:

Table 7.5
PFC-IDA Recipe
The solutions below are combined and diluted to 200 mL with Methanol.

IDA	Stock Conc. (µg/mL)	Aliquot (mL)	IDA Mix Conc. (µg/mL)	IDA	Stock Conc. (µg/mL)	Aliquot (mL)	IDA Mix Conc. (µg/mL)
13C4-PFBA	50	0.10	0.025	d3-MeFOSAA	50	0.10	0.025
13C5-PFPeA	50	0.10	0.025	M2-4:2FTS	46.7	0.10	0.02335
13C2-PFHxA	50	0.10	0.025	M2-6:2FTS	47.5	0.10	0.02375
13C4-PFHpA	50	0.10	0.025	M2-8:2FTS	47.9	0.10	0.02395

Table 7.5
PFC-IDA Recipe
The solutions below are combined and diluted to 200 mL with Methanol.

IDA	Stock Conc. (µg/mL)	Aliquot (mL)	IDA Mix Conc. (µg/mL)	IDA	Stock Conc. (µg/mL)	Aliquot (mL)	IDA Mix Conc. (µg/mL)
13C4-PFOA	50	0.10	0.025	M2 10:2 FTS	47.36	0.10	0.02368
13C5-PFNA	50	0.10	0.025	d5-EtFOSA	50	0.10	0.025
13C2-PFDA	50	0.10	0.025	d3-MeFOSA	50	0.10	0.025
13C2-PFUdA	50	0.10	0.025	d9-Et-FOSE	50	0.10	0.025
13C2-PFDoA	50	0.10	0.025	d7-Me-FOSE	50	0.10	0.025
18O2-PFHxS	47.3	0.10	0.02365	13C3-HFPO-DA	50	0.10	0.025
13C4-PFOS	47.8	0.10	0.0239	13C-6:2 FTCA	50	0.10	0.025
13C3-PFBS	46.5	0.10	0.02325	13C-8:2 FTCA	50	0.10	0.025
13C2-PFTeDA	50	0.10	0.025	13C-10:2 FTCA	50	0.10	0.025
13C2-PFHxDA	50	0.10	0.025	13C-6:2 FTUCA	50	0.10	0.025
13C8-FOSA	50	0.10	0.025	13C-8:2 FTUCA	50	0.10	0.025
d5-EtFOSAA	50	0.10	0.025	13C-10:2 FTUCA	50	0.10	0.025

7.6. Internal Standard Solution, 25 ng/mL

The PFC_IS solution is added to all extracts prior to analysis and used as an intermediate solution for preparation of the instrument calibration standards. This solution is prepared by diluting 100 uL of a 50 ug/mL solution containing 13C2-PFOA to 200 mL in methanol, for a final concentration of 0.025 ug/L (25 ng/mL).

7.7. Calibration Standards

Calibration solutions are prepared from the standards described in Sections 7.3, 7.4.1, 7.5, and 7.6, above. For each level, a 100 mL volumetric flask is filled with 20 mL of water, and methanol added. The appropriate amount (see table below) of the solutions are added, and then the flask is filled to the mark with methanol to achieve the ratio of 80% methanol to 20% water, v/v.

Table 7.7
Calibration Solution Recipe

PFAS Standards	Volume (mL) to add in 100 mL FV						
	CS-1	CS-2	CS-3	CS-4	CS-5	CS-6	CS-7
PFC IM/LCS (0.02 µg/mL)	0.125	0.25	1.25	5	12.5	25	50
PFC3SP (0.02 ug/mL)	0.125	0.25	1.25	5	12.5	25	50
IDA Mix (0.025µg/mL)	5.0	5.0	5.0	5.0	5.0	5.0	5.0
IS Mix (0.025 µg/mL)	5.0	5.0	5.0	5.0	5.0	5.0	5.0

7.7.1. Initial Calibration (ICAL) Levels (ng/mL)

Table 7.7.1
Initial Calibration Solution Concentrations (ng/mL)

Compound	CS-1	CS-2	CS-3	CS-4	CS-5	CS-6	CS-7
PFBA	0.025	0.05	0.25	1	2.5	5	10
PFPeA	0.025	0.05	0.25	1	2.5	5	10
PFHxA	0.025	0.05	0.25	1	2.5	5	10
PFHpA	0.025	0.05	0.25	1	2.5	5	10
PFOA	0.025	0.05	0.25	1	2.5	5	10
PFNA	0.025	0.05	0.25	1	2.5	5	10
PFDA	0.025	0.05	0.25	1	2.5	5	10
PFUdA	0.025	0.05	0.25	1	2.5	5	10
PFDoA	0.025	0.05	0.25	1	2.5	5	10
PFTrDA	0.025	0.05	0.25	1	2.5	5	10
PFTeDA	0.025	0.05	0.25	1	2.5	5	10
PFHxDA	0.025	0.05	0.25	1	2.5	5	10
PFODA	0.025	0.05	0.25	1	2.5	5	10
PFBS	0.0221	0.0442	0.221	0.0884	2.21	4.42	0.884
PFPeS	0.02345	0.0469	0.2345	0.0938	2.345	4.69	0.938
PFHxS*	0.02275	0.0455	0.2275	0.91	2.275	4.55	9.1
PFHpS	0.0238	0.0476	0.238	0.952	2.38	4.76	9.52
PFOS*	0.0232	0.0464	0.232	0.928	2.32	4.64	9.28
PFNS	0.024	0.048	0.24	0.96	2.4	4.8	9.6
PFDS	0.0241	0.0482	0.241	0.0964	2.41	4.82	0.964
PFDoS	0.0242	0.0484	0.242	0.0968	2.42	4.84	0.968
FOSA	0.025	0.05	0.25	1	2.5	5	10
Et-FOSA	0.025	0.05	0.25	1	2.5	5	10
Me-FOSA	0.025	0.05	0.25	1	2.5	5	10
Et-FOSE	0.025	0.05	0.25	1	2.5	5	10
Me-FOSE	0.025	0.05	0.25	1	2.5	5	10
EtFOSAA*	0.025	0.05	0.25	1	2.5	5	10
MeFOSAA*	0.025	0.05	0.25	1	2.5	5	10
4:2 FTS	0.02335	0.0467	0.2335	0.934	2.335	4.67	9.34
6:2 FTS	0.0237	0.0474	0.237	0.948	2.37	4.74	9.48
8:2 FTS	0.02395	0.0479	0.2395	0.958	2.395	4.79	9.58
10:2 FTS	0.0241	0.0482	0.241	0.964	2.41	4.82	9.64
HFPO-DA	0.025	0.05	0.25	1	2.5	5	10
9Cl-PF3ONS	0.0233	0.0466	0.233	0.932	2.33	4.66	9.32
11Cl-PF3OUdS	0.02355	0.0471	0.2355	0.0942	2.355	4.71	9.42
DONA	0.02355	0.0471	0.2355	0.0942	2.355	4.71	0.942
Hydro-EVE Acid	0.025	0.05	0.25	1	2.5	5	10
Hydro-PS Acid	0.025	0.05	0.25	1	2.5	5	10
MTP	0.025	0.05	0.25	1	2.5	5	10
NVHOS	0.025	0.05	0.25	1	2.5	5	10
PEPA	0.025	0.05	0.25	1	2.5	5	10
PFECA G	0.025	0.05	0.25	1	2.5	5	10
PFMOAA	0.025	0.05	0.25	1	2.5	5	10
PFO2HxA	0.025	0.05	0.25	1	2.5	5	10
PFO3OA	0.025	0.05	0.25	1	2.5	5	10
PFO4DA	0.025	0.05	0.25	1	2.5	5	10
PMPA	0.025	0.05	0.25	1	2.5	5	10

Table 7.7.1
Initial Calibration Solution Concentrations (ng/mL)

Compound	CS-1	CS-2	CS-3	CS-4	CS-5	CS-6	CS-7
PS Acid	0.025	0.05	0.25	1	2.5	5	10
EVE Acid	0.025	0.05	0.25	1	2.5	5	10
R-EVE	0.025	0.05	0.25	1	2.5	5	10
R-PSDCA	0.025	0.05	0.25	1	2.5	5	10
TAF	0.025	0.05	0.25	1	2.5	5	10
3:3 FTCA	0.025	0.05	0.25	1	2.5	5	10
5:3 FTCA	0.025	0.05	0.25	1	2.5	5	10
7:3 FTCA	0.025	0.05	0.25	1	2.5	5	10
6:2 FTCA	0.025	0.05	0.25	1	2.5	5	10
8:2 FTCA	0.025	0.05	0.25	1	2.5	5	10
10:2 FTCA	0.025	0.05	0.25	1	2.5	5	10
6:2 FTUCA	0.025	0.05	0.25	1	2.5	5	10
8:2 FTUCA	0.025	0.05	0.25	1	2.5	5	10
10:2 FTUCA	0.025	0.05	0.25	1	2.5	5	10
PFECHS	0.02305	0.0461	0.2305	0.922	2.305	4.61	9.22
PFPrA	0.02425	0.0485	0.2425	0.97	2.425	4.85	9.7
PFPrS	0.0229	0.0458	0.229	0.916	2.29	4.58	9.16
PFECA F	0.025	0.05	0.25	1	2.5	5	10
PFECA A	0.025	0.05	0.25	1	2.5	5	10
PFECA B	0.025	0.05	0.25	1	2.5	5	10
PES	0.0215	0.043	0.215	0.86	2.15	4.3	8.9
Labeled Isotope Dilution Analytes (IDA)							
13C4-PFBA	1.25	1.25	1.25	1.25	1.25	1.25	1.25
13C5-PFPeA	1.25	1.25	1.25	1.25	1.25	1.25	1.25
13C2-PFHxA	1.25	1.25	1.25	1.25	1.25	1.25	1.25
13C4-PFHpA	1.25	1.25	1.25	1.25	1.25	1.25	1.25
13C4-PFOA	1.25	1.25	1.25	1.25	1.25	1.25	1.25
13C5-PFNA	1.25	1.25	1.25	1.25	1.25	1.25	1.25
13C2-PFDA	1.25	1.25	1.25	1.25	1.25	1.25	1.25
13C2-PFUdA	1.25	1.25	1.25	1.25	1.25	1.25	1.25
13C2-PFDoA	1.25	1.25	1.25	1.25	1.25	1.25	1.25
18O2-PFHxS	1.1825	1.1825	1.1825	1.1825	1.1825	1.1825	1.1825
13C4-PFOS	1.195	1.195	1.195	1.195	1.195	1.195	1.195
13C3-PFBS	1.1625	1.1625	1.1625	1.1625	1.1625	1.1625	1.1625
13C2-PFTeDA	1.25	1.25	1.25	1.25	1.25	1.25	1.25
13C2-PFHxDA	1.25	1.25	1.25	1.25	1.25	1.25	1.25
13C8-FOSA	1.25	1.25	1.25	1.25	1.25	1.25	1.25
d5-EtFOSAA	1.25	1.25	1.25	1.25	1.25	1.25	1.25
d3-MeFOSAA	1.25	1.25	1.25	1.25	1.25	1.25	1.25
M2-4:2FTS ǂ	1.1675	1.1675	1.1675	1.1675	1.1675	1.1675	1.1675
M2-6:2FTS	1.1875	1.1875	1.1875	1.1875	1.1875	1.1875	1.1875
M2-8:2FTS	1.1975	1.1975	1.1975	1.1975	1.1975	1.1975	1.1975
M2 10:2 FTS	1.184	1.184	1.184	1.184	1.184	1.184	1.184
d5-EtFOSA	1.25	1.25	1.25	1.25	1.25	1.25	1.25
d3-MeFOSA	1.25	1.25	1.25	1.25	1.25	1.25	1.25
d9-Et-FOSE	1.25	1.25	1.25	1.25	1.25	1.25	1.25

Table 7.7.1
Initial Calibration Solution Concentrations (ng/mL)

Compound	CS-1	CS-2	CS-3	CS-4	CS-5	CS-6	CS-7
d7-Me-FOSE	1.25	1.25	1.25	1.25	1.25	1.25	1.25
13C3-HFPO-DA	1.25	1.25	1.25	1.25	1.25	1.25	1.25
13C-6:2 FTCA	1.25	1.25	1.25	1.25	1.25	1.25	1.25
13C-8:2 FTCA	1.25	1.25	1.25	1.25	1.25	1.25	1.25
13C-10:2 FTCA	1.25	1.25	1.25	1.25	1.25	1.25	1.25
13C-6:2 FTUCA	1.25	1.25	1.25	1.25	1.25	1.25	1.25
13C-8:2 FTUCA	1.25	1.25	1.25	1.25	1.25	1.25	1.25
13C-10:2 FTUCA	1.25	1.25	1.25	1.25	1.25	1.25	1.25
Internal Standard (IS)							
13C2-PFOA	1.25	1.25	1.25	1.25	1.25	1.25	1.25

** Both branched and linear isomers are used.*

ǂ - This compound is used as a reverse surrogate for the TOP analysis.

***Note**: Sample extracts are in 80% MeOH/H_2O.*

***Note**: The above calibration limits are provided only as an example. The actual ICAL level used for each analytical batch will depend upon the LOQ requirements of the program.*

7.7.2. A technical (qualitative) grade PFOA standard which contains both linear and branched isomers is used as a retention time (RT) marker. This is used to integrate the total response for both linear and branched isomers of PFOA in environmental samples while relying on the initial calibration with the linear isomer quantitative standard. This technical (qualitative) grade PFOA standard is analyzed initially, after every initial calibration or when significant changes are made to the HPLC parameters.

7.7.2.1. Attach this document to the ICV from the associated ICAL by scanning the document and associating it to the file as a document type of High Res MS Tune in TALS. Use the following naming convention: "_TFOA_Instrument_Date." Example: _TFOA_A10_15Mar2019.

7.8. Initial Calibration Verification Standard (ICV)

7.8.1. The ICV is prepared from commercially available mixed solutions (the PFC-MXB mixture from Wellington) augmented by individual stock solutions for those components not present in the commercial mixture. When available, individual stock solutions are purchased from a vendor other than Wellington laboratories. If not available, a second lot from Wellington is sourced, and if that is not available, a second laboratory chemist will prepare the intermediate mixed solution for the ICV. Currently, the commercially available mixture contains the following

compounds at the listed concentrations in methanol:

Table 7.8.1
PFC-MXB composition

Analyte	Stock Conc. (µg/mL)	Analyte	Stock Conc. (µg/mL)
PFHxA	2	PFBS	2
PFHpA	2	PFHxS	2
PFOA	2	PFOS	2
PFNA	2	EtFOSAA	2
PFDA	2	MeFOSAA	2
PFUdA	2	HFPO-DA	2
PFDoA	2	9CI-PF3ONS	2
PFTrDA	2	11CI-PF3OUdS	2
PFTeDA	2	4,8-dioxa-3H- PFNA (DONA)	2

7.8.2. ICV-IM: 10 mL of a combined stock for the analytes listed below is created, using the recipe below, and methanol as the final solvent:

Table 7.8.2
ICV-IM Recipe

Analyte	Stock Conc. (µg/mL)	Aliquot (mL)	ICV-IM Conc. (µg/mL)	Analyte	Stock Conc. (µg/mL)	Aliquot (mL)	ICV-IM Conc. (µg/mL)
PFBA	50	0.1	0.5	FOSA	50	0.1	0.5
PFPeA	50	0.1	0.5	Et-FOSA	50	0.1	0.5
PFHxDA	50	0.1	0.5	Me-FOSA	50	0.1	0.5
PFODA	50	0.1	0.5	Et-FOSE	50	0.1	0.5
PFPeS	46.9	0.1	0.469	Me-FOSE	50	0.1	0.5
PFHpS	47.6	0.1	0.476	4:2 FTS	46.7	0.1	0.467
PFNS	48	0.1	0.480	6:2 FTS	47.4	0.1	0.474
PFDS	48.2	0.1	0.482	8:2 FTS	47.9	0.1	0.479
PFDoS	48.4	0.1	0.484	10:2 FTS	48.2	0.1	0.482

7.8.3. ICV-IM2: 10 mL of a combined stock for the analytes listed below is created, using the recipe below, and methanol as the final solvent:

Table 7.8.3
ICV-IM2 Recipe

Analyte	Stock Conc. (µg/mL)	Aliquot (mL)	ICV-IM Conc. (µg/mL)	Analyte	Stock Conc. (µg/mL)	Aliquot (mL)	ICV-IM Conc. (µg/mL)
3:3 FTCA	50	0.1	0.5	10:2 FTUCA	50	0.1	0.5
5:3 FTCA	50	0.1	0.5	PES	44.5	0.1	0.445
7:3 FTCA	50	0.1	0.5	PFECA F	50	0.1	0.5
6:2 FTCA	50	0.1	0.5	PFECA A	50	0.1	0.5
8:2 FTCA	50	0.1	0.5	PFECA B	50	0.1	0.5
10:2 FTCA	50	0.1	0.5	PFECHS	46.1	0.1	0.461
6:2 FTUCA	50	0.1	0.5	PFPrS	45.8	0.1	0.458
8:2 FTUCA	50	0.1	0.5	PFPrA (PPF Acid)	97	0.05	0.458

7.8.4. ICV-IM3: 10 mL of a combined stock for the analytes listed below is created, using the recipe below, and methanol as the final solvent:

Table 7.8.4
ICV-IM3 Recipe

Analyte	Stock Conc. (µg/mL)	Aliquot (mL)	ICV-IM Conc. (µg/mL)	Analyte	Stock Conc. (µg/mL)	Aliquot (mL)	ICV-IM Conc. (µg/mL)
DFSA	1000	0.025	0.05	PFMOAA	1000	0.025	0.05
EVE Acid	1000	0.025	0.05	PFO2HxA	1000	0.025	0.05
Hydro-EVE Acid	1000	0.025	0.05	PFO3OA	1000	0.025	0.05
Hydrolyzed PSDA	1000	0.025	0.05	PFO4DA	1000	0.025	0.05
Hydro-PS Acid	1000	0.025	0.05	PMPA	1000	0.025	0.05
MMF	1000	0.025	0.05	PS Acid	1000	0.025	0.05
MTP	1000	0.025	0.05	R-EVE	1000	0.025	0.05
NVHOS	1000	0.025	0.05	R-PSDA	1000	0.025	0.05
PEPA	1000	0.025	0.05	R-PSDCA	1000	0.025	0.05
PFECA G	1000	0.025	0.05	TAF	1000	0.025	0.05

7.8.5. Finally, the ICV solution is created, at a nominal concentration of 2.5 ng/mL for target analytes (sulfonic acids slightly less), and the same concentrations as the calibration solutions for IS and IDA, by filling a 100 mL flask with 20 mL of water, then adding methanol. After adding the solutions below, the contents are diluted to the mark with methanol:

Table 7.8.5
ICV Recipe

PFAS Standards	Volume (mL) to add in 100 mL FV
Commercial PFAS Mix	0.125
Combined ICV IM Mix (0.5 ug/mL)	0.50
Combined ICV IM2 Mix (0.5 ug/mL)	0.50
Combined ICV IM3 Mix (0.5 ug/mL)	0.50
IDA Mix (0.05 µg/mL)	5.0
IS Mix (0.05 µg/mL)	5.0

7.9. TOP-Surr, 1000 ng/mL: The reverse surrogate solution used for samples subjected to the oxidation process to monitor the efficiency of the oxidation process. This solution is prepared by diluting 2 mL of a 50 ug/mL solution containing M2-4:2 FTS to 100 mL in water, for a final concentration of 1000 ng/mL.

7.10. TOP-IDA, 25ng/mL

The TOP-IDA solution is used for those samples subjected to the oxidation process. It omits M2-4:2 FTS, as that compound is used as a reverse surrogate for demonstrating the efficiency of the oxidation step. 200 mL of the solution at a nominal concentration of 0.025 ug/mL (25 ng/mL) is prepared from the individual solutions described in Section 7.2.5 using the recipe below:

Table 7.10
TOP-IDA Recipe
All solutions below are diluted to 200 mL with Methanol.

IDA	Stock Conc. (µg/mL)	Aliquot (mL) to	IDA Mix Conc. (µg/mL)	IDA	Stock Conc. (µg/mL)	Aliquot (mL) to	IDA Mix Conc. (µg/mL)
13C4-PFBA	50	0.10	0.025	d3-MeFOSAA	50	0.1	0.025
13C5-PFPeA	50	0.10	0.025	M2-6:2FTS	47.5	0.1	0.02375
13C2-PFHxA	50	0.10	0.025	M2-8:2FTS	47.9	0.1	0.02395
13C4-PFHpA	50	0.10	0.025	M2 10:2 FTS	47.36	0.1	0.02368
13C4-PFOA	50	0.10	0.025	d5-EtFOSA	50	0.1	0.025
13C5-PFNA	50	0.10	0.025	d3-MeFOSA	50	0.1	0.025
13C2-PFDA	50	0.10	0.025	d9-Et-FOSE	50	0.1	0.025
13C2-PFUdA	50	0.10	0.025	d7-Me-FOSE	50	0.1	0.025
13C2-PFDoA	50	0.10	0.025	13C3-HFPO-DA	50	0.1	0.025
18O2-PFHxS	47.3	0.10	0.02365	13C-6:2 FTCA	50	0.1	0.025
13C4-PFOS	47.8	0.10	0.0239	13C-8:2 FTCA	50	0.1	0.025
13C3-PFBS	46.5	0.10	0.02325	13C-10:2 FTCA	50	0.1	0.025

13C2-PFTeDA	50	0.10	0.025	13C-6:2 FTUCA	50	0.1	0.025
13C2-PFHxDA	50	0.10	0.025	13C-8:2 FTUCA	50	0.1	0.025
13C8-FOSA	50	0.10	0.025	13C-10:2 FTUCA	50	0.1	0.025
d5-EtFOSAA	50	0.10	0.025				

8. SAMPLE COLLECTION, PRESERVATION, AND STORAGE

Laboratory default requirements for sample containers, sample size, preservation and holding time are detailed in the table below.

Table 8
Sample Collection, Preservation, and Storage Requirements

Matrix	Sample Container	Minimum Sample Size	Preservation	Holding Time[1]
Water	250 mL HDPE Bottle	250 mL	0-6°C *(if from a known chlorinated source add Trizma (5g/L))*	14 days
Soil/Sediment	4 oz. HDPE wide-mouth container	100 g	0-6°C	14 days
Tissue	4 oz. HDPE wide-mouth container	50 g	≤ -10 °C	1 year (365 days)

Extraction holding time is calculated from date of collection. Analytical holding time is determined from date of extraction.

8.1. Extracts are stored at 0 - 6°C and must be analyzed within 40 days of extraction.

8.2. Many jurisdictions have additional requirements for PFAS analysis, including different holding times and preservation requirements. These are detailed in the document WS-WI-0066, "Agency Specific Criteria for PFAS in Matrices Other Than Drinking Water".

8.3. Unless otherwise specified by client or regulatory program, after analysis, samples and extracts are retained for a minimum of 30 days after provision of the project report and then disposed of in accordance with applicable regulations.

Note: *As of this writing, Method 537 provides for a 14 day holding time for water samples preserved with Trizma buffer. The scientific literature indicates that perfluorinated substances are highly persistent in the environment. Eurofins TestAmerica Sacramento has conducted time stability studies that support a 14 day holding time for aqueous samples with and without Trizma preservation. TestAmerica Denver has conducted stability studies indicating that medium- and low-level solutions of PFOA are stable for at least three months in polystyrene and polypropylene plastics at 0-6°C. The 14/40 day holding times given above are based on the stability study and general EPA convention for the holding time of extractable organic compounds in water and soil.*

8.4. Biphasic samples

8.4.1. Samples denoted as aqueous (groundwaters, surface waters, and waste waters) are prepared and handled as a liquid sample (Section 11.2) regardless of solids content unless otherwise instructed or agreed upon with the client. Detailed descriptions of such deviations from the procedure must be documented in the LIMS NCM program.

8.4.2. Samples considered solids (including biosolids, sediments, and soils) are prepared and handled as solid samples following appropriate homogenization as per Section 11.7. Correction for moisture content is provided through the LIMS when required by the client.

8.4.3. In the event that results are required individually for the solid and aqueous phases of a sample, the phases are separated via centrifugation, and extracted separately using the appropriate preparation (Section 11.2 for the aqueous phase and Section 11.7 for the solid phase). The extracts are analyzed, and results reported for each phase separately.

9. QUALITY CONTROL

Please note: Many states and regulatory programs have their own specifications which differ from the laboratory's default program for QC, calibration, sample preparation and data evaluation. Please refer to WS-WI-0066 for state/client specific programs that have differing criteria from those listed in Sections 9 through 12.

9.1. Initial Demonstration of Capability (IDOC)

The initial demonstration and method detection limit (MDL) studies described in Section 13 must be acceptable before analysis of samples may begin.

9.2. Batches are defined at the sample preparation step. Batches should be kept together through the whole analytical process as far as possible, but it is not mandatory to analyze prepared extracts on the same instrument or in the same sequence. Refer to the QC program document (WS-PQA-003) for further details of the batch definition.

9.2.1. The quality control batch is a set of up to 20 samples of the same matrix processed using the same procedure and reagents within the same time period. The quality control batch must contain a matrix spike/matrix spike duplicate (MS/MSD), a laboratory control sample (LCS) and a method blank. Laboratory generated QC samples (Blank, LCS, MS/MSD) do not count toward the maximum 20 samples in a batch. Field QC samples are included in the batch count. In some cases, at client request, the MS/MSD may be replaced with a matrix spike and sample duplicate. If insufficient sample is available for an MS/MSD, an LCSD may be substituted if batch

precision is required by the program or client. In the event that multiple MS/MSDs are run with a batch due to client requirements, the additional MS/MSDs do not count toward the maximum 20 samples in a batch.

9.3. One method blank (MB, laboratory reagent blank) must be extracted with every process batch of similar matrix, not to exceed twenty (20) samples. For aqueous samples, the method blank is an aliquot of laboratory reagent water. For solid samples, the method blank is an aliquot of Ottawa sand. The method blank is processed in the same manner and at the same time as the associated samples. Corrective actions must be documented on a Non-Conformance memo, and then implemented when target analytes are detected in the method blank above the reporting limit or when IDA recoveries are outside of the control limits. Re-extraction of the blank, other batch QC and the affected samples are required when the method blank is deemed unacceptable. See policy WS-PQA-003 for specific acceptance criteria.

9.3.1. If the MB produces a peak within the retention time window of any of the analytes, determine the source of the contamination and eliminate the interference before processing samples.

9.3.2. The method blank must not contain any analyte at or above the reporting limit, or at or above 10% of the measured concentration of that analyte in the associated samples, whichever is higher.

9.3.3. If there is no target analyte greater than the RL in the samples associated with an unacceptable method blank, the data may be reported with qualifiers. Such action should be taken in consultation with the client.

9.3.4. Re-extraction and reanalysis of samples associated with an unacceptable method blank is required when reportable concentrations are determined in the samples.

9.3.5. Refer to WS-PQA-003 for further details of the corrective actions.

9.3.6. Projects performed under the auspices of the DOD/DOE must meet QSM specific criteria for method blanks. Results are acceptable if the blank contamination is less than ½ of the reporting limit/LOQ for each analyte, or less than 1/10 of the regulatory limit, or less than 1/10 of the sample result for the same analyte, whichever is greater. If the method blank does not meet the acceptance criteria, the source of contamination must be investigated and measures taken to correct, minimize or eliminate the problem. Reprepare and reanalyze all field and QC samples associated with the contaminated method blank.

9.3.7. The position of the method blank in the SPE manifold during SPE extraction

is rotated across batches.

9.4. A laboratory control sample (LCS) must be extracted with every process batch of similar matrix, not to exceed twenty (20) samples. The LCS is an aliquot of laboratory matrix (e.g. water for aqueous samples and Ottawa sand for solids) spiked with analytes of known identity and concentration. The LCS must be processed in the same manner and at the same time as the associated samples. Corrective actions must be documented on a Non-Conformance memo, then implemented when recoveries of any spiked analyte is outside of the control limits. Re-extraction of the blank, other batch QC, and all associated samples are required if the LCS is deemed unacceptable. See WS-PQA-0003 for specific acceptance criteria. The control limits for the LCS are stored in TALS.

9.5. A matrix spike/matrix spike duplicate (MS/MSD or MS/SD) pair must be extracted with every process batch of similar matrix, not to exceed twenty (20) samples. An MS/MSD pair is aliquots of a selected field sample spiked with analytes of known identity and concentration. The MS/MSD pair must be processed in the same manner and at the same time as the associated samples. Spiked analytes with recoveries or precision outside of the control limits must be within the control limits in the LCS. Corrective actions must be documented on a nonconformance memo, and then implemented when recoveries of any spiked analyte are outside of the control limits provided by TALS or by the client.

9.6. A duplicate control sample (LCSD or DCS) may be added when insufficient sample volume is provided to process an MS/MSD pair, or is requested by the client. The LCSD is evaluated in the same manner as the LCS. See WS-PQA-003 for specific acceptance criteria.

9.7. Initial calibration verification (ICV) –A second source standard is analyzed with the initial calibration curve. The concentration should be at the mid-range of the curve.

Corrective actions for the ICV include:

- Rerun the ICV.
- Remake or acquire a new ICV.
- Evaluate the instrument conditions.
- Evaluate the initial calibration standards.
- Rerun the initial calibration.

9.8. Isotope Dilution Analytes

9.8.1. The IDA solution is added to each field and QC sample at the time of extraction, as described in Section 11. As described in Section 7, this solution consists of isotopically labeled analogs of the analytes of interest.

9.8.2. IDA recoveries are flagged if they are outside of the acceptance limits (25–150%). Quantitation by isotope dilution generally precludes any adverse effect on data quality due to IDA recoveries being outside of the acceptance limits as long as the signal-to-nose ratio is greater than 10:1.

9.8.2.1. Evaluate data quality for usability, flag and submit a non-conformance memo for any analytes outside of the recovery criteria, and report if data is deemed not adversely effected.

9.8.2.2. If IDA recovery is >150%, check for laboratory error and correct if identified. If no laboratory error is identified proceed as follows:

Condition:	**Corrective Action:**
Field samples are ND for associated native target analytes.	Report the data with appropriate qualifiers and narrative comments.
Field samples are positive for the associated native target analytes and IDA recovery is <200%	Report the data with appropriate qualifiers and narrative comments.
Field samples are positive for the associated native analytes and IDA recovery >200%	RI at an appropriate dilution then report both sets of data with appropriate qualifiers and narrative comments.

9.8.2.3. If IDA recovery is <25% (10% for Me/Et-FOSE), check laboratory error and correct if identified, if no laboratory error is identified, proceed as follows:

<table>
<tr><th>Condition:</th><th colspan="2">Corrective Action:</th></tr>
<tr><td>Field samples are positive for the associated native target analyte and IDA recovery is >10% (>5% for Me/Et-FOSE)</td><td colspan="2">Report the data with appropriate qualifiers and narrative comments</td></tr>
<tr><td rowspan="3">Field samples are ND for associated native target analytes and IDA recovery is >10% (>%5 for Me/Et-FOSE)</td><td colspan="2">Evaluate the S/N of the associated Native analytes in the most recent RL (CCVL) standard or L1 if an ICAL is ran that day:</td></tr>
<tr><td>S/N X the IDA recovery is >10</td><td>Report the data with appropriate qualifiers and narrative comments</td></tr>
<tr><td>S/N X the IDA recovery is <10</td><td>Report an elevated RL if project DQO allows. Qualify and narrate, otherwise RX or RI at an appropriate dilution</td></tr>
<tr><td colspan="3">Example: If the CCVL has 50 S/N X 0.25 (25% IDA) = 12.5. 12.5 > 10 and RL is supported.

If the CCVL has 50 S/N X 0.15 (15% IDA) = 7.5. 7.5 < 10, therefor the RL must be elevated.

Note: if the RL is to be elevated add a comment into the worksheet about such for the 2nd level reviewer.</td></tr>
</table>

9.8.2.4. Re-extraction of samples should be performed if the signal-to-noise for any IDA is less than 10:1 or if the IDA recoveries fall below 10% (<5% for Me/Et-FOSE).

9.8.2.4.1. Re-extraction may be necessary under other circumstances when data quality has been determined to be adversely affected.

9.8.2.5. For samples analyzed in accordance with version 5.1 or higher of the DoD/DOE QSM, the IDA recovery criteria is 50-150%. If QC or field samples do not meet these criteria then see sections 9.8.2.1, 9.8.2.2, and 9.8.2.3for actions.

9.9. Internal Standard

9.9.1. The Internal Standard (IS) is added to each field and QC samples prior to analysis. The CCV IS response (peak area) must not deviate by more than 50% from the average response (peak area) of the initial calibration.

9.9.2. Sample IS response (peak area) must be within ±50% of the response (peak area) in the most recent CCV.

9.9.3. If the IS does not meet criteria, re-analyze the extract, at dilution if needed. If the IS meets criteria in the second analysis, report that analysis. If the IS does not meet criteria in the second analysis, report the first analysis with narration.

9.10. TOP Oxidation Efficiency

9.10.1. If the field sample data indicates incomplete oxidation (i.e. the Post-TOP M2-4:2 FTS recovery is greater than 10% or the Post-TOP precursor concentration is greater than 10% of the Pre-TOP concentration), but the laboratory QA are in control, report the data with narration and/or contact the client to prepare a second billable aliquot (10 mL or a 0.1g equivalent) to be processed.

9.10.2. A reduced sample size may be used initially if sample history or other information indicates the sample is grossly contaminated.

9.11. Ion Ratio

9.11.1. Compare the quantifier/qualifier SRM transition ratio in the sample to the SRM transition ratio in the standard.

Equation 1 $$Ion\ Ratio = \frac{Area\ Quantitation\ Ion\ (1°\ Transition)}{Area\ Qualitative\ Ion\ (2°\ Transition)}$$

9.11.2. The quantifier/qualifier SRM ion ratio should be within ±50% of the average of the quantifier/qualifier SRM ion ratios calculated from the midlevel ICAL point or from the CCV, if an ICAL is not run.

9.11.3. At this time the ion ratio evaluation is a quantitative identification tool. Analyst judgement should be used if the ratio does not meet criteria. Data should be qualified "I" if the ratio is not met.

9.11.4. If the ion ration >2X the target, then do not report the analyte. It should be either ND at the RL or elevate the RL as needed (G flag).

9.11.5. For samples analyzed in accordance with the DoD/DOE QSM version 5.3; if the quantitation ion peak does not meet the maximization criteria the peak shall be included in the summed integration. The result should be flagged "estimated, high bias". As there is not a default qualifier for this in the TALS formatter, use the "see case narrative" flag and NCM the issue.

10. CALIBRATION

10.1. For details of the calculations used to generate the regression equations, and how to use the factors generated by these equations, refer to SOP CA-Q-P-003 "Calibration Curves and Selection of Calibration Points".

10.2. Routine instrument operating conditions are listed in the table in Section 11.17.

10.3. Instrument Tuning & Mass Calibration

10.3.1. Mass Calibration is performed by instrument manufacturer service representatives in accordance with the manufacturer's procedures during installation, and annually thereafter. Mass calibration is performed such that all precursor and product ions for primary and confirmation transitions are bracketed.

10.3.2. Instrument tuning is done initially when the method is first developed and thereafter as needed during troubleshooting. Tuning is done by infusing each individual compound (native and/or IDA) into the mobile phase using a tee fitting at a point just before the entrance to the electrospray probe. The responses for the parent and daughter ions for each compound are observed and optimized for sensitivity and resolution. Mass assignments are reviewed and updated as needed. The mass assignments must be within ± 0.5 amu of the values shown in the table in Section 11.17.

10.3.3. Once the optimal mass assignments (within ±0.5 amu of true) are made immediately following the initial tune, the lowest level standard from the initial calibration curve is assessed to ensure that a signal to noise ratio greater than 10 to 1 (S/N > 10:1) is achieved for each PFAS analyte. The first level standard from the initial calibration curve is used to evaluate the tune stability on an ongoing basis. The instrument mass windows are set initially at ± 0.5 amu of the true value; therefore, continued detection of the analyte transition with S/N > 10:1 serves as verification that the assigned mass remains within ± 0.5 amu of the true value, which meets the DoD/DOE QSM 5.1 tune criterion. For QSM 5.1 or higher work, the instrument sensitivity check (section 10.12.4) is also evaluated to ensure that the signal to noise criteria is met.

10.3.3.1. For samples run in accordance with the DoD/DOE QSM version 5.3, the instrument must have a valid mass calibration prior to sample analysis. This is verified through the acquisition of a full scan continuum mass spectrum of a PFAS stock standard. All masses must be verified to be within ± 0.5 amu of true value.

10.4. A new calibration curve must be generated after major changes to the system or when the continuing calibration criteria cannot be met. Major changes include, but are not limited to, new columns or pump seals. A new calibration is not required after minor maintenance.

10.5. With the exception of the circumstances delineated in policy CA-Q-P-003, it is not acceptable to remove points from a calibration curve. In any event, at least five points must be included in the calibration curve. Average Response Factor and linear fit calibrations require five points, whereas Quadratic (second order) calibrations require six points.

10.6. A fixed injection volume is used for quantitation purposes and is to be the same for both the sample and standards.

10.7. All units used in the calculations must be consistently uniform, such as concentration in ng/mL.

10.8. Some jurisdictions may have additional requirements for PFAS in initial and continuing calibrations. These are detailed in the document WS-WI-0066, “Agency Specific Criteria for PFAS in Matrices Other Than Drinking Water”.

10.9. Retention Times

10.9.1. Retention time windows of at least ± 0.25 minutes are set within the data system to facilitate peak identification.

10.9.2. The retention times of the target and reference compounds are initially set in the data system using the mid-range standard from the initial calibration. They are updated using the first CCV on days when an initial calibration is not performed.

10.10. Initial Calibration

10.10.1. A number of analytical standards of different analyte concentrations are used to generate the curve. Each standard is injected once to obtain the peak response for each analyte at each concentration. These standards define the working range of the analysis.

10.10.1.1. A minimum of five analytical standards is used when using average response factor and/or linear calibration fits.

10.10.1.2. A minimum of six analytical standards is used when a quadratic fit is used to generate the curve.

10.10.2. Calibration is by average response factor, linear fit, or by quadratic fit. Quadratic fit is used for the analyte if the response is non-linear.

10.10.2.1. For average response factor (RFa), the relative standard deviation (RSD) for all compounds except those identified as poor performers must be < 30% for the curve to be valid.

10.10.2.2. Poor performing analytes are: 6:2 FTS, PFHxDA and PFODA.

10.10.2.3. For average response factor (RFa), the relative standard deviation (RSD) for poor performing compounds must be < 50% for the curve to be valid.

10.10.2.4. For linear fit, the intercept of the line must be less than ½ the reporting limit, and the coefficient of determination (r2) must be greater than or equal to 0.990 for the curve to be considered valid (or the correlation coefficient (r) > 0.995).

10.10.2.5. For quadratic fits, the intercept of the line must be less than ½ the reporting limit, and the coefficient of determination (r2) must be greater than or equal to 0.990 for the curve to be considered valid.

10.10.2.6. The Internal Standard (IS) response (peak area) must not deviate by more than 50% from the average response (peak area) of the initial calibration.

10.10.2.7. Criteria for samples analyzed in accordance with QSM 5.3 or higher:

- The %RSD of the RFs for all analytes must be <20%.
- Linear or non-linear calibrations must have r^2>0.99 for each analyte.
- Analytes must be within 70-130% of their true value for each calibration standard.

10.11. Calibration Curve Fits

10.11.1. Linear regression or quadratic curves may be used to fit the data to a calibration function. Detailed descriptions and formulas for each fitting type can be found in SOP CA-Q-P-003, "Calibration Curves and Selection of Calibration Points".

10.11.2. The Chrom data system is programmed to complement the calibration evaluation guidelines in policy CA-Q-P-003 by evaluating calibration curve fits in the order listed below. An optimal fit is recommended to the analyst, who may override based on evaluation of the residuals for each calibration level, as per policy CA-Q-P-003.

- Average Response Factor
- Linear, 1/concentration^2 weighting
- Linear, 1/concentration weighting, forced through zero
- Quadratic, 1/concentration^2 weighting

10.11.3. The linear curve uses the following function:

Equation 2

$$y = bx + c$$

Where:

y = $\frac{Area\ (Analyte)}{Area\ (IDA)} \times Concentration(IDA)$

x = concentration

b = slope

c = intercept

10.11.4. The quadratic curve uses the following function:

Equation 3

$$y = ax^2 + bx + c$$

Where y, x, b, and c are the same as above, and a = curvature.

10.11.5. Evaluation of Calibration Curves

The following requirements must be met for any calibration to be used:

- Response must increase with increasing concentration.

- The absolute value of the intercept of a regression line (linear or non-linear) at zero response must be less than the reporting limit.
- There should be no carryover at or above 1/2 MRL after a high CAL standard.

If these criteria are not met, instrument conditions and standards will be checked, and the ICAL successfully repeated before continuing.

10.11.6. Weighting of Calibration Points

In linear and quadratic calibration fits, the points at the lower end of the calibration curve have less absolute variance than points at the high concentration end of the curve. This can cause severe errors in quantitation at the low end of the calibration. Because accuracy at the low end of the curve is very important for this analysis, it is preferable to increase the weighting of the lower concentration points. 1/concentration or 1/x weighting is encouraged. Visual inspection of the line fitted to the data is important in selecting the best fit.

10.12. Initial Calibration Blank (ICB)

10.12.1. Immediately following the ICAL, a calibration blank is analyzed that consists of an injection of 80:20 methanol:water blank containing both IDA and IS.

10.12.2. The result for the calibration blank must be less than the reporting limit.

10.12.3. If the ICB is greater than the reporting limit then the source of contamination must be identified and any necessary cleaning completed, and then the instrument should be recalibrated.

10.12.4. Criteria for samples analyzed in accordance with QSM 5.3 or higher:

- Instrument blanks are required immediately following the highest standard analyzed and *daily prior to sample analysis*.
- The instrument blank must be < ½ the LOQ.

10.13. Initial Calibration Verification (ICV)

10.13.1. Following the ICAL and the ICB, an ICV standard obtained from a different source or vendor than the ICAL standards is analyzed. This ICV standard is a mid-range standard.

10.13.2. The recovery for the ICV must meet the appropriate following criteria:

10.13.2.1. The native analyte must be within or equal to 70-130% for all native analytes. The native analyte must be within or equal to 50-150% for all poor performing analytes. The IDA must be within or equal to 50-150%.

10.13.3. Criteria for samples analyzed in accordance with QSM 5.3 or higher: Analyte concentrations must be within ±30% of their true values for all analytes, IDA and target.

10.13.4. See Section 9.7 for corrective actions in the event that the ICV does not meet the criteria above.

10.14. Continuing Calibration Verification (CCV)

Analyze a CCV at the beginning of a run, the end of a run, and after every 10 samples to determine if the calibration is still valid. The exception is after an acceptable curve and ICV are run 10 samples can be analyzed before a CCV is required. The CCVs are usually at the mid-level range of the curve and should vary throughout the run from low level (LOQ/RL) to mid-level. The curve and ICV do not need to be run every day. To start an analytical on days when an ICAL is not performed, a CCV and CCVL (low standard at or below the RL and at or above the lowest levels used in the ICAL) are analyzed and if they meet acceptance criteria a run can be started.

10.14.1. The recovery for the CCV standards must be equal to or within 70-130% for all natives and equal to or within 50% to 150% for all poor performers. The recovery for the IDA must be within or equal to 50-150%.

10.14.2. The recovery for the CCVL (low-level CCV at or below the RL) standards must be equal to or within 50-150% for all natives and IDA.

10.14.3. The Internal Standard (IS) response (peak area) must be within ± 50% from the response (peak area) from the midpoint of the initial calibration.

10.14.3.1. Sample IS response (peak area) must be within ± 50% of the response (peak area) in the most recent CCV.

10.14.4. If this is not achieved, the instrument has drifted outside the calibration limits. The instrument must be recalibrated.

10.14.5. Criteria for samples analyzed in accordance with QSM 5.3 or higher:

- All analyte concentrations must be within ± 30% of their true value.
- Additionally, prior to analysis and at least once every 12 hours an instrument sensitivity check (ISC/CCVL) must be analyzed. The analyte

concentrations must be at LOQ and the concentrations must be within ± 30% of their true value. This can be used as a CCV.

11. PROCEDURE

11.1. One-time procedural variations are allowed only if deemed necessary in the professional judgment of a supervisor to accommodate variation in sample matrix, chemistry, sample size, or other parameters. Any variation in procedure shall be completely documented using a non-conformance memo (NCM). The NCM process is described in more detail in SOP WS-QA-0023. The NCM shall be filed in the project file and addressed in the case narrative.

Any deviations from this procedure identified after the work has been completed must be documented in an NCM, with a cause and corrective action described.

11.2. Water Sample Preparation

11.2.1. Visually inspect samples for the presence of settled and/or suspended sediment/particulates. If present or if the sample is biphasic add IDA prior to any sample decanting or centrifugation. If the sample requires decanting or centrifugation contact the client for guidance prior to such action. Decanting or filtering of the sample can lead to a low bias. Filtration is discouraged.

11.2.2. If authorized by the client to filter the sample, filter the water sample through a glass fiber filter (Whatman GF/F Cat No 1825 090 or equivalent). Gravity or vacuum can be used to pass the sample through the filter. Prepare a filtration blank with any samples requiring filtration. File an NCM noting the need for filtration.

11.2.2.1. Filters are rinsed with 4 mL of 0.3% NH_4OH/methanol when the bottle is rinsed (Section 11.5.1).

Warning: The use of a vacuum system creates the risk of glassware implosion. Inspect all glassware prior to use. Glassware with chips, scratches, rub marks or cracks must not be used.

11.2.3. Weigh the sample container prior to extraction and then weigh the sample container after extraction to determine the initial volume. Unless otherwise directed by client, use the entire sample volume, and spike directly into the sample container.

11.2.4. Prepare additional aliquots of a field sample for the MS/MSD, if requested.

11.2.5. Prepare two 250 mL aliquots of HPLC-grade water for the method blank

and LCS.

11.2.6. Vortex the LCS/Matrix PFC Spike and IDA PFC solutions prior to use.

11.2.7. Spike the LCS and MS/MSD (if requested) with 0.5 mL of the LCS/Matrix PFC Spike solution (Section 7.3). This will result in a sample concentration of 40 ng/L.

11.2.8. Add 0.5 mL of the IDA PFC solution (Section 7.4) into each sample and QC sample, for a fixed concentration of 1.25-2.5 ng/mL in the final sample vial. Allow the spikes to equilibrate with the samples for at least 10 minutes before loading onto the SPE cartridge (Section 11.3.5).

11.3. Solid Phase Extraction (SPE) of Aqueous Samples

The automated Zymark Auto-Trace Workstation can be used as long as the program follows these conditions and passes the background check.

11.3.1. Condition the SPE cartridges (Section 6.9.2, [redacted] or equivalent) by passing the following without drying the column.

Note: *The cartridges should not be allowed to go dry until the final elution step with methanol. At all of the other transition steps, the solvent/sample level should be stopped at the top of the column before the next liquid is added.*

WARNING: The use of a vacuum system creates the risk of glassware implosion. Inspect all glassware prior to use. Glassware with chips, scratches, rub marks or cracks must not be used.

11.3.2. Wash with 5.0 mL of [redacted]

11.3.3. Wash with 5.0 mL of 0.1N NaOH/water. Close valve when ~ 200 uL remains on top to keep column wet. After this step, the columns cannot go dry until the completion of loading and rinsing samples.

11.3.4. Appropriately label the columns and add the reservoir to the column. Be certain to rotate method blank samples through each sample port on the SPE manifold, such that each new batch uses a different port for the MB.

11.3.5. Add samples to the columns and with vacuum, pull the entire 250 mL aliquot of the sample through the cartridge at a rate of approximately 2 to 5 drops per second.

11.3.5.1. If the SPE column should plug (flow rate <1 drop per minute) prior to the entire content of the sample container passing through the column do the following:

1. Stop adding sample to the reservoir.
2. Return any remaining sample volume back to the original container.
3. Weigh the original container and record this weight into the worksheet notes field within the TALS extraction batch.
4. Determine the full volume of sample fortified by using the "Gross Weight" – (remaining sample volume – default tare weight of a sample container (26.1 g)).
5. Enter this value into the "Initial Amount" field in the TALS extraction batch.
6. Proceed to Section 11.4, noting that additional vacuum or pressure might be needed to elute the SPE column.

11.3.6. After the entire sample has been loaded onto the column, rinse the sample bottle with two 5 mL aliquots of reagent water and pour onto the column reservoir.

11.3.7. After the final loading of the sample but before completely passed through the column, rinse the SPE column with 1 mL of water.

11.3.8. After the sample and water rinse have completely passed through the cartridge, allow the column to dry well with vacuum for 15 minutes.

11.4. SPE Column Wash of Aqueous Samples with 30:70 methanol:water.

11.4.1. Load the first 5 mL of 30:70 methanol:water wash and let soak for five minutes and then elute to waste.

11.4.2. Load the second 5 mL of 30:70 methanol:water wash and elute to waste (without a soaking period).

11.4.3. Allow the column to dry with vacuum for 10 minutes. Columns must be dried before continuing.

11.5. SPE Elution of Aqueous Samples – using 15 mL polypropylene test tubes as receiving tubes in the SPE manifold.

11.5.1. Rinse sample bottles with 4 mL [redacted] and transfer to the column reservoir onto the cartridge. Allow the solution to soak for 5 minutes and then elute into the 15 mL collection tube.

11.5.2. Repeat sample bottle to column reservoir rinse and cartridge elution with a second 4 mL aliquot [redacted] The total collection should be approximately 8 mL.

11.5.3. Proceed to Section 11.6 for final volume.

11.6. Final volume for extract

11.6.1. Vortex the IS solution prior to use.

11.6.2. Add 0.5 mL of IS (Section 7.6) at 25 ng/mL concentration and 2 mL of water to the extract, for a final volume of 10 mL. Verify that the volume 10 mL using the graduations on the tube. This will create an extract with a final solvent composition of 80:20 methanol:water.

11.6.2.1. Seal the test tube tightly. Invert container several times and then vortex. Allow extract to settle for 10 minutes prior to moving to the next step. This permits particulates (SPE resin and/or residual carbon) to settle to the bottom of the tube so that they are not transferred to the autosampler vial.

11.6.3. Transfer a portion of the extract to a 300 uL polypropylene autosampler vial (7 drop-wise or approximately ½ filled is sufficient). Archive the rest of the extracts for re-injection and dilution.

11.6.4. Seal the vial with a polypropylene screw cap. Note: Teflon lined caps cannot be used due to detection of low level concentration of PFAS.

11.7. Soil, Sediment and Tissue Sample Preparation and Extraction

11.7.1. Visually inspect soil samples. Homogenize the entire sample in accordance with SOP WS-QA-0018. If the sample cannot be mixed in the container, pour into a larger QC'd PFAS-free container and mix thoroughly. Transfer the sample label to the new container.

11.7.2. Weigh a representative 5 g aliquot of sample (1g for tissues) into a 50 mL centrifuge tube. Weigh additional sample amounts for the matrix spike and matrix spike duplicate analyses if they are requested.

11.7.3. For the method blank and LCS matrix, use 5 g each of Ottawa sand (solids) or 0.02 g of vegetable oil (tissues).

11.7.4. Vortex the LCS/Matrix PFC Spike and IDA PFC solutions prior to use.

11.7.5. Spike the LCS and MS/MSD (if requested) with 0.5 mL of the LCS/Matrix PFC Spike solution (Section 7.3).

11.7.6. Add 0.5 mL of the IDA PFC solution (Section 7.4) into each sample and QC sample, for a fixed concentration of 1.25 ng/mL in the final sample vial.

11.7.7. Cap the tubes and allow the spike to settle into the sample matrix. Gently shake the tubes to mix the spike into the matrix.

11.7.8. Add 10 mL of [redacted] to each sample. Cap and vortex.

11.7.9. Extract the samples in an ultrasonic water bath for 1 hour.

11.7.10. After the completion of extraction, centrifuge each sample at 3500 rpm for 5 minutes.

11.7.11. Collect and decant the [redacted] into a new container.

11.7.12. Add another 4 mL of [redacted] solution to the residue, briefly shake to mix and centrifuge at 3500 rpm for 5 minutes.

11.7.13. Combine the rinsate to the first corresponding containers.

11.7.14. To the final [redacted] extract, bring the volume up to 125 mL with HPLC-grade water.

11.7.15. Neutralize with glacial acetic acid and/or sodium hydroxide, and mix the contents well with vortex mixer. Check the pH to ensure pH is between 6 and 8.

11.8. Solid Extract Cleanup by SPE

Set up SPE cartridges (Section 6.9.2, [redacted] or equivalent) for sample cleanup using vacuum manifold.

11.8.1. Condition the SPE cartridges by passing the following without drying the column.

Note: *The cartridges should not be allowed to go dry until the final elution step with methanol. At all of the other transition steps, the solvent/sample level should be stopped at the top of the column before the next liquid is added.*

WARNING: The use of a vacuum system creates the risk of glassware implosion. Inspect all glassware prior to use. Glassware with chips, scratches, rub marks or cracks must not be used.

11.8.2. Wash with 5.0 mL of [redacted]

11.8.3. Wash with 5 mL of 0.1 N NaOH/water. Close valve when ~ 500 µL remains on top of column to keep column wet. *After this step, the columns cannot go dry until the completion of loading and rinsing samples.*

11.8.4. Be certain to rotate method blank samples through each sample port on the

SPE manifold, such that each new batch uses a different port for the MB.

11.8.5. Add extracts to the columns and with vacuum, pull the entire extracts through the cartridge at rate of approximately 3 to 5 drops per second.

11.8.6. Rinse the sample tube with 5 mL of water and add to the SPE column.

11.8.7. Dry the columns with vacuum for 15 minutes.

11.9. SPE Column Wash of Solid Extracts with 30:70 methanol:water.

11.9.1. Load the first 5 mL of the 30:70 methanol:water wash to soak for five minutes, and elute to waste.

11.9.2. Load the second 5 mL of the 30:70 methanol:water wash and elute to waste (without a soaking period).

11.9.3. Allow the column to dry with vacuum for 10 minutes. Columns must be dried before continuing.

11.10. SPE Elution of Solid Extracts – using 15 mL polypropylene test tube as receiving tube in the SPE manifold.

11.10.1. Rinse extraction bottles with 4 mL of [redacted] and transfer to the column reservoir onto the cartridge. Allow the solution to soak for 5 minutes and then elute into the 15 mL collection tube.

11.10.2. Repeat extract bottle to column reservoir rinse and cartridge elution with a second 4 mL aliquot of [redacted] The total collection should be approximately 8 mL.

11.10.3. Proceed to Section 11.6 for final volume.

11.11. Product/Waste Samples

Note: Please see WS-WI-0065 for the preparation of methanol extracts and dispersion samples.

Vortex all spike solutions immediately prior to use.

11.11.1. Check the solubility of the material in both methanol and water

11.11.1.1. If the material is soluble in water, dilute 0.5 mL of sample into 250 mL of DI water and proceed to Section 11.3 (follow water extraction procedures). Fortify sample appropriately with IDA or PFC spike solution, see Section 11.2.

11.11.1.2. If the material is soluble in methanol, dilute 1 g (if solid) or 1 mL (if liquid) of material into 10 mL of methanol (MeOH).

- If the material does not completely dissolve, contact your immediate supervisor.

11.11.2. Take 100 µL of the 10 mL solution and dilute it to 10 mL in MeOH.

11.11.3. Take a 1 mL aliquot of this solution (effective dilution of 1000x (1 mg for solid or 0.001 mL for liquid)) and fortify with 0.5 mL of labeled IDA solution (Section 7.4).

11.11.4. Prepare two 1.0 mL/g aliquots of HPLC-grade water for the method blank and LCS.

11.11.5. Spike the LCS and MS/MSD (if requested) with 0.5 mL of the LCS/Matrix PFC Spike solution (Section 7.3).

11.11.6. Add 0.5 mL of the IDA PFC solution (Section 7.4) into each QC sample.

11.11.7. DO NOT PASS EXTRACT THROUGH SPE CARTIRIDGE (omit steps 11.9 – 11.11).

11.11.8. Proceed to Section 11.6 for final volume.

11.12. TOP (Total Oxidizable Precursor) Assay for Aqueous Samples

11.12.1. Prepare 3-250 mL HDPE containers with HPLC grade water to create the needed QC Samples (MB, LCS/LCSD).

11.12.2. Prepare enough 125 mL HDPE containers as needed for all “Pre” and “Post” samples, including QC. Label each appropriately.

11.12.3. Vortex reverse surrogate and LCS spike solutions immediately prior to use.

11.12.4. Spike the “Pre” and “Post” MB 125 mL containers with 25 µL of the reverse surrogate solution of M2-4:2 FTS (Section 7.8).

11.12.5. Spike the “Pre” and “Post” LCS/LCSD 125 mL containers with 0.5 mL of the LCS Spike solution (Section 7.6), and 25 uL of the reverse surrogate solution (Section 7.8).

11.12.6. Add 2g of [redacted] and 1.9 mL of [redacted] to each “Post” sample container.

11.12.7. Subsample 100 mL aliquots of water from each field sample and QC from the 250 mL containers into each of the corresponding 125 mL containers for both the "Pre" and "Post" samples. Spike all "Pre" and "Post" samples with 25uL of the reverse surrogate solution (Section 7.9).

11.12.8. Set aside all "Pre" sample containers.

11.12.9. Cap each "Post" sample container, invert 2-3 times prior to placing container into water bath.

11.12.10. Add 2 g of [redacted] and 1.9 mL of [redacted] to each "Post" sample container.

11.12.11. Heat each "Post" sample container in a water bath (KD) at 85°C for 6 hours.

11.12.12. After digestion for 6 hours, place the "Post" sample containers in an ice bath for 30 minutes.

11.12.13. Adjust the pH of "Post" samples and associated QC aliquots to 7 with concentrated HCl. Use pH paper to determine the pH.

11.12.14. Spike both "Pre" and "Post" samples and their associated QC samples with 0.5 mL of TOP IDA solution (Section 7.10). Vortex the IDA solution prior to use.

11.12.15. Proceed to Section 11.13.26 SPE for TOP Assay for both "Pre" and "Post" aliquots.

11.13. TOP (Total Oxidizable Precursor) Assay for Soil Samples

11.13.1. Weigh representative 1 g aliquots of soil for each "Pre" and "Post" sample into a 50 mL centrifuge tube.

11.13.2. For the method blank and LCS matrix, use 1 g each of Ottawa sand for each "Pre" and "Post" QC sample.

11.13.3. Add 20 mL of [redacted] to each sample.

11.13.4. Extract the samples in an ultrasonic water bath for 1 hour.

11.13.5. After the completion of extraction, centrifuge each sample at 3500 rpm for 5 minutes.

11.13.6. Collect and decant the [redacted] extract to a new 50 mL centrifuge tube.

11.13.7. Add another 2 mL of [redacted] solution to the residue, briefly shake to mix and centrifuge at 3500 rpm for 15 minutes.

11.13.8. Combine the rinsate to the first corresponding tubes.

11.13.9. Proceed to Section 11.15.2 (Envi-carb clean up), following steps 11.15.2.1. through 11.15.2.4.

11.13.10. To the final [redacted] extract, add 0.5 mL of water to each.

11.13.11. Concentrate the [redacted] extract under nitrogen to less than 0.25 mL.

11.13.12. Dilute extract up to 50 mL with water in the centrifuge tube and vortex.

11.13.13. Prepare enough 125 mL HDPE containers as needed for all “Pre” and “Post” samples, including QC. Label each appropriately.

11.13.14. Vortex reverse surrogate and LCS spike solutions immediately prior to use.

11.13.15. Spike the “Pre” and “Post” MB 125 mL containers with 25 µL of the reverse surrogate solution of M2-4:2 FTS (Section 7.9).

11.13.16. Spike the “Pre” and “Post” LCS/LCSD 125 mL containers with 0.5 mL of the LCS Spike solution and 25 µL of the reverse surrogate solution (Sections 7.3 and 7.9).

11.13.17. Add 2 g of [redacted] and 1.9 mL of [redacted] to each “Post” sample container.

11.13.18. Transfer extract from the centrifuge tube to the appropriate 125 mL container.

11.13.19. Rinse the centrifuge container with an additional 50 mL of water and transfer to the appropriate 125 mL container.

11.13.20. Set aside all “Pre” sample containers.

11.13.21. Cap each “Post” sample container, invert 2-3 times prior to placing container into water bath.

11.13.22. Heat each “Post” sample container in a water bath (KD) at 85°C for 6 hours.

11.13.23. After digestion for 6 hours, place the “Post” sample containers in an ice bath for 30 minutes.

11.13.24. Adjust the pH of both "Pre" and "Post" samples and associated QC aliquots to 7 with concentrated HCl. Use pH paper to determine the pH.

11.13.25. Spike both "Pre" and "Post" samples and their associated QC samples with 0.5 mL of TOP IDA solution (Section 7.10). Vortex the IDA solution prior to use.

11.13.26. Proceed to Section 11.13.26 SPE for TOP Assay for both "Pre" and "Post" aliquots.

11.14. SPE Extraction for TOP Assay

Use the following SPE procedure for both "Pre" and "Post" samples for both solid and aqueous samples:

11.14.1. Set up [redacted] SPE columns for sample extraction using a vacuum manifold.

11.14.2. Establish a sample loading flow rate of 3-5 drops per second for each port of the vacuum manifold, for as many ports as will be used simultaneously during sample loading.

11.14.3. Wash/condition the SPE column with 5 mL of [redacted] then 5 mL water.

11.14.4. Load 100 mL of sample onto the SPE cartridge at a flow rate of 3-5 drops per second.

11.14.5. Add 5 mL rinse water

11.14.6. After the sample and water rinse have completely passed through the column, allow it to dry well using vacuum with a flow rate of 1 mL/minute for 15 minutes.

11.14.7. Wash the SPE column with 10 mL hexane rinse eluting all to waste.

11.14.8. Allow the column to dry well using vacuum for 5 minutes. Columns must be dry before continuing.

11.14.9. Elute the samples into 15 mL polypropylene test tubes in the SPE manifold by rinsing each 125 mL sample container with 4 mL of [redacted], and add to the SPE cartridge as eluent.

11.14.10. Repeat with another 4 mL of [redacted].

11.14.11. Collect the eluent and proceed to Section 11.6 for final volume.

11.15. Other Types of Sample Cleanup

11.15.1. Freezing technique to remove lipids.

If samples contain lipids then freeze the methanolic extract and QC extracts at -20°C for at least 1 hour. Collect the solvent layer.

11.15.2. Additional cleanup with graphitized carbon can be applied to those samples with severe matrix impacts that can benefit from an additional treatment of carbon.

11.15.2.1. Add 100 mg of graphitized carbon to each sample extract and QC extracts.

11.15.2.2. Shake vigorously and then let sit for 10 minutes.

11.15.2.3. Centrifuge each sample for 2 minutes at 1000 rpm.

11.15.2.4. Decant the solvent layer.

11.15.2.5. Proceed to Section 11.6.

11.16. AFFF Sample Preparation

11.16.1. QC for AFFF samples consists of a method blank, a laboratory control sample and a sample or matrix duplicate only. No matrix spike or matrix spike duplicate is needed.

11.16.2. Perform a 1,000,000 X serial dilution of the AFFF sample. Dilute 1 mL of AFFF sample to 1 L with laboratory supplied water. Then dilute 1mL of this dilution to 1 L with laboratory supplied water.

11.16.2.1. Be sure to retain all dilutions should the initial analysis warrant re-analysis at higher concentration.

11.16.3. Subsample 2.0 mL of this dilution and fortify with 0.5 mL IDA solution and 0.5 mL of IS (1.25-2.5 ng/mL) solution: then add 7.0 mL of methanol. Vortex the IDA solution prior to use.

11.16.4. Vortex the subsample, then transfer a portion of the sample to a 300 µL polypropylene autosampler vial (7 drop-wise or approximately ½ filled is sufficient). Archive the rest of the sample for re-injection or dilution.

11.17. Instrument Analysis

Suggested operating conditions are listed in Tables 1-4 for the SCIEX LCMS systems:

Table 11.17 - 1 **Recommended Instrument Operating Conditions**				
HPLC Conditions ([redacted])				
Column (Column temp = [redacted]°C)	[redacted]			
Mobile Phase Composition	A = [redacted] B = [redacted]			
Gradient Program	**Time**	**%A**	**%B**	**Flow Rate - mL/min**
	[redacted]	[redacted]	[redacted]	[redacted]
	[redacted]	[redacted]	[redacted]	[redacted]
	[redacted]	[redacted]	[redacted]	[redacted]
	[redacted]	[redacted]	[redacted]	[redacted]
	[redacted]	[redacted]	[redacted]	[redacted]
	Maximum pressure limit = 5,000 psi			
Injection Size	[redacted] (fixed amount throughout the sequence).			
Run Time	~[redacted]			
Mass Spectrometer Interface Settings ([redacted])				
MS Interface Mode	ESI Negative Ion. Minimum of 10 scans/peak.			
Ion Spray Voltage (kV)	[redacted]			
Entrance Potential (V)	[redacted]			
Declustering Potential (V)	[redacted]			
Desolvation Temp	[redacted]°C			
Curtain Gas	[redacted]			
Collision Gas	[redacted]			

Table 11.17 - 2 **Recommended Instrument Operating Conditions**								
Mass Spectrometer Scan Settings ([redacted])								
Compound	Comments	Reaction (MRM)	Dwell (sec)	Ent. Pot. (V)	Col. Energy (V)	Declu. Pot. (V)	Cell Exit Pot. (V)	Typ RT (Min)
PFPrA	Native Analyte	162.95>119	0.011	[redacted]				
MTP	Native Analyte	175>97	0.011	[redacted]				
PFMOAA	Native Analyte	179>84.9	0.011	[redacted]				
PFBA	Native Analyte	212.9>169	0.011	[redacted]				
13C4_PFBA	IDA	217>172	0.011	[redacted]				
PFECA F	Native Analyte	229>85	0.011	[redacted]				
PMPA	Native Analyte	229>185	0.011	[redacted]				
3:3 FTCA	Native Analyte	241>177.1	0.011	[redacted]				
3:3 FTCA_2	Native Analyte	241>116.9	0.011	[redacted]				
PFO2HxA	Native Analyte	245>85	0.011	[redacted]				
PFPrS	Native Analyte	249.1>80	0.011	[redacted]				

Table 11.17 - 2
Recommended Instrument Operating Conditions
Mass Spectrometer Scan Settings ([redacted])

Compound	Comments	Reaction (MRM)	Dwell (sec)	Ent. Pot. (V)	Col. Energy (V)	Declu. Pot. (V)	Cell Exit Pot. (V)	Typ RT (Min)
PFPeA	Native Analyte	262.9>219	0.011	[redacted]				
13C5_PFPeA	IDA	267.1>223	0.011					
PEPA	Native Analyte	278.9>234.9	0.011					
PFECA A	Native Analyte	278.95>84.9	0.011					
HFPO-DA	Native Analyte	285>169	0.011					
HFPO-DA_2	Native Analyte	285>185	0.011					
13C3_HFPO-DA	IDA	287>169	0.011					
PFECA B	Native Analyte	295.1>201	0.011					
NVHOS	Native Analyte	297>135	0.011					
PFBS	Native Analyte	298.9>80	0.011					
PFBS_2	Native Analyte	298.9>99	0.011					
M3-PFBS	IDA	301.9>80	0.011					
PFO3OA	Native Analyte	311.1>85.2	0.011					
PFHxA	Native Analyte	313>269	0.011					
PFHxA_2	Native Analyte	313>119	0.011					
PES	Native Analyte	314.8>135	0.011					
13C2_PFHxA	IDA	315>270	0.011					
4:2 FTS	Native Analyte	327>307	0.011					
4:2FTS_2	Native Analyte	327>80	0.011					
M2-4:2FTS	IDA	329>81	0.011					
5:3 FTCA	Native Analyte	340.88>236.9	0.011					
5:3 FTCA_2	Native Analyte	340.88>216.9	0.011					
PFPeS	Native Analyte	349>80	0.011					
PFPeS_2	Native Analyte	349>99	0.011					
6:2 FTUCA	Native Analyte	356.86>292.9	0.011					
6:2 FTUCA_2	Native Analyte	356.86>243	0.011					
6:2 FTUCA_3	Native Analyte	356.95>93	0.011					
13C-6:2 FTUCA	IDA	358.86>293.9	0.011					
PFHpA	Native Analyte	363>319	0.011					
PFHpA_2	Native Analyte	363>169	0.011					
13C4_PFHpA	IDA	367>322	0.011					
PFO4DA	Native Analyte	376.9>85	0.011					
DONA	Native Analyte	377>251	0.011					
DONA_2	Native Analyte	377>85	0.011					
6:2 FTCA	Native Analyte	377.1>313.1	0.011					
6:2 FTCA_2	Native Analyte	377.1>63	0.011					
13C-6:2 FTCA	IDA	378.88>293.9	0.011					
PFECA G	Native Analyte	378.9>184.9	0.011					
R-PSDCA	Native Analyte	397>217	0.011					
PFHxS	Native Analyte	399>80	0.011					
PFHxS_2	Native Analyte	399>99	0.011					
18O2_PFHxS	IDA	403>84	0.011					
R-EVE	Native Analyte	405>217	0.011					
PFOA	Native Analyte	413>369	0.011					
PFOA_2	Native Analyte	413>169	0.011					
13C2_PFOA	IDA	415>370	0.011					
13C4_PFOA	IDA	417>372	0.011					

Table 11.17 - 2
Recommended Instrument Operating Conditions

Mass Spectrometer Scan Settings ([redacted])

Compound	Comments	Reaction (MRM)	Dwell (sec)	Ent. Pot. (V)	Col. Energy (V)	Declu. Pot. (V)	Cell Exit Pot. (V)	Typ RT (Min)
13C8_PFOA	IDA	421>376	0.011	[redacted]				
6:2 FTS	Native Analyte	427>407	0.011					
Hydro-EVE Acid	Native Analyte	427>282.9	0.011					
6:2 FTS_2	Native Analyte	427>79.96	0.011					
M2-6:2FTS	IDA	429>81	0.011					
7:3 FTCA	Native Analyte	441>337	0.011					
7:3 FTCA_2	Native Analyte	441>317	0.011					
PS Acid	Native Analyte	442.8>146.8	0.011					
PFO5DoA (TAF)	Native Analyte	442.9>85	0.011					
PFHpS	Native Analyte	449>80	0.011					
PFHpS_2	Native Analyte	449>99	0.011					
8:2 FTUCA	Native Analyte	456.86>392.9	0.011					
8:2 FTUCA_2	Native Analyte	456.86>343	0.011					
13C-8:2 FTUCA	IDA	458.86>393.6	0.011					
EVE Acid	Native Analyte	407 > 262.9	0.011					
PFECHS_2	Native Analyte	460.8>98.9	0.011					
PFECHS	Native Analyte	460.8>380.9	0.011					
PFNA	Native Analyte	463>419	0.011					
PFNA_2	Native Analyte	463>169	0.011					
Hydro-PS Acid	Native Analyte	463>263	0.011					
13C5_PFNA	IDA	468>423	0.011					
8:2 FTCA	Native Analyte	477>393.1	0.011					
8:2 FTCA_2	Native Analyte	477>63.2	0.011					
13C-8:2 FTCA	IDA	478.85>393.9	0.011					
PFOSA	Native Analyte	498>78	0.011					
PFOS	Native Analyte	499>80	0.011					
PFOS_2	Native Analyte	499>99	0.011					
13C4_PFOS	IDA	503>80	0.011					
13C8_PFOSA	IDA	506>78	0.011					
13C8_PFOS	IDA	507>99	0.011					
MeFOSA	Native Analyte	512>169	0.011					
MeFOSA_2	Native Analyte	512>218.99	0.011					
PFDA	Native Analyte	513>469	0.011					
PFDA_2	Native Analyte	513>169	0.011					
13C2_PFDA	IDA	515>470	0.011					
d3MeFOSA	IDA	515>169	0.011					
EtFOSA	Native Analyte	526>169	0.011					
EtFOSA_2	Native Analyte	526>218.99	0.011					
8:2 FTS	Native Analyte	527>507	0.011					
8:2 FTS_2	Native Analyte	528.97>79.96	0.011					
M2-8:2FTS	IDA	529>81	0.011					
d5EtFOSA	IDA	531>169	0.011					
9Cl-PF3ONS	Native Analyte	531>351	0.011					
9Cl-PF3ONS_2	Native Analyte	531>79.96	0.011					
PFNS	Native Analyte	549>80	0.011					
PFNS_2	Native Analyte	549>99	0.011					
10:2 FTUCA	Native Analyte	556.86>492.9	0.011					

Table 11.17 - 2
Recommended Instrument Operating Conditions
Mass Spectrometer Scan Settings ([redacted])

Compound	Comments	Reaction (MRM)	Dwell (sec)	Ent. Pot. (V)	Col. Energy (V)	Declu. Pot. (V)	Cell Exit Pot. (V)	Typ RT (Min)
10:2 FTUCA_2	Native Analyte	556.97>472.99	0.011	[redacted]				
13C-10:2 FTUCA	IDA	558.86>493.9	0.011					
PFUdA	Native Analyte	563>519	0.011					
PFUdA_2	Native Analyte	563>169	0.011					
13C2_PFUdA	IDA	565>520	0.011					
N-MeFOSAA	Native Analyte	570>419	0.011					
N-MeFOSAA_2	Native Analyte	570>483	0.011					
d3-MeFOSAA	IDA	573>419	0.011					
10:2 FTCA	Native Analyte	576.8>493	0.011					
10:2 FTCA_2	Native Analyte	576.8>63.1	0.011					
13C-10:2 FTCA_3	IDA	578.8>493.9	0.011					
N-EtFOSAA	Native Analyte	584>419	0.011					
N-EtFOSAA_2	Native Analyte	584>526.1	0.011					
d5-EtFOSAA	IDA	589>419	0.011					
PFDS	Native Analyte	599>80	0.011					
PFDS_2	Native Analyte	599>99	0.011					
PFDoA	Native Analyte	613>569	0.011					
PFDoA_2	Native Analyte	613>169	0.011					
13C2_PFDoA	IDA	615>570	0.011					
N-MeFOSE	Native Analyte	616>59	0.011					
d7N-MeFOSE	IDA	623>59	0.011					
10:2 FTS	Native Analyte	627>607	0.011					
10:2 FTS_2	Native Analyte	627>79.96	0.011					
N-EtFOSE	Native Analyte	630>59	0.011					
11Cl-PF3OUdS	Native Analyte	631>451	0.011					
11Cl-PF3OUdS_2	Native Analyte	631>79.96	0.011					
M2-10:2FTS	IDA	634.21>612	0.011					
d9N-EtFOSE	IDA	639>59	0.011					
PFTrDA	Native Analyte	663>619	0.011					
PFTrDA_2	Native Analyte	663>169	0.011					
PFDoS	Native Analyte	699>80	0.011					
PFDoS_2	Native Analyte	699>99	0.011					
PFTeDA	Native Analyte	713>169	0.011					
PFTeDA_2	Native Analyte	713>219	0.011					
13C2_PFTeDA	IDA	715>670	0.011					
PFHxDA	Native Analyte	813>769	0.011					
PFHxDA_2	Native Analyte	813>169	0.011					
13C2_PFHxDA	IDA	815>770	0.011					
PFODA	Native Analyte	913>869	0.011					
PFODA_2	Native Analyte	913>169	0.011					

Table 11.17 – 3
Retention Times & Quantitation

Native Compounds	Typical Native RT (minutes)	IDA analog	Typical IDA RT (minutes)	Quantitation Method
PFPrA	[redacted]	13C4_PFBA	[redacted]	Isotope Dilution
PFMOAA		13C4_PFBA		Isotope Dilution
R-EVE		13C4_PFBA		Isotope Dilution
PFBA		13C4_PFBA		Isotope Dilution
PMPA		13C4_PFBA		Isotope Dilution
PFPrS		13C3-PFBS		Isotope Dilution
NVHOS		13C4_PFBA		Isotope Dilution
PFECA F		13C5_PFPeA		Isotope Dilution
PFO2HxA		13C5_PFPeA		Isotope Dilution
PEPA		13C5_PFPeA		Isotope Dilution
3:3 FTCA		13C3-PFBS		Isotope Dilution
PFPeA		13C5_PFPeA		Isotope Dilution
PFBS		M3-PFBS		Isotope Dilution
PFECA A		13C5_PFPeA		Isotope Dilution
PES		13C3-PFBS		Isotope Dilution
PFECA B		13C2_PFHxA		Isotope Dilution
4:2 FTS		M2-4:2FTS		Isotope Dilution
PFO3OA		13C2_PFHxA		Isotope Dilution
PFHxA		13C2_PFHxA		Isotope Dilution
PFPeS		13C3-PFBS		Isotope Dilution
HFPO-DA		13C3_HFPO-DA		Isotope Dilution
R-PSDCA		13C4_PFHpA		Isotope Dilution
Hydro-EVE Acid		13C4_PFHpA		Isotope Dilution
5:3 FTCA		13C-6:2 FTCA		Isotope Dilution
PFO4DA		13C4_PFHpA		Isotope Dilution
PFECA_G		13C-6:2 FTCA		Isotope Dilution
PFHpA		13C4_PFHpA		Isotope Dilution
PFHxS		18O2_PFHxS		Isotope Dilution
6:2 FTUCA		13C-6:2 FTUCA		Isotope Dilution
6:2 FTCA		13C-6:2 FTCA		Isotope Dilution
DONA		13C4_PFOS		Isotope Dilution
PS Acid		13C4_PFOA		Isotope Dilution
EVE Acid		13C4_PFOA		Isotope Dilution
PFECHS		13C4_PFOA		Isotope Dilution
6:2 FTS		M2-6:2FTS		Isotope Dilution
PFOA		13C4_PFOA		Isotope Dilution
PFHpS		13C4_PFOS		Isotope Dilution
Hydro-PS Acid		13C4_PFHpA		Isotope Dilution
PFO5DoA (TAF		13C4_PFOA		Isotope Dilution
7:3 FTCA		13C-8:2 FTCA		Isotope Dilution

Table 11.17 – 3
Retention Times & Quantitation

Native Compounds	Typical Native RT (minutes)	IDA analog	Typical IDA RT (minutes)	Quantitation Method
8:2 FTUCA	[redacted]	13C-8:2 FTUCA	[redacted]	Isotope Dilution
PFOS		13C4_PFOS		Isotope Dilution
PFNA		13C5_PFNA		Isotope Dilution
8:2 FTCA		13C-8:2 FTCA		Isotope Dilution
9Cl-PF3ONS		13C4_PFOS		Isotope Dilution
PFOSA		13C8_PFOSA		Isotope Dilution
PFNS		13C4_PFOS		Isotope Dilution
PFDA		13C2_PFDA		Isotope Dilution
8:2 FTS		M2-8:2FTS		Isotope Dilution
N-MeFOSAA		d3-MeFOSAA		Isotope Dilution
PFDS		13C4_PFOS		Isotope Dilution
10:2 FTUCA		13C-10:2 FTUCA		Isotope Dilution
10:2 FTCA		13C-10:2 FTCA		Isotope Dilution
PFUdA		13C2_PFUdA		Isotope Dilution
N-EtFOSAA		d5-EtFOSAA		Isotope Dilution
N-MeFOSE		d7N-MeFOSE		Isotope Dilution
MeFOSA		d3MeFOSA		Isotope Dilution
11Cl-PF3OUdS		13C4_PFOS		Isotope Dilution
N-EtFOSE		d9N-EtFOSE		Isotope Dilution
EtFOSA		d5EtFOSA		Isotope Dilution
PFDoA		13C2_PFDoA		Isotope Dilution
10:2 FTS		M2-10:2FTS		Isotope Dilution
PFDoS		13C4_PFOS		Isotope Dilution
PFTrDA		13C2_PFDoA		Isotope Dilution
PFTeDA		13C2_PFTeDA		Isotope Dilution
PFHxDA		13C2_PFHxDA		Isotope Dilution
PFODA		13C2_PFHxDA		Isotope Dilution

11.17.1. Post Spike Sample Analysis for AFFF samples

11.17.1.1. This section only applies to aqueous samples prepared by serial dilution instead of SPE that have reported value of <LOQ (RL) for any analyte.

11.17.1.2. Spike aliquots of the sample at the final dilution reported for the sample with all analytes that have reported of <LOQ in the final dilution. The spike must be at the LOQ concentration to be reported with the sample (the < LOQ value).

11.17.1.3. When analyte concentrations are calculated as <LOQ, the spike must recover within 70-130% of its true value.

11.17.1.4. It the recovery does not meet this criteria, the sample, sample duplicate and post spike sample must be reanalyzed at consecutively higher dilutions until the criteria is met.

11.17.2. Tune and calibrate the instrument as described in Section 10.

11.17.3. A typical run sequence is as follows:

- Rinse Blank (RB, not linked to anything)
- Start ICAL with CCVL but called IC in TALS (starts the 12 hour clock or time 0:00)
- Rest of ICAL
- ICB: link to midpoint of ICAL and samples
- ICV: link to midpoint of ICAL and samples (If ICAL good)
- CCB: link to midpoint of ICAL and samples
- PFOA RT marker
- Rinse Blank (RB, not linked to anything)
- 10 samples: link to midpoint of ICAL
- CCV: link to midpoint of ICAL
- 10 more samples: link to midpoint of ICAL
- CCV: link to midpoint of ICAL
- Etc.
- CCVL (within 12 hours from CCVL in ICAL, can be the ending CCV and starts 12 hours all over again): if this occurs link to the midpoint of the ICAL/toggle it as opening/closing CCV.
- CCV: link to midpoint of ICAL
- 10 samples: link to midpoint of ICAL
- CCV: link to midpoint of ICAL
- If no ICAL run that day
- CCB: link to CCVIS
- CCVL (starts 12 hour clock): link to CCVIS
- CCVIS: link to midpoint of ICAL
- 10 samples: link to CCVIS
- CCV: link to CCVIS
- 10 samples: link to CCVIS
- CCV: link to CCVIS
- Etc.

- If going over 12 hours in the sequence: CCVL (within 12 hours from CCVL at item 2 above, can be the ending CCV and starts 12 hours all over again): if this occurs link to the CCVIS /toggle as opening and closing CCV.
- CCV: link to CCVIS
- 10 samples: link to CCVIS
- CCV: link to CCVIS

11.18. Vortex all sample aliquots and standards prior to placing on the autosampler.

11.19. Samples analyzed subsequent to any sample with results at or above the upper calibration limit must be evaluated for potential carryover, and corrective actions taken, as detailed below.

11.19.1. If carryover is suspected, those samples are to be re-analyzed from a fresh extract aliquot (i.e. go the archive of the extract).

11.19.2. Should there be instrument contamination, as evident by sample carryover, any sample >5X the UCL or instrument blanks with detections > RL:

- Analyze 20 blanks alternating between 1% formic acid/methanol and 1% formic acid/water.
- Then analyze 3 methanol only blanks.
- If the system is clean resume analyses. Proceed to 11.19.4. If not clean, proceed as directed below.

11.19.3. If the system is still contaminated the following items might need to be cleaned or replaced:

- Reverse flush the analytical column
- Reverse flush the isolation column
- Replace the column (isolation, analytical or both)
- Clean the cones/entry port
- Replace the PEEK tubing in the sample pathway
- Then, repeat 11.19.2.

11.19.4. Should a high level sample be analyzed that triggers these steps then detections for those analytes over the next 2-3 days require additional evaluation (are all instrument blanks from the sequence < ½ RL) and possible re-analysis. If sample results replicate and the associated instrument blanks from the sequences are <1/2 RL then one can assume the system is under control and confirmation of positive detections can stop.

12. CALCULATIONS / DATA REDUCTION

12.1. If the concentration of the analyte ions exceeds the working range as defined by the calibration standards, then the sample might require to be diluted and reanalyzed, based upon client need. It may be necessary to dilute samples due to matrix.

12.2. Extracts can be diluted up to 100X without diluting out the IDA and thus preserving quantitation via isotope dilution. Dilutions greater than 100X can be performed but additional IDA must be added. The quantitation will now be via internal standard as a result and will have a low bias as extraction losses will no longer be taken into account. Consult the client for authorization of such a dilution.

12.3. Results less than the reporting limit are flagged in the client report as estimated. Generally, the "J" flag is used to denote ≥ MDL and ≤ RL, but the specific flag may change based on client requirements.

12.4. Qualitative Identification

12.4.1. The retention times of PFAS with labeled standards should be the same as that of the labeled IDA's to within 0.1 min. For PFAS with no labeled standards, the RT must be within ± 0.3 minutes of the ICV if analyzed immediately following the ICAL or the most recent CCV standard.

Note: The IDA RT and native RT may be offset by 0.02 to 0.04 minutes.

12.4.1.1. Criteria for samples analyzed in accordance with QSM 5.3: The peak RT must be within 0.4 mins of the CCV or midpoint of the ICAL.

12.4.2. PFBS, PFHxS, PFOS, NMeFOSAA, and NEtFOSAA have multiple chromatographic peaks using the LC conditions specified in the method due to the linear and branch isomers of these compounds. Most PFAS compounds are produced by one of two processes. One gives rise to linear PFAS only while the other process produces both linear and branched isomers. Both branched and linear PFAS compounds can potentially be found in the environment. For the aforementioned compounds that give rise to more than one peak, all chromatographic peaks observed in the standard must be integrated and the areas totaled. Chromatographic peaks in the sample must be integrated in the same way as the calibration standard and concentrations reported as a total for each of these analytes.

12.4.3. The expected retention times (RT) are established in the Chrom data processing module during the processing of the ICAL by selecting Edit>Method>Update RT. Once the retention times are established Chrom

will look for a peak within ± 0.25 minutes of the RT. The analyst confirms that the branched isomers present in the quantitative calibration standards for PFOS, PFHxS, NEtFOSAA and NMeFOSAA are within the ± 0.25 minute window. If they are not, an adjustment to the RT window is made. The analyst confirms the presence of the branched isomers in the technical (qualitative) PFOA standard as well, and adjusts the RT window for PFOA if they are not present within the ± 0.25 minute window.

12.4.3.1. If a peak is detected within this window of ±0.25 minutes, Chrom will assign the absolute retention time at the apex of the peak. Chrom assigns the RT to the most predominant peak within this window. As the linear peak is the predominant peak in calibration solutions for those PFAS that are calibrated with the combination of both branched and linear isomers, those PFAS require additional evaluation in the event that the branched isomer is the predominant peak in a field sample and Chrom has not positively identified the peak due to the RT shift, as the apex may now be the branched isomer.

12.4.3.2. Additional evaluation is required if the field samples contain branched isomers not present in the quantitative or qualitative standards. The analyst confirms that only the peaks present in the calibration standards are included in the peak integration, or adjusts the peak integration to assure that only the peaks present in the standards are identified and quantitated.

12.4.3.3. RT are updated as needed based upon evaluation of the daily CCV.

12.4.4. The signal to noise ratio for both quantitative and qualitative ions/transitions must be ≥ 3:1 for a baseline deflection to be considered a peak. If this criterion is not met, the analyte is not considered and reported as "non-detect".

12.5. The ICAL established in Section 10 is used to calculate concentrations for the extracts.

12.6. Extract concentrations are calculated as below. The first equation applies Average Response Factor model, the second to a linear fit, and the third to the quadratic line fit.

Equation 4 $$Concentration\ (ng/mL) = \frac{y}{RRF}$$

Equation 5 $$Concentration\ (ng/mL) = \frac{y-c}{b}$$

Equation 6 $$Concentration\ (ng/mL) = \frac{-b \pm \sqrt{b^2 - 4a(c-y)}}{2a}$$

Where:

y = $\frac{Area_{Target}}{Area_{IDA}} \times Concentration(IDA)$

RRF = Relative Response Factor

x = concentration

a = curvature

b = slope

c = intercept

12.7. Water Sample Result Calculation:

Equation 7 $$Concentration\ (ng/L) = \frac{C_{ex}V_t}{V_0}$$

Where:

C_{ex} = Concentration measured in sample extract (ng/mL)

V_t = Volume of total extract (mL)

V_o = Volume of water extracted (L), i.e. total volume fortified with IDA

12.8. Soil Sample Result Calculation:

Equation 8 $$Concentration\ (ng/g) = \frac{C_{ex}V_t}{W_s D}$$

Where ng/g = µg/kg and:

C_{ex} = Concentration measured in sample extract (ng/mL)

V_t = Volume of total extract (mL)

W_s = Weight of sample extracted (g)

D = Fraction of dry solids, which is calculated as follows:

$\frac{100 - \%\ moisture\ in\ sample}{100}$ (for dry weight result)

12.9. IDA Recovery Calculation:

Equation 9 $$\%\ Recovery = \frac{A_{IDA}Q_{IS}}{A_{IS}Q_{IDA}RRF_{IDA}} \times 100$$

Where:

RRF_{IDA} = Response Factor for IDA compound

A_{IDA} = Area response for IDA compound

A_{IS} = Area Response for IS compound

Q_{IS} = Amount of IS added

Q_{IDA} = Amount of IDA added

12.10. Raw data, calibration summaries, QC data, and sample results are reviewed by the analyst. These must also be reviewed thoroughly by a second qualified person. See the Data Review Policy (WS-PQA-0012). These reviews are documented in TALS.

13. METHOD PERFORMANCE

13.1. The group/team leader has the responsibility to ensure that this procedure is performed by an associate who has been properly trained in its use and has the required expertise.

13.2. Method Detection Limit

The laboratory must generate a valid method detection limit for each analyte of interest. The MDL must be below the reporting limit for each analyte. The procedure for determination of the method detection limit is given in 40 CFR Part 136, Appendix B, and further defined in SOP WS-QA-0006 and policy WS-PQA-003. MDLs are available in the Quality Assurance Department.

13.3. Initial Demonstration of Capability (IDOC)

Each analyst performing this procedure must successfully analyze four LCS QC samples using current laboratory LCS control limits. IDOCs are approved by the Quality Assurance Manager and the Technical Director. IDOC records are maintained by the QA staff in the central training files.

14. POLLUTION PREVENTION

14.1. All waste will be disposed of in accordance with Federal, State and Local regulations.

14.2. Solid phase extraction used for water samples greatly reduces the amount of solvent used compared to liquid-liquid extraction.

14.3. Standards and reagents are purchased and prepared in volumes consistent with laboratory use to minimize the volume of expired standards and reagents requiring disposal.

14.4. Where reasonably feasible, technological changes have been implemented to minimize the potential for pollution of the environment. Employees will abide by this method and the policies in Section 13 of the Corporate Safety Manual for “Waste Management and Pollution Prevention.”

14.5. Do not allow waste solvent to vent into the hoods. All solvent waste is stored in capped containers unless waste is being transferred.

14.6. Transfer waste solvent from collection cups (tri-pour and similar containers) to jugs and/or carboys as quickly as possible to minimize evaporation.

15. WASTE MANAGEMENT

The following waste streams are produced when this method is carried out:

15.1. Assorted test tubes, autovials, syringes, filter discs and cartridges. Dump the solid waste into a yellow contaminated lab trash bucket. When the bucket is full or after no more than one year, tie the plastic bag liner shut and put the lab trash into the hazardous waste – landfill steel collection drum in the H3 closet. When the drum is full or after no more than 75 days, move it to the waste collection area for shipment.

15.2. Extracted soil samples, used sodium sulfate, paper funnel filters, glass wool, thimbles, and extracted solids saturated with solvents. Dump these materials into an orange contaminated lab trash bucket. When the bucket is full or after no more than one year, tie the plastic bag liner shut and put the lab trash into the incineration steel collection drum in the H3 closet. When the drum is full or after no more than 75 days, move it to the waste collection area for shipment.

15.3. Waste Methanol. Collect the waste solvents in tripours during use. Empty the tripours into a 1-liter to 4-liter carboy at the fume hood. When the carboy is full, or at the end of your shift, whichever comes first, empty the carboy into the steel flammable solvent drum in the H3 closet. When the drum is full to between four and six inches of the top, or after no more than 75 days, move the steel flammable solvent drum to the waste collection area for shipment.

15.4. Mixed water/methanol waste from soil extraction. Collect the waste in the HPLC waste carboy. When full, or after no more than one year, dump into the blue plastic HPLC collection drum in the H3 closet. When the drum is full to between four and six inches of the top or after no more than 75 days, move it to the waste collection area for shipment.

15.5. Aqueous acidic waste from the LCMS instrument contaminated with methanol. This is collected in a 1-gallon carboy at the instrument. When the carboy is full, or after no more than one year, it is emptied into the blue plastic HPLC collection drum in the H3 closet. When the drum is full to between four and six inches of the top or after no more than 75 days, move it to the waste collection area for shipment.

15.6. Autovials contaminated with methanol. As the autovials are removed from the instrument after analysis, they are collected in open containers at the instrument. After all autovials are removed, the open container must be dumped into a closed satellite collection container in a fume hood, as the punctured septa in the autovial can allow methanol and other contaminants to evaporate into the atmosphere. The satellite collection containers are transferred to the waste disposal area when full or after no more than one year, where they are disposed through the vial eater.

16. REFERENCES

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16.2. John Giesy et al., "Accumulation of Perfluorooctane Sulfonate in Marine Mammals", Environmental Science & Technology, 2001 Vol. 35, No. 8, pages 1593-1598.

16.3. U.S. EPA, "Residue Chemistry Test Guidelines, OPPTS 860.1340, Residue Analytical Method", EPA 712-C-95-174, August 1995.

16.4. STL Denver White Paper DEN-W-LC-002, "Method Validation Study for Analysis of Ammonium Perfluorooctanate in Soil Matrices by High Performance Liquid Chromatography/Mass Spectrometry (HPLC/MS/MS)", Mark Dymerski, September 5, 2003.

16.5. STL Denver White Paper DEN-W-LC-003, "Addendum A to Method Validation Study for Analysis of Ammonium Perfluorooctanate in Soil Matrices by High Performance Liquid Chromatography/Mass Spectrometry (HPLC/MS/MS)", Mark Dymerski, August 6, 2003.

16.6. STL Denver White Paper DEN-W-LC-004, "Method Validation Study for Analysis of Perfluorooctanoic Acid in Waters by High Performance Liquid Chromatography/Tandem Mass Spectrometry (HPLC/MS/MS)", Mark Dymerski, January 26, 2005.

16.7. Waters application note; "Acquity UPLC System for Quantifying Trace Levels of Perfluorinated Compounds with an Acquity PFC Analysis Kit", Peter J. Lee, Evan T. Bernier, Gordon T. Fujimoto, Jeremy Shia, Michael S. Young, and Alice J. Di Gloia, Waters Corporation, Milford, MA. USA.

16.8. US EPA, "Method 537 - Determination of Selected Perfluorinated alkyl acids in Drinking Water by Solid Phase Extraction and Liquid Chromatography/Tandem Mass Spectrometery (LC/MS/MS)", Version 1.1, September 2009, J.A. Shoemaker, P.E. Grimmett, B.K. Boutin, EPA Document #: EPA/600/R-08/092

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16.10. Erika F. Houtz and David L. Sedlak, "Oxidative Conversion as a Means of Detecting Precursors to Perfluoroalkyl Acids in Urban Runoff," Environmental Science and Technology 46, no. 17 (2012): 9342-49.

16.11. U.S. Department of Denfense (DoD)/Department of Energy (DOE) Consolidated Quality Systems Manual (QSM) for Environmental Laboratories, Version 5.1.1, dated 2017.

16.12. U.S. Department of Denfense (DoD)/Department of Energy (DOE) Consolidated Quality Systems Manual (QSM) for Environmental Laboratories, Version 5.3 dated 2019.

17. METHOD MODIFICATIONS

17.1. Modifications from Method 537 are detailed below:

17.1.1. Target analyte results are quantitated via isotope dilution.

17.1.2. Two ion transitions (precursor to quant ion and precursor to confirmation ion) are monitored for those analytes that have two transitions. Ion ratios are monitored as well for these analytes.

17.1.3. Water sample containers are not preserved with Trizma.

17.1.4. The method has been modified to address soil/solid matrices. The extraction holding time is set at 14 days.

17.1.5. The analyte list has been expanded. The number of labeled analytes has been expanded as well to improve quantitation.

17.1.6. The reporting limits differ as they are all set at one consistent value whenever possible.

17.1.7. Calibration levels differ from the referenced method.

17.1.8. More labeled analytes are fortified into the samples prior to the extraction process. Most target analytes are quantitated against a labeled analyte.

17.1.9. There is no symmetry requirement.

17.1.10. Calibration, both initial and continuing, has different acceptance criteria due to the longer list of analytes, and the use of isotope dilution quantitation.

17.1.11. The eluents and HPLC configuration differs. As a result the final extract is in 80:20 methanol:water.

17.1.12. The LCS and MS/MSD are spiked at one concentration and do not rotate between a low to high levels.

17.1.13. Samples are not checked for residual chlorine or pH.

17.1.14. A different SPE cartridge [redacted] is used for the extraction process. As a result solvents and elution procedures are different.

18. ATTACHMENTS

There are no attachments to this SOP.

19. REVISION HISTORY

Revisions prior to 9/1/2020 have been removed and are available in previous versions of this SOP.

19.1. Comparison of WS-LC-0025 Revision 3.6 to WS-LC-0025 Revision 4.0, Effective 01/27/2021

19.1.1. This SOP has undergone substantial revision to incorporate many new analytes. The addition of parameters affects Sections 1, 7.4 through 7.9, and 11.16.

19.1.2. Removed all references to Waters LCMS systems – this affects sections 6 and 11.

19.1.3. Removed all references and procedures for concentrating extracts.

19.1.4. All references to the DOD/DOE QSM have been updated to refer to Version 5.3.

19.1.5. The soil preparation has been revised to use a shorter extraction process. Table 1.3, Section 2.2 and Section 11.7 have been updated to reflect these changes.

19.1.6. Agency-specific criteria for calibration, holding times, QC acceptance, etc., have been codified in SOP WS-WI-0066. With the exception of DOD/DOE requirements, they are not included in this document.

19.1.7. Specific instruction for preparation of standard solutions (intermediate and working) has been included in Sections 7.4 through 7.9. This includes information formerly present in WS-LC-0025 Revision 3.6 Attachment 2. The tables have been updated to reflect changed concentration values for specific IDA. The IDA that were at 5x the others are now at the same concentration.

19.1.8. The information present in Attachment 1 of Revision 3.6 (describing an in-

line SPE process for analysis of water samples) has been moved to SOP WS-LC-0025 Att1.

19.1.9. The SPE cartridges (Section 6.9) used for water extraction and solid extract cleanup have been changed. The new cartridges incorporate graphitized carbon, which is now applied to all sample extracts. The solvent systems used with this cartridges have been updated as needed in Section 11.

19.1.10. Columns and SPE cartridges no longer used have been removed from Section 6.

19.1.11. Section 4.5 (discussion of branched and linear isomers) has been revised to include Et-FOSAA and Me-FOSAA.

19.1.12. Section 7.15 (Ammonium Acetate preparation) has been revised to remove the filtration prior to use, and to correct the weight of the salt to 1.54g.

19.1.13. Section 8 (Sample Collection, Preservation, and Holding Times) has been reformatted with a table to clarify containers, preservation, and holding times. Guidance for bi-phasic samples has been incorporated into this section.

19.1.14. Corrective actions for IDA have been added to Section 9.8

19.1.15. Updated the guidance and criteria for the TOP Assay in the event of incomplete oxidation of field samples in Section 9.10.

19.1.16. Guidance and criteria for ion ratios has been added as Section 9.11.

19.1.17. Section 10.3 updated to clarify mass calibration process and frequency for the LCMS.

19.1.18. Section 11.7, Tables 2 and 3 have been combined. The transitions monitored for HFPO-DA and 13C-HFPO-DA have been updated to match those detailed in Method 537.1.

19.1.19. Added guidance in Section 12 regarding the maximum dilution before IDA are diluted out.

19.1.20. Added a note in Section 12 regarding flagging of results less than the reporting limit.

19.1.21. Section 16 has been updated to include reference to QSM version 5.1.1 and 5.3, as well as Method 537.1

19.1.22. Updated Section 17 to include mention of isotope dilution, monitoring two ion transitions, and ion ratios.

19.1.23. Editorial changes

19.2. Comparison of WS-LC-0025 Revision 3.8 to WS-LC-0025 Revision 4.0, Effective 09/30/2020

19.2.1. This SOP has undergone substantial revision to incorporate many new analytes. The addition of parameters affects Sections 1, 7.4 through 7.9, and 11.16.

19.2.2. All references to the DOD/DOE QSM have been updated to refer to Version 5.3.

19.2.3. The soil preparation has been revised to use a different aliquot size, and a shorter extraction process. Table 1.3, Section 2.2 and Section 11.7 have been updated to reflect these changes.

19.2.4. References to agency-specific criteria for calibration, holding times, QC acceptance, as codified in SOP WS-WI-0066 have been added.

19.2.5. The SPE cartridges (Section 6.9) used for water extraction and solid extract cleanup have been changed. The new cartridges incorporate graphitized carbon, which is now applied to all sample extracts. The solvent systems used with this cartridges have been updated as needed in Section 11.

19.2.6. Section 4.5 (discussion of branched and linear isomers) has been revised to include Et-FOSAA and Me-FOSAA.

19.2.7. Section 7.1.2 (Ammonium Acetate preparation) has been revised to remove the filtration prior to use, and to correct the weight of the salt to 1.54g.

19.2.8. Section 7.10 now directs the user to make the TOP reverse surrogate solution in water, rather than Methanol.

19.2.9. Section 8 (Sample Collection, Preservation, and Holding Times) has been reformatted with a table to clarify containers, preservation, and holding times. Guidance for bi-phasic samples has been incorporated into this section.

19.2.10. Expanded the guidance and corrective actions for IDAs in Section 9.8. Also updated the criteria for the FOSE IDA.

19.2.11. Updated the guidance and criteria for the TOP Assay in the event of incomplete oxidation of field samples in Section 9.10.

19.2.12. Updated the guidance and criteria for ion ratios has been added in Section 9.11.

19.2.13. Section 11.7, Tables 2 and 3 have been combined. The transitions monitored for HFPO-DA and 13C-HFPO-DA have been updated to match those detailed in Method 537.1.

19.2.14. Section 12.4 has been expanded to include more detail regarding retention times and qualitative identification.

19.2.15. Editorial changes.

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