THE UNITED STATES AIR FORCE

INSTALLATION RESTORATION PROGRAM



Final
Per- and Polyfluoroalkyl Substances (PFAS) Plume Monitoring
Eielson Air Force Base, Alaska

Unform Federal Policy – Quality Assurance Project Plan (UFP-QAPP)

Prepared for:
U.S. Army Corps of Engineers and Air Force Civil Engineer Center

July 2024

Final
Per- and Polyfluoroalkyl Substances (PFAS) Plume Monitoring
Eielson Air Force Base, Alaska

Unform Federal Policy – Quality Assurance Project Plan (UFP-QAPP)

Prepared for:
U.S. Army Corps of Engineers and Air Force Civil Engineer Center

Prepared by:
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Contract No. W911KB-20-D-0012

July 2024

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Appendix F: Regulatory Comments

ACRONYMS AND ABBREVIATIONS

°C	degrees Celsius
%D	Percent difference
µg/L	Microgram(s) per liter
AAC	Alaska Administrative Code
ADEC	Alaska Department of Environmental Conservation
AFB	Air Force Base
AFCEC	Air Force Civil Engineer Center
AFFF	Aqueous Film-Forming Foam
APP	Accident Prevention Plan
AST	Aboveground storage tank
bgs	Below ground surface
CCV	Continuing calibration verification
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CoC	Chain of custody
COR	Contracting Officer's Representative
CWMA	Critical Water Management Area
DL	Detection limit
DO	Dissolved oxygen
DoD	Department of Defense
DOT	Department of Transportation
DQI	Data quality indicator
DQO	Data quality objective
DU	(Laboratory) duplicate
DUA	Data usability assessment
EA	EA Engineering, Science, and Technology, Inc., PBC
EDD	Electronic Data Deliverable
EIS	Extracted Internal Standard
ELAP	Environmental Laboratory Accreditation Program
ENVF	environmental form
ENVP	Environmental Procedure
EO	Executive Order
EPA	United States Environmental Protection Agency

ERPIMS	Environmental Restoration Program Information Management System
Eurofins	Eurofins Sacramento Laboratories Environmental, LLC
FDNM	Fairbanks Daily News-Miner
FFA	Federal Facilities Agreement
FNSB	Fairbanks North Star Borough
ft	Feet
GAC	Granular activated carbon
gpm	Gallons per minute
HA	US EPA Drinking Water Health Advisory Level
HDPE	High-density polypropylene
HQ	Hazard quotient
IB	Instrument blank
ICAL	Initial calibration
ICV	Initial calibration verification
ID	Identification
IDQTF	Intergovernmental Data Quality Task Force
IDW	Investigation-derived waste
IRP	Installation Restoration Program
ISC	Instrument sensitivity check
JV	Joint Venture
LC/MS/MS	Liquid chromatography tandem mass spectrometry
LCL	Lower control limit
LCS	Laboratory control sample
LDPE	Low-density polyethylene
LHA	Lifetime Health Advisory
LLCS	Low-level laboratory control sample
LOD	Limit of detection
LOQ	Limit of quantitation
LUC	Land use control
MAROS	Monitoring and Remediation Optimization System
MB	Method blank
MDL	Method detection limit
MED	Manual for Electronic Deliverables

MS	Matrix spike
MSD	Matrix spike duplicate
mV	Millivolt
NA	Not applicable
NELAP	National Environmental Laboratory Accreditation Program
ng/L	Nanograms per liter
NIS	Non-extracted internal standard
NPL	National Priorities List
NTU	Nephelometric turbidity unit
ORP	Oxidation reduction potential
OU	Operable unit
PAL	Project action level
PDF	Portable Document Format
PFAS	Per- and polyfluoroalkyl substances
PFOA	Perfluorooctanoic acid
PFOS	Perfluorooctanesulfonic acid
PG	Professional Geologist
PM	Project Manager
PMP	Project Management Professional
POC	Point of contact
PPE	Personal protective equipment
ppt	parts per trillion
PQO	Project quality objective
PVC	Polyvinyl chloride
QA	Quality assurance
QAP	Quality Assurance Procedure
QAPP	Quality assurance project plan
QC	Quality control
QSM	Quality Systems Manual
ROD	Record of Decision
RPD	Relative percent difference
RPM	Remedial Project Manager
RSE	Relative standard error

RSL	Regional Screening Level
SARA	Superfund Amendments and Reauthorization Act of 1986
SDG	Sample Delivery Group
SOP	Standard operating procedure
SPF	Sun protection factor
SSHO	Site Safety and Health Officer
TBD	To be determined
UCL	Upper control limit
UFP	Uniform Federal Policy
USACE	United States Army Corps of Engineers
USAF	United States Air Force
UST	Underground storage tank

1.0 INTRODUCTION

North Wind-EA Joint Venture (JV) has developed this Uniform Federal Policy for Quality Assurance Project Plan (UFP-QAPP) in accordance with the UFP-QAPP format prescribed by the Intergovernmental Data Quality Task Force (IDQTF; 2005) and Optimized UFP-QAPP Worksheets (IDQTF 2012). This UFP-QAPP provides guidance and applicable information for executing field activities, data analysis, and reporting as part of environmental restoration support in the continuation of interim remedy implementation for Moose Creek long-term water supply through groundwater sampling and plume evaluation for 80 monitoring wells from per- and polyfluoroalkyl substances (PFAS) contamination migrating from Eielson Air Force Base (AFB) to Moose Creek, Alaska. This work is conducted under Contract No. W911KB-20-D-0012 for the Air Force Civil Engineering Center (AFCEC).

1.1 Purpose

The work is performed under the Installation Restoration Program (IRP), which was developed to provide response actions for Department of Defense (DoD) installations, as required by Section 120 of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) (as clarified by Executive Order [EO] 12316 and amended by the Superfund Amendments and Reauthorization Act of 1986 [SARA]). The current DoD policy was specified in the Defense Environmental Quality Program Policy Memorandum 81-5, dated 11 December 1981, and was implemented by the United States Air Force (USAF) in a message dated 21 January 1982. The DoD policy is to identify and fully evaluate suspected problems associated with past operations that may have caused hazardous waste contamination, and to implement remedial actions that will minimize the hazards to human health and the environment resulting from such past operations.

PFAS are a class of synthetic fluorinated chemicals used in industrial and consumer products, including defense-related applications. In the early 1970s, the USAF began using aqueous film-forming foam (AFFF) containing PFAS, specifically perfluorooctane sulfonate (PFOS), which may degrade to perfluorooctanoic acid (PFOA). Releases of AFFF to the environment routinely occur during fire training, equipment maintenance, storage, and use. Releases of PFOS and PFOA to soil and groundwater were confirmed on Eielson AFB in Summer 2014. This work was conducted under the *UFP-QAPP for Site Investigations of Fire Fighting Foam Usage at Various AFBs in the United States* (USACE 2013). Groundwater data indicated the potential for contamination to migrate offsite into the Moose Creek community (to the northwest of Eielson AFB).

In 2015, the USAF initiated a supplemental remedial investigation–risk assessment (RI-RA), and workplans were developed for each of the six OUs to address the need for additional data and/or mitigation. As of 2022, the RI-RA reports were finalized. USAF has begun developing workplans for Supplemental RI/RA data gaps investigations. ADEC and EPA are currently reviewing the work plans.

During 2016, site inspections were conducted at 15 aqueous film forming foam (AFFF) areas at Eielson AFB. PFAS concentrations were found to be highest in soil and groundwater within the Former Ball Field Spray Test Area and Former Fire Training Areas by the current Entomology Building (Figure 2).

The *Expanded Perfluorooctanoic Acid (PFOA) and Perfluorooctanesulfonic (PFOS) and Perfluorobutane Sulfonate (PFBS) Site Inspection, Uniform Federal Policy-Quality Assurance Project Plan Work Plan, Eielson Air Force Base and Moose Creek, Alaska (*EA Engineering 2019), was approved by EPA and DEC in September 2019. The inspection is completed and has provided information on the extent of PFOS and PFOA in groundwater. The work included the installation of permanent monitoring wells on the PFOS/PFOA plume edge (USAF 2022).

During 2019, North Wind-EA JV conducted biannual sampling of 20 monitoring wells (including 12 nested wells installed by North Wind – EA JV) for PFAS analysis. In 2021, the biannual sampling was increased to 40 monitoring wells and then 80 existing monitoring wells during 2022 and 2023. Beginning in 2022, the groundwater analytical data for shallow wells was used to evaluate plume characteristics and characterize the plume concentrations using Monitoring and Remediation Optimization System (MAROS) software Version 2.2. The intermediate and deeper wells were evaluated by trend analysis utilizing the EPA's statistical software ProUCL version 5.2.

Per this contract, W911KB-20-D-0012, North Wind-EA JV will continue to provide environmental restoration support at Eielson AFB, in the continuation of Interim Remedy implementation for Moose Creek Long-Term Water Supply. The proposed activities addressed in this QAPP include:

1. Groundwater sampling of up to 80 existing monitoring wells, twice a year, to be analyzed for PFAS via United States Environmental Protection Agency (EPA) Method 1633; and
2. Groundwater plume evaluation for PFAS.

This UFP-QAPP outlines the policies, organization, and specific quality assurance (QA)/quality control (QC) measures associated with the collection, analysis, and reporting of data in support of the project actions to achieve the data quality goals. This document meets the requirements and elements set forth in the IDQTF UFP for QAPPs (EPA 2005, 2012).

1.2 Document Organization

The UFP-QAPP worksheets immediately follow this introduction. References used in the preparation of this QAPP are provided following the QAPP worksheets. The appendices discussed in this report are as follows:

- **Appendix A**: Field and Data Reporting Forms.
- **Appendix B**: Groundwater Plume Evaluation Work Plan
- **Appendix C**: Field Sampling Standard Operating Procedures (SOPs).
- **Appendix D**: Laboratory DoD Environmental Laboratory Accreditation Program (ELAP) and Alaska Department of Environmental Conservation (ADEC) Environmental Laboratory Approval Program Certificates and SOP.
- **Appendix E**: Waste Management Plan.
- **Appendix F**: Regulatory Comments

QAPP WORKSHEET #1: Title and Approval Page

Site Name/Project Name:	Perfluorinated Compounds Eielson-Moose Creek
Site Location:	Eielson Air Force Base (AFB)-Moose Creek Fairbanks North Star Borough (FNSB), Alaska
Document Title:	Per- and Polyfluoroalkyl Substances (PFAS) Plume Monitoring, Eielson Air Force Base, Alaska, Quality Assurance Project Plan (QAPP)
Lead Organization:	Air Force Civil Engineering Center (AFCEC)
Preparer's Name and Organizational Affiliation:	Kristy Carlstrom North Wind Site Services, LLC
Preparer's Address:	2525 C. Street, Suite 130 Anchorage, Alaska 99503
Telephone: **Number and E-mail address:**	(708) 359-6358 kristy.carlstrom@northwindgrp.com
Preparation Date (Month/Year):	November 2023
Investigative Organization's Project Manager/Date:	
Printed Name/Organization:	Kristy Carlstrom/North Wind Project Manager
Investigative Organization's Project QA/QC Manager/Date:	
Printed Name/Organization:	Candace Christenson/North Wind Regional Quality Manager
Document Control Numbering System:	Not required for this project.

Note: Approval letters for the UFP-QAPP from ADEC and USEPA will be provided in Appendix F of the Final UFP-QAPP.

QAPP WORKSHEET #2: QAPP Identifying Information

Site Name/Project Name: Perfluorinated Compounds Eielson-Moose Creek

Site Location: Eielson AFB and Moose Creek, FNSB, Alaska

Title: Perfluorinated Compounds Eielson-Moose Creek QAPP

Site Number/Code:	Not applicable (NA)	**Revision Number**:	01
Operable Unit:	NA	**Revision Date**:	December 2023
Contractor Name:	North Wind-EA JV, LLC.		
Contract Title:	Moose Creek Long-Term Water Supply Interim Remedy Continuation of Water Provisioning, Community Involvement, Treatment System Installation/Monitoring/Operations/Maintenance, Sampling and Groundwater Plume Evaluation for Eielson AFB, Alaska		
Contractor Number:	NA	**Work Assignment Number**:	NA

1. Identify regulatory program: CERCLA EO 12316 and amended by SARA
2. Identify approval entity: USACE/Eielson AFB/ADEC/EPA Region 10
3. The QAPP is (select one): _____ Generic ____X__Project Specific
4. List dates of scoping sessions that were held: _25 October 2023_
5. List dates and titles of QAPP documents written for previous site work, if applicable:

Title
Perfluorinated Compounds Investigation Work Plan, Eielson Air Force Base, Alaska, Final April 2015 (USAF 2015a).
Addendum #1 to the Final Perfluorinated Compounds Investigations Work Plan, (Final) 27 May 2015 (USAF 2015b).
Final Revision 1 Moose Creek Water Treatment Work Plan Eielson Air Force Base, Alaska June 2016 (USAF 2016a).
Revised Addendum #2 to the Perfluorinated Compounds Investigation Work Plan, Eielson Air Force Base, Alaska, Final 24 June 2016 (USAF 2016b).

Title
Final Addendum #4 to the Final Perfluorinated Compounds Investigations Work Plan, Eielson Air Force Base, Alaska, 30 June 2016 (USAF 2016c).
Final Perfluorinated Compounds Eielson-Moose Creek Quality Assurance Project Plan, Eielson Air Force Base, Alaska (USAF 2018a).
2021-22 Quality Assurance Project Plan (QAPP) Addendum, Perfluorinated Compounds, Eielson-Moose Creek, Eielson Air Force Base (AFB), Alaska (North Wind 2021).
2022-23 Quality Assurance Project Plan (QAPP) Addendum, Perfluorinated Compounds, Eielson-Moose Creek, Eielson Air Force Base (AFB), Alaska (North Wind 2022).

6. List organization partners (stakeholders and connection with lead organization):

Partners	Connection
USACE	Sponsor organization
Eielson AFB	Lead organization/technical oversight organization
EPA Region 10	Federal regulatory agency
ADEC	State regulatory agency
Property owners/tenants	Property owners/tenants

Abbreviations:
ADEC – Alaska Department of Environmental Conservation
AFB – Air Force Base
USACE – United States Army Corps of Engineers
EPA – United States Environmental Protection Agency

7. List data users: Same as above under No. 6.

QAPP WORKSHEET #3: Distribution List

QAPP Recipients	Title	Organization	Telephone Number	E-mail Address
Phil Charles	Contracting Officer	USACE	(907) 753-5579	phil.charles@usace.army.mil
Samantha Fox	Project Manager (PM)	USACE	(907) 753-2720	samantha.r.fox@usace.army.mil
Julie Allan	Contracting Officer's Representative (COR)	USACE	(907) 753-5555	julie.allan@usace.army.mil
Kristina Smith	Remedial PM	Eielson AFB	(907) 377-4299	kristina.smith.10@us.af.mil
Michael Boese	Alternate Remedial PM	Eielson AFB	(907)441-1346	michael.boese.1@us.af.mil
William Mangini	Remedial PM	Eielson AFB	907-726-4431	wdmangini@us.af.mil
Dawn Rodriguez	PFAS Program Manager	Eielson AFB	(907) 552-0312	dawn.rodriguez.2@us.af.mil
Axl LeVan	Remedial PM	ADEC	(907) 451-2156	axl.levan@alaska.gov
Sarah Bernhardt	Alternate Remedial PM	ADEC	(907) 269-7527	sarah.bernhardt@alaska.gov
Erin Gleason	Remedial PM	EPA Region 10	(907) 271-1209	Gleason.Erin@epa.gov
Renee LaFata	Program Manager	North Wind	(907)-891-7338	rlafata@northwindgrp.com
Kristy Carlstrom	PM	North Wind	(708) 359-6358	kristy.carlstrom@northwindgrp.com
Kevin Boyd	Project Chemist	North Wind	(951) 639-7170	kevin.boyd@northwindgrp.com
Candace Christensen	Regional Quality Manager	North Wind	(678) 972-5788	cchristensen@northwindgrp.com
Ray Peters	Corporate Health and Safety Director	North Wind	(865) 256-9812	rpeters@northwindgrp.com

QAPP Recipients	Title	Organization	Telephone Number	E-mail Address
John Blankenship	Site Safety and Health Officer (SSHO)	North Wind	(907) 347-3348	john.blankenship@northwindgrp.com
Mark Wilkinson	Alaska Operations Manager/Deputy PM	EA	(907)-646-0203	mwilkinson@eaest.com
Michael Jones	Project Engineer	EA	(907) 223-8701	mjones@eaest.com
Brenda Nuding	Project Chemist	EA	(808) 256-8268	bnuding@eaest.com
Sean Arnold	SSHO/Field Team Lead	EA	(907) 646-0211	sarnold@eaest.com;
Nathaniel Horner	Laboratory PM	Eurofins	(916) 374-4306	Nathaniel.Horner@et.eurofinsus.com

Abbreviations:
ADEC – Alaska Department of Environmental Conservation
AFB – Air Force Base
EA - EA Engineering, Science, and Technology, Inc. PBC
EPA – United States Environmental Protection Agency
Eurofins - Eurofins Sacramento Laboratories Environmental, LLC
North Wind - North Wind Site Services, LLC
QAPP - Quality Assurance Project Plan
USACE – United States Army Corps of Engineers

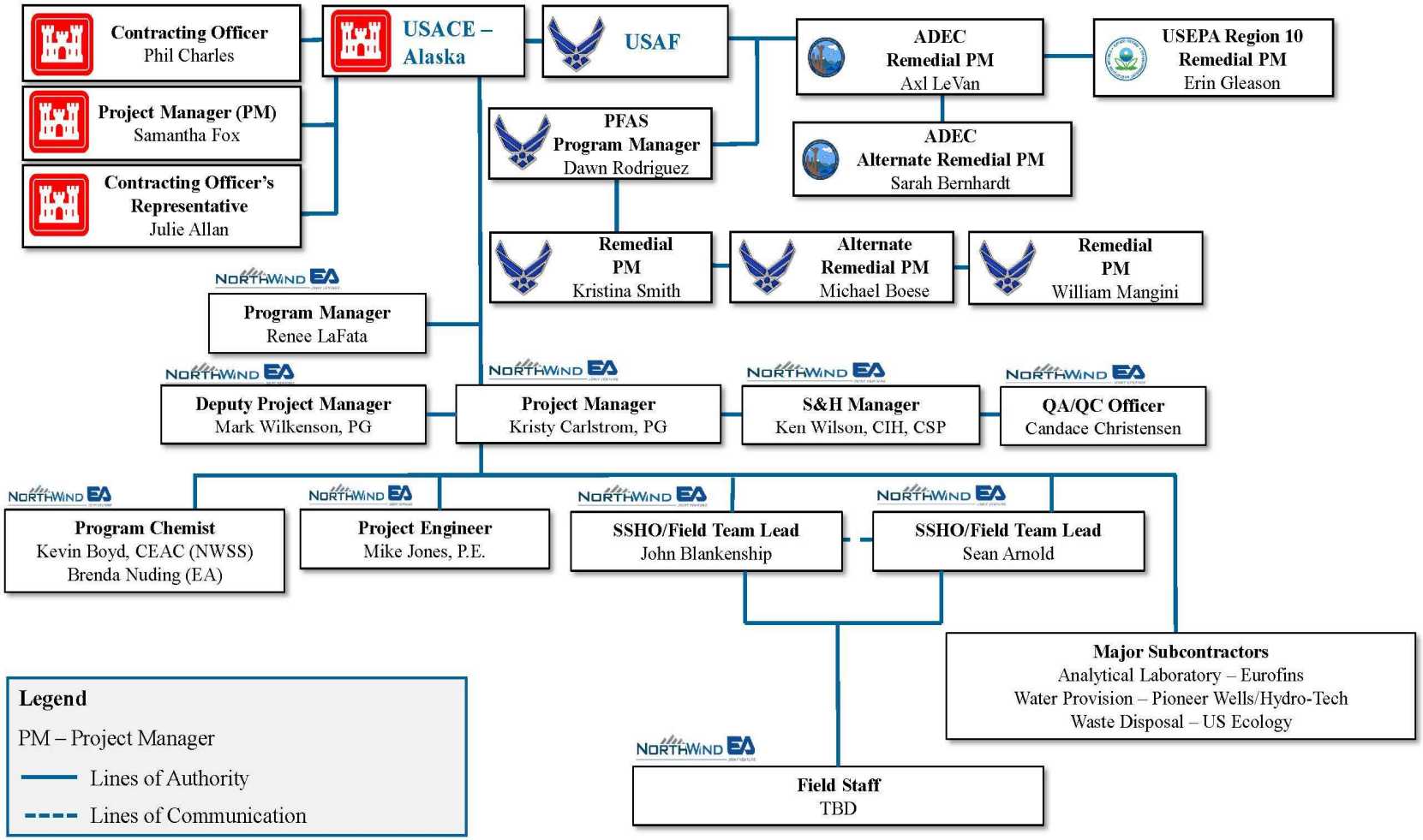
QAPP WORKSHEET #4: Project Personnel Sign-Off Sheet

Organization: North Wind, EA, and Analytical Laboratories

Project Personnel	Title	Telephone Number	Signature	Date Read
Kristy Carlstrom, PG, CPG	PM, North Wind	(708) 359-6358		
Mark Wilkinson, PG	Deputy PM, EA	(907) 646-0203		
Renee LaFata	Program Manager, North Wind	(907) 891-7338		
Candace Christensen	Regional Quality Manager, North Wind	(678) 972-5788		
Ray Peters, PE, CIH, CSP	North Wind Corporate Health and Safety Director, North Wind	(865) 256-9812		
John Blankenship	SSHO	(907) 347-3348		
Mike Jones. PE	Project Engineer, EA	(907) 223-8701		
Kevin Boyd, CEAC	Project Chemist, North Wind	(951) 639-7170		
Brenda Nuding	Project Chemist, EA	(808) 256-8268		
Rob Marcase	Director of Health and Safety	(717) 586-9878		
Sean Arnold	SSHO/Field Team Lead Well Sampling, EA	(843) 364-6539		
Gilbert Manning, PG	Alternate SSHO	(512) 433-9918		
Nathaniel Horner	Laboratory PM, Eurofins	(916) 374-4306		

Abbreviations:
CEAC – Certified Environmental Analytical Chemist
CIH – Certified Industrial Hygienist
CPG – Certified Professional Geologist
CSP – Certified Safety Professional
EA – EA Engineering, Science, and Technology, Inc. PBC
North Wind - North Wind Site Services, LLC
PE – Professional Engineer
PG – Professional Geologist
PMP – Project Management Professional

QAPP WORKSHEET #5: Project Organization Chart



QAPP WORKSHEET #6: Communication Pathways

Discussion with stakeholders in the decision process will be aided by the submittal of annual reports presenting the data to be evaluated. A memorandum will summarize the outcome of the discussion with the stakeholders and will include a sign-off page to document concurrence from the three agencies before proceeding with the implementation of the decision. Field change forms (included in **Appendix A**) will be completed by North Wind-EA JV when there are modifications to approved documents. The North Wind PM will email the field change form to the USACE PM and USAF PM, the USAF PM will then review and sign the field change form and then forward the form to EPA and ADEC for review and approval. Approval of field change forms will be within 48 hours unless submitted on Friday.

Communication Drivers	Responsible Entity	Name	Phone Number	Procedure (Timing, Pathways, etc.)
Modifications to Program	USACE PM	Samantha Fox	(907) 753-2720	Primary point-of-contact (POC) for USACE. Programmatic information, coordination issues, and draft and final reports. By email or phone as needed.
Modifications to Contractual Responsibilities	USACE PM	Samantha Fox	(907) 753-2720	All contracting and work/invoice approval/authorization. By email or phone as needed.
Modifications to Contractor Program	North Wind PM	Kristy Carlstrom	(708) 359-6358	Coordinate field work, programmatic direction, and issue resolution. By email as needed.
Daily safety briefing	North Wind SSHO	John Blankenship	(907) 347-3348	The SSHO will conduct and document a daily safety briefing and ensure the safety program established meets the requirements of this contract.
Modifications to QAPP once in execution	North Wind Field Lead	John Blankenship	(907) 347-3348	Notify Kristy Carlstrom of field-related problems by phone, email, or fax by close of business the next business day. Field change forms will be emailed to the ADEC, EPA, and USACE for approval within 48 hours.
	Field Manager	Gilbert Manning	(512) 433-9918	Notify Michael Jones of field-related problems by phone, email, or fax by close of business the next business day. Field change forms will be emailed to the ADEC, EPA, and USACE for approval within 48 hours.
Significant corrective actions	EA Field Manager USAF Remedial Project Manager (RPM)	Michael Jones Kristina Smith/William Mangini	(907) 456-4751 (907) 377-4299 / (907-726-4431	Coordinate field work, programmatic direction, and issue resolution. Notification of issues to USACE and Eielson AFB. By email as needed. Coordination and resolution of issues between USAF/EPA/ADEC RPMs. By email or phone as needed.

Communication Drivers	Responsible Entity	Name	Phone Number	Procedure (Timing, Pathways, etc.)
Modifications to Technical Direction or Modification of Approved Documents	EA Deputy PM	Mark Wilkinson	(907) 456-4751	The PM will direct the Field Team Leader/SSHO in the implementation of the field activities. Field change forms will be emailed to the ADEC, EPA, and USACE for approval within 48 hours.
Daily safety briefing	EA SSHO	Sean Arnold	(843) 364-6539	The SSHO will conduct and document a daily safety briefing and ensure the safety program established meets the requirements of this contract.
	EA Alternate SSHO	Gilbert Manning	(512) 433-9918	
Project QA/QC Responsibilities	Project QA/QC Manager	Candace Christensen	(678) 972-5788	Report on the adequacy, status, and effectiveness of the QA program by phone or email during the quarterly project review meetings and as needed
Modifications to Analytical Corrective Actions	Project Chemist	Kevin Boyd	(951) 639-7170	Report on the adequacy, status, and effectiveness of the QA program by phone or email during the quarterly project review meetings and as needed to Mr. Jones.
Approval of Amendments to QAPP	ADEC Remedial PM	Axl LeVan	(907) 451-2156	The USAF PM will provide either a field change form or a QAPP addendum to ADEC and EPA PMs for approval.
	EPA Remedial PM	Erin Gleason	(907) 271-1209	
Amendments to QAPP	EA Deputy PM	Mark Wilkinson	(907) 456-4751	Notify Field Manager, SSHO, and Project Chemist of QAPP amendments by phone, email, or fax by close of business the next business day.
Modifications to analytical laboratory responsibilities	Project Chemist	Kevin Boyd	(951) 639-7170	Notify PM and USACE within 1 week of performance problems encountered by the contracted analytical laboratories by phone, email, or fax.
Modifications to Eurofins analytical responsibilities	Analytical Laboratory PM	Nathaniel Horner	(916) 374-4306	Report project nonconformance issues within 1 week to the Project Chemist by phone, email, or fax.

Abbreviations:
ADEC – Alaska Department of Environmental Conservation
EA – EA Engineering, Science, and Technology, Inc. PBC
EPA – United States Environmental Protection Agency
Eurofins – Eurofins Sacramento Laboratories Environmental, LLC
North Wind – North Wind Site Services, LLC
QA – Quality Assurance
QAPP – Quality Assurance Project Plan
QC – Quality Control
RPM – Remedial Project Manager
USACE – United States Army Corps of Engineers
USAF – United States Air Force

QAPP WORKSHEET #7/8: Personnel Responsibilities and Qualifications Table

The qualifications and responsibilities of the USACE, AFCEC, and Eielson AFB personnel are under the purview of the DoD and will not be outlined in this QAPP. In addition, state and federal stakeholders' qualifications and responsibilities are under the purview of their respective agencies and will not be presented in this QAPP.

Name	Title	Organizational Affiliation	Responsibilities	Specialized Training / Certifications	Education and Experience Qualifications
Kristy Carlstrom	PM	North Wind	Submission of QAPP and any QAPP revisions and amendments to appropriate personnel for review and approval. Maintains the official approved QAPP version with support from the Project QA/QC Manager. Also responsible for ensuring that the documents (QAPP, Site Health and Safety Plan) meet USACE objectives, regulatory requirements, and quality standards. Responsible for the following activities: project technical direction; coordination of technical and logistical aspects of the project; resolving issues; development and maintenance of detailed project schedule; review of all reports before submittal to USACE; representation of the project team at meetings; and preparation of the final reports.	PG Certified Professional Geologist	B.S., Geology, with 18 years of environmental experience, largely DoD environmental investigation, remediation, and construction management.
Candace Christensen	Project QA/QC Manager	North Wind	• Ensuring that QA/QC procedures are followed • Reviewing and approving this QAPP • Providing oversight of North Wind QA Program • Providing oversight of North Wind surveillance and audit activities • Act as POC for QA matters	PMP, CQM, NQA-1 Lead Auditor, Lean Six Sigma Green Belt	B.S., PMP, with 21+ years of experience

Name	Title	Organizational Affiliation	Responsibilities	Specialized Training / Certifications	Education and Experience Qualifications
			• Coordinating training on matters pertaining to generation and maintenance of quality of data • Authorizing the suspension of project execution if QA requirements are not adequately followed • Reviewing and approving North Wind selected field sampling procedures.		
Kevin Boyd	Senior Chemist	North Wind	Technical oversight of the analytical laboratories. Responsible for data quality in conformance with the QAPP, interfacing directly with the analytical laboratories.	Certified Environmental Analytical Chemist	B.A., Chemistry. 10+ years of chemistry task management, including laboratory interfacing, DoD and Department of Energy Quality Systems Manual (QSM) compliance, data management and review, and field sample auditing. Mr. Boyd has served as the Project Chemist for remediation efforts at a multitude of federal installations across the United States for both the USACE and Navy. Experience includes leading the chemistry and data management efforts for feasibility studies, remedial investigations, and long-term monitoring. Additionally, Mr. Boyd is well-versed in the world of PFAS, including proper multi-media sampling techniques and precautions for maintaining data quality.
Mark Wilkinson	Deputy PM	EA	Submission of QAPP and any QAPP revisions and amendments to appropriate personnel for review and approval. Maintains the official approved QAPP version with support from the	PG Certified Professional Geologist	M.S.; Science Management; B.A.; Geology Mr. Wilkinson currently serves as the Manager of EA's Alaska Operations

Name	Title	Organizational Affiliation	Responsibilities	Specialized Training / Certifications	Education and Experience Qualifications
			Project QA/QC Manager. Also responsible for ensuring that the documents (QAPP, Site Health and Safety Plan) meet USACE objectives, regulatory requirements, and quality standards. Responsible for the following activities: project technical direction; coordination of technical and logistical aspects of the project; resolving issues; development and maintenance of detailed project schedule; review of all reports before submittal to USACE; representation of the project team at meetings; and preparation of the final reports.		with offices in Anchorage and Fairbanks. He has over 20 years of environmental services experience within Alaska and is experienced serving as PM/Deputy Program Manager for large, interdisciplinary Indefinite Delivery/Indefinite Quantity contracts, including management of investigation and remediation of contaminated sites on up to 20 simultaneous Task Orders. His experience also includes all aspects of investigations for contaminated soil and groundwater from initial response actions to achieving construction complete phase. Mr. Wilkinson has worked at over 10 remote locations within Alaska and over 40 Installation Restoration Program sites at Eielson AFB and King Salmon Air Station.
Michael Jones	Deputy PM/Field Coordinator	EA	Submission of QAPP and any QAPP revisions and amendments to appropriate personnel for review and approval. Maintains the official approved QAPP version with support from the Project QA/QC Manager. Also responsible for ensuring that the documents (QAPP, Site Health and Safety Plan) meet USACE objectives, regulatory requirements, and quality standards. Responsible for the following activities: project technical direction, coordination of technical and logistical aspects of the project, resolving issues, development and maintenance of detailed project schedule, review of all reports before submittal to	Professional Engineer	B.S.; Mechanical Engineering Mr. Jones has over 25 years of experience in program and project management, engineering, design, and management of remedial actions and bulk fuel tank installations; petroleum spills; contaminated sediment dredging; and preliminary or environmental site assessments. Additionally, he is experienced in surface water and UST investigations, hazardous materials emergency response, remedial investigation/feasibility studies, Global Positioning System positioning, spill

Name	Title	Organizational Affiliation	Responsibilities	Specialized Training / Certifications	Education and Experience Qualifications
			USACE, representation of the project team at meetings, and preparation of the final reports.		prevention control and countermeasure planning, geophysics investigations, solid waste landfill post-closure operations, remediation pilot studies, and construction and demolition oversight.
Gilbert Manning	SSHO/QAPP Lead/Field Manager	EA	Responsible for compliance with the Site Health and Safety Plan. Preparation of QAPP and QAPP revisions.	PG Alaska Qualified Environmental Professional	B.S. Geology Mr. Manning has over 20 years of experience in environmental investigation and remediation. He is a Texas registered PG and has extensive experience with conducting soil and groundwater investigations, site assessments, aquifer testing, waste management, and environmental remediation. Previous experience includes managing complex industrial projects for the state of Texas Resource Conservation and Recovery Act and leaking petroleum storage tank programs.
Sean Arnold	Field Team Lead	EA	Responsible for implementation of the QAPP and Site Health and Safety Plan. Also responsible for day-to-day field coordination, activities, procedures, and modifications.	PG Certified PG Alaska Qualified Environmental Professional	
Nathaniel Horner	Laboratory PM	Eurofins Sacramento	Acts as direct contact between the project team and analytical laboratory. Once analytical laboratory receives project samples, will provide oversight of analysis process all the way through the final submittal of analytical results to North Wind.	NA	

Name	Title	Organizational Affiliation	Responsibilities	Specialized Training / Certifications	Education and Experience Qualifications
Robert Hrabak	Director of QA (Laboratory Quality Manager)	Eurofins Sacramento	Overall Laboratory Quality Manager. Responsibilities include: remain independent of work conducted at Eurofins Sacramento to ensure the quality of the data; review QA/QC documentation; determine whether to implement corrective actions; and ensure that the laboratory can demonstrate that a method audit for the specific analytical procedure used in support of this QAPP has been performed within the last year. Report project non-conformances to the Laboratory PM; ensure that applicable SOPs and project protocols are followed; assess and improve processes; perform QA/QC reviews to ensure that data are accurately presented.	NA	

Abbreviations:
EA – EA Engineering, Science, and Technology, Inc. PBC
Eurofins – Eurofins Sacramento Laboratories Environmental, LLC
NA – Not applicable
North Wind – North Wind Site Services, LLC
QA – Quality Assurance
QC – Quality Control

QAPP WORKSHEET #9: Project Scoping Session Summary

Site Name/Project Name:	Perfluorinated Compounds Eielson-Moose Creek
Site Location:	Moose Creek
Projected Date(s) of Sampling:	Spring and Fall 2024
Project Manager:	Kristy Carlstrom
Date of Session:	25 October 2023
Scoping Session Purpose:	Kickoff Meeting

Name	Organization	Project Role	Phone	E-mail Address
Phil Charles	USACE	Contracting Officer	(907) 753-5579	phil.charles@usace.army.mil
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Michael Boese	USAF	Alternate Regional PM	(907) 441-1346	michael.boese.1@us.af.mil
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Kimberley Kearney	North Wind	Program Manager	(208) 557-7908	kkearney@northwindgrp.com
Kristy Carlstrom	North Wind	PM	(708) 539-6358	kristy.carlstrom@northwindgrp.com
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Rachel Apsher	North Wind	MAROS evaluations	(208) 528-8718	rachel.apsher@northwindgrp.com
Kevin Boyd	North Wind	Senior Chemist	(951) 639-7170	kevin.boyd@northwindgrp.com
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John Blankenship	North Wind	SSHO	(907) 347-3348	john.blankenship@northwindgrp.com

Name	Organization	Project Role	Phone	E-mail Address
Shanon Brailsford	North Wind	Geographic Information System (GIS)	(208) 419-4042	shanon.brailsford@northwindgrp.com
Renee LaFata	North Wind	Regional Manager	(907) 602-3082	rlafata@northwindgrp.com
Mark Wilkinson	EA	Deputy PM	(907) 646-0203	mwilkinson@eaest.com
Mike Jones	EA	Lead Engineer	(907) 223-8701	mjones@eaest.com

9.1 Comments

The objective of this project kickoff meeting was to discuss team member roles and responsibilities, communications/coordination, and the overall project scope. The discussion followed the attached agenda points and was initiated with attendee introductions.

9.2 Roles and Responsibilities

The roles and responsibilities for project personnel were discussed and are summarized on **Worksheet #7/8**. The following topics were discussed during the kickoff meeting and are outlined below:

- Scope and Schedule,
- Documents,
- Chemistry,
- Communication,
- Project Controls, and
- Invoicing.

9.3 Documents

9.3.1 Deliverables

- Schedule – 10 days after Kickoff.
- Monthly Summary Reports – 10th of each month.
- Accident Prevention Plan (APP)/SSHP – Draft and Final.
- UFP- QAPP / Waste Management Plan – 80 well sampling- Pre-Draft, Draft, Draft Final, Final.
- Work Plan – Groundwater Evaluation - Pre-Draft, Draft, Draft Final, Final.
- Groundwater Sampling Report with MAROS Plume Evaluation Report - Pre-Draft, Draft, Red-Line Strike Out Draft Final, Final.

9.3.2 Alaska Manual for Electronic Deliverables Submittals

- April 2017 Manual for Electronic Deliverables (MED) (USACE 2017).
- Full MED with exception of the Formerly Used Defense Site specific requirements outlined in Section 10 of the MED.
- Full MED is required only for final submittal. MAROS input tables and chemistry related files (native excel sample summary spreadsheet, SEDD files, Stage 4 laboratory reports) will be provided with the Pre-Draft Groundwater Sampling Report.

9.4 Chemistry

- Laboratory – Eurofins, West Sacramento.
- EPA Draft Method 1633.
- Data Validation:
    - The preferred procedure is for laboratories to use ERPTools to input/submit chemistry data for initial validation, import, and submission by the Prime Contractor.
    - Validation shall be performed to a 90% Stage 2b standard and a 10% Stage 4 standard with recalculation of appropriate data for each sample delivery group (SDG), including DoD QSM version 5.4, Table B-24 requirements.
    - Laboratory deliverables will consist of a portable document format (PDF) of the laboratory data consistent with QSM Stage 4 reporting requirements and Staged Electronic Data Deliverable Version 5.2 Stage 2A electronic data. Stage 4 data packages shall be submitted to the USACE and AFCEC.
- Environmental Restoration Program Information Management System (ERPIMS) submittal 90 days after sample collection.
- New North Pacific Division Laboratory Project number to be provided by USACE.
- Per the project scoping meeting, the project action levels (PALs) are currently based on the Assistant Secretary of Defense Memorandum: *Memorandum for Sampling of Per- and Polyfluoroalkyl Substances in DoD-Owned Drinking Water Systems* (DoD 2023). This was to be revised upon EPA announcing new maximum contaminant levels (Note: per a meeting with USACE and AFCEC on May 14, 2024, the DoD drinking water PFAS guidance in effect at the time of the annual report's pre-draft will be used as the PAL[s]).

9.5 Communication

- Client POC – Samantha Fox.
- All correspondence should include Steven Vaughn and Kristy Carlstrom.

9.6 Project Controls

- Monthly Activities – Accruals, Estimate to Complete, Schedule Update.
- Courtney Kassner (North Wind) to provide cost and schedule status data for Monthly Report.

9.7 Invoicing

- Invoice monthly (ENG Form 93) at the contract line item number level.
- Submit invoices to USACE PM for approval prior to formal submittal. Invoices will be submitted to the following e-mail addresses:
  - Samantha.R.Fox@usace.army.mil, and
  - DLL-CEPOA-Accounts-Payables@usace.army.mil.

QAPP WORKSHEET #10: Conceptual Site Model

10.1 Eielson Air Force Base Background

Eielson AFB is an active military installation that has been used for military operations since its establishment in 1944. Eielson AFB is located within the Fairbanks North Star Borough (FNSB), a county-scale municipality. Fairbanks is the urban center of the FNSB. North Pole, Moose Creek, and Salcha are other nearby suburban/rural areas located within the FNSB. North Pole is located approximately 7 miles northwest of the Base, while Moose Creek is located approximately 3 miles north of the Base (**Figure 1**). Eielson AFB encompasses 19,790 acres of the FNSB. Approximately 3,651 acres of the Base is improved or partially improved land, and 16,139 acres is undeveloped land encompassing forests, wetlands, lakes, and ponds.

Historical operations at Eielson AFB have generated varying quantities of hazardous and nonhazardous wastes from industrial and airfield operations, and fuel management. On 21 November 1989, the EPA listed Eielson AFB on the National Priorities List (NPL) of federal Superfund sites by the EPA (site is currently active). On 25 October 1990, the USAF, ADEC, and EPA entered into the Federal Facility Agreement (FFA) for Eielson AFB pursuant to § 1220(1) under CERCLA (EPA, ADEC, and USAF 1990). In 1994, a Remedial Investigation and Feasibility Study (RI/FS) was conducted at Eielson AFB as a requirement of CERCLA, the National Contingency Plan (NCP), and the Federal Facility Agreement (FFA) and was conducted per the *Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA* (EPA 1988). The results of the RI/FS found 66 source areas of possible contamination.

10.1.1 Eielson Air Force Base and Moose Creek Assessment History

In the 1996 ROD for Eielson AFB, 29 areas were divided into six operable units (OUs) based on common characteristics or contaminants, and 31 other areas of contamination were evaluated through a source evaluation process. A seventh OU (the Sitewide OU), which contains one source area (SS67), was added after the FFA was signed (EPA, ADEC, and USAF 1990). The remaining contaminated sites are addressed through ADEC regulations (USAF 1996).

During November 2012, ADEC issued a letter requesting the USAF sample for PFAS at four fire training areas (South Ramp Spray Test Area, KC-135 Fire, Former Ball Field Spray Test Area, and Foamed Runway) (**Figure 2**). During July 2014, the USAF collected groundwater, soil, and surface water samples from the four areas and the results indicated widespread PFAS contamination. During January 2015, the EPA issued a letter requesting the USAF sample the base drinking water for PFAS. Several of the base drinking water supply wells were found to contain PFOS exceeding the public health advisory of 0.2 micrograms per liter (µg/L) (**Figure 3**).

During April 2015, groundwater and surface water were sampled along the northern boundary of Eielson AFB to determine if contamination was migrating off-base. The results found PFOS over a broad front and extending to a depth of 100 ft below ground surface (bgs).

In 2015, the USAF initiated a supplemental remedial investigation–risk assessment (RI-RA), and workplans were developed for each of the six OUs to address the need for additional data and/or mitigation. As of 2022, the RI-RA reports were finalized. USAF has begun developing workplans for Supplemental RI/RA data gaps investigations. ADEC and EPA are currently reviewing the work plans.

During 2016, site inspections were conducted at 15 aqueous film forming foam (AFFF) areas at Eielson AFB. PFAS concentrations were found to be highest in soil and groundwater within the Former Ball Field Spray Test Area and Former Fire Training Areas by the current Entomology Building (Figure 2).

The *Expanded Perfluorooctanoic Acid (PFOA) and Perfluorooctanesulfonic (PFOS) and Perfluorobutane Sulfonate (PFBS) Site Inspection, Uniform Federal Policy-Quality Assurance Project Plan Work Plan, Eielson Air Force Base and Moose Creek, Alaska (*EA Engineering 2022*)*, was approved by EPA and DEC in September 2019. The inspection is completed and has provided information on the extent of PFOS and PFOA in groundwater. The work included the installation of permanent monitoring wells on the PFOS/PFOA plume edge (USAF 2022).

During 2019, North Wind-EA JV conducted biannual sampling of 20 monitoring wells (including 12 nested wells installed by North Wind – EA JV) for PFAS analysis. In 2021, the biannual sampling was increased to 40 monitoring wells and then 80 existing monitoring wells during 2022 and 2023. Beginning in 2022, the groundwater analytical data for shallow wells was used to evaluate plume characteristics and characterize the plume concentrations using MAROS software Version 2.2 and the intermediate and deeper wells were evaluated by trend analysis utilizing the EPA's statistical software ProUCL version 5.2.

10.2 Physical Characteristics

Eielson AFB was constructed on the floodplain of the Tanana River, a relatively flat surface with meandering streams and a complex network of shallow swales. Approximately 89% of the Eielson AFB is flat alluvial floodplain with elevations ranging from 520 to 556 feet (ft). The remaining 11% of the AFB occurs in the uplands along the eastern edge of the valley. Elevations in the main industrial area surrounding the flightline range from 548 to 556 ft. Engineer Hill, which reaches 1,000 ft above mean sea level, is located in the uplands at the northeast extent of the AFB. The highest elevation is 1,125 ft, which occurs on Quarry Hill in the uplands at the southeastern corner of the AFB (AECOM 2013).

10.2.1 Geology

Consolidated rocks in the Eielson AFB area are part of the Birch Creek Schist of Precambrian age. This unit is primarily slate to schistose, although it includes quartzite and quartz veins (Cederstrom 1963). The schist weathers to silt and clayey silt. The weathering product has been described as yellow clay in drill logs. The weathering zone may be relatively thick (≥150 ft). Because thick sediment accumulations are present in the Tanana Basin, depth to bedrock is several hundred feet deep in the middle of the valley.

In the Eielson AFB area, the low hills and lower slopes consist primarily of Quaternary loess sediments, with shallow or outcropping bedrock where sediments are thin or not present. Some of these sediments have been reworked and redistributed downslope. The valley floor consists primarily of alluvium. Sedimentary deposits overlie the Birch Creek Schist in much of the area surrounding Eielson AFB. The most recent glaciation occurred during the Late Pleistocene (Wisconsinan glaciation), at which time the ice sheet advanced nearly to the Tanana River. During glacial retreat, outwash and alluvial fans were deposited to the south and west of the river. This glacial environment created extreme changes in surface-water flow rates, including high flow created by melt water and low flow when no melt water was available. As a result, the Tanana is braided with multiple channels that wander across the valley, leaving abandoned channel belts.

The prevailing wind direction appears to have been from the west, blowing silt-size particles from the alluvial fans and plastering them on the hill slopes of the Tanana Uplands, east of Eielson AFB. These are well sorted, massive silt deposits with little jointing or stratification, and are thickest near major rivers draining glaciated areas (Pewe and Bell 1975). Along the hill slopes and underlying the loess are sediments deposited by solifluction occurring in periglacial settings where water-saturated soil is moved downslope with melt water. Weathered bedrock fragments may be included in the reworked material. This solifluction layer is widespread and inactive and has been referred to as the Tanana Formation (Pewe and Bell 1975). The valley-fill deposits of the Tanana Basin are complex and heterogeneous, consisting of alternating sand, gravel, and silt (Cederstrom 1963). These braided river deposits are composed of variable gradations of fine and coarse material. Generally, individual lenses are less than 20 ft thick. Many structures found in these deposits are small-scale and cannot be correlated over great distances.

Today, perennially frozen ground is not usually continuous over wide areas on the valley floor. The thick masses of permafrost (where present) may thin laterally, either gradually or abruptly, generally where a stream or the course of a former stream is approached. Where thick permafrost has been penetrated by wells in Fairbanks, the mass is ordinarily solid, and apparently unfrozen layers are absent. Near the edge of the frozen mass, however, lateral melting at different rates has produced a sawtooth pattern in cross sections.

Eielson AFB is in the area of an abandoned river-channel belt, and the subsurface underlying most of the Base consists of braided river deposits. These deposits are complex in structure but similar in lithology. In the Tanana River Valley, these deposits are ≥300 ft thick. In the developed portion of the Base, fill material, generally described as silty sand and gravelly sand, was used during construction. This material was quarried nearby and is lithologically similar to natural soil, although the sedimentary structures would have been obliterated. Only the upper part of the floodplain sediments (<30 feet in some areas) has been explored. These sediments consist primarily of gravelly sand and sandy gravel (AECOM 2013).

10.2.2 Hydrogeology

The Birch Creek Schist underlies the unconsolidated, sedimentary deposits near Eielson AFB. However, the unconsolidated deposits do not extend far up the hill slopes. Groundwater flows down the hill slopes within the Birch Creek Schist and within the overlying sediments of the valley fill toward the basin.

Water supply wells in these areas tap into the schist, which is an inferior water-bearing formation seldom yielding more than 10 gallons per minute (gpm). Of more significance, in terms of well yield, are the sediment-filled valleys along the mountain slopes. These valleys are commonly underlain with sand and gravel, and wells drilled into these deposits may yield 100 gpm or more (Cederstrom 1963).

By contrast, the sands and gravels underlying the Tanana River Valley (i.e., braided river deposits) provide large quantities of water (1,000 gpm or more) to wells. This unit has been called the Tanana Basin Aquifer. Well yields of up to 3,400 gpm with minimal drawdown have been reported. Recharge is predominantly from seepage into the aquifer from stream beds during periods of melt water rather than from precipitation. During these times, the river elevations are higher than the groundwater levels.

Recharge to the Tanana Basin aquifer is from precipitation, snowmelt, and infiltration from stream beds. Historical water-level data indicate that recharge typically increases from April through May, often beginning in late March and continuing through mid-June, indicating recharge from snowmelt and from high water levels in the rivers and streams. Declines in water-level begin in July or August. The largest recharge to the aquifer is from the river during periods of high flow. There also is recharge from the Birch Creek Schist from groundwater flowing down the hill slopes to the valley. The wetlands at the foot of the

uplands, which are located to the east of Eielson AFB, are likely fed from this source and precipitation perched on permafrost. Therefore, the wetlands also may lose water to the Tanana Basin aquifer. The water within the Tanana Basin aquifer is a calcium bicarbonate or calcium magnesium bicarbonate type. The water quality is highly variable, suitable for most uses in many areas, but locally contains high iron and manganese and may not be usable for drinking water without treatment.

Water levels in the Tanana Basin aquifer vary seasonally, rising during snowmelt and declining in winter. Analysis of river stage elevations compared with groundwater levels indicates that there is little separation between the two (<0.2 ft), although data are limited. Based on these data, the sloughs at or near Eielson AFB are likely to be at the same elevation as the groundwater. Eielson AFB is surrounded by wetland areas; on the eastern side of Eielson AFB, these wetlands likely recharge groundwater.

In general, groundwater flow is to the north-northwest, turning more westerly to the north, paralleling the sloughs. This parallel flow pattern indicates that the overall groundwater flow is more influenced by aquifer boundaries than the tendency to receive recharge from or discharge to the sloughs. The aquifer is bounded by lower permeability schist and alluvial fans. These features act hydraulically as no-flow boundaries, although a small amount of groundwater is present in both. This hydraulic boundary effect is the result of the contrast in permeability, the schist and alluvial fans being low, and the braided river deposits being very high. Therefore, the shape of the valley controls the overall direction of groundwater flow. However, local perturbations in the contours created by changes in river stage may occur.

Alluvial fans fine toward their distal ends. These fan deposits are typically much finer than the braided river deposits encountered at the Base, causing the boundary effect. However, the thickness of the alluvial fans is unknown. It is likely that at least a portion of the fans has pushed out over older braided river deposits. If this is the case, the groundwater flow direction in the deep part of the aquifer could be more westerly than the shallow flow direction.

The Tanana Basin aquifer is composed of a heterogeneous mixture of gravelly sands and sandy gravels. Although very permeable, this heterogeneity causes local changes in groundwater flow velocity. Groundwater depths range from the ground surface in wetland areas to 10 ft bgs in developed areas of Eielson AFB, and groundwater flow is generally to the northwest (AECOM 2013).

10.3 Nature and Extent of Contamination

10.3.1 Per- and Polyfluorinated Alkyl Substances Overview

PFAS are a group of manufactured chemicals that have been used in commercial and industrial consumer products for decades. Although there are thousands of different PFAS compounds, the groundwater sampling events for this contract will focus on the list of 40 PFAS analytes listed below:

Perfluoroalkyl carboxylic acids

Perfluoro-n-butanoic acid (PFBA)
Perfluoro-n-pentanoic acid (PFPeA)
Perfluorohexanoic acid (PFHxA)
Perfluoroheptanoic acid (PFHpA)
Perfluorooctanoic acid (PFOA)
Perfluorononanoic acid (PFNA)
Perfluorodecanoic acid (PFDA)
Perfluoroundecanoic acid (PFUnA)
Perfluorododecanoic acid (PFDoA)
Perfluorotridecanoic acid (PFTrDA)
Perfluorotetradecanoic acid (PFTeDA)

Perfluoroalkyl sulfonic acids (acid form)

Perfluorobutanesulfonic acid (PFBS)
Perfluoropentansulfonic acid (PFPeS)
Perfluorohexanesulfonic acid (PFHxS)
Perfluoroheptanesulfonic acid (PFHpS)
Perfluorooctanesulfonic acid (PFOS)
Perfluorononanesulfonic acid (PFNS)
Perfluorodecanesulfonic acid (PFDS)
Perfluorododecanesulfonic acid (PFDoS)

Fluorotelomer sulfonic acids

1H,1H, 2H, 2H-Perfluorohexane sulfonic acid (4:2FTS)

1H,1H, 2H, 2H-Perfluorooctane sulfonic acid (6:2FTS)

1H,1H, 2H, 2H-Perfluorodecane sulfonic acid (8:2FTS)

Perfluorooctane sulfonamides

Perfluorooctanesulfonamide (PFOSA)
N-methyl perfluorooctanesulfonamide (NMeFOSA)
N-ethyl perfluorooctanesulfonamide (NEtFOSA)

Perfluorooctane sulfonamidoacetic acids

N-methyl perfluorooctanesulfonamidoacetic acid (NMeFOSAA)

N-ethyl perfluorooctanesulfonamidoacetic acid (NEtFOSE)

Per- and Polyfluoroether carboxylic acids

Hexafluoropropylene oxide dimer acid (HFPO-DA)

4,8-Dioxa-3H-perfluorononanoic acid (ADONA)

Perfluoro-3-methoxypropanoic acid (PFMPA)

Perfluoro-4-methoxybutanoic acid (PFMBA)

Nonafluoro-3,6-dioxaheptanoic acid (NFDHA)

Ether sulfonic acids

9-Chlorohexadecafluoro-3-oxanonane-1-sulfonic acid (9Cl-PF3ONS)

11-Chloroeicosafluoro-3-oxaundecane-1-sulfonic acid (11Cl-PF3OUdS)

Perfluoro(2-ethoxyethane)sulfonic acid (PFEESA)

Fluorotelomer carboxylic acids

3-Perfluoropropyl propanoic acid (3:3FTCA)

2H,2H,3H,3H-Perfluorooctanoic acid (5:3FTCA)

3-Perfluoroheptyl propanoic acid (7:3FTCA)

PFAS are known for their slow rate of degradation, resulting in continuous accumulation in people, animals, and their environments. The accumulation of PFAS in the human body can lead to cancer, reproductive harm, developmental and cardiovascular effects, as well as immunological issues (EPA 2023a). As a result, one of the goals of groundwater monitoring at Eielson AFB and Moose Creek is to determine the current state of the PFAS plume, which may directly impact neighboring communities and the environment.

10.3.2 Site Land Use

Eielson AFB is an active military installation. As a result, operations are restricted to government and military activities. However, the areas surrounding Eielson AFB (i.e., Moose Creek) do consist of residential and commercial land uses.

10.3.3 Potential Migration and Exposure Pathways

PFAS are water soluble and can migrate readily from soil to groundwater, where they can be easily transported long distances. PFAS are also chemically and biologically stable in the environment and resist typical environmental degradation. As a result, they are extremely persistent in the environment. Therefore, the primary transport mechanism of interest to this project is dissolved-phase transport in the saturated zone, which is driven by groundwater flow within the aquifer.

The primary potential receptors of PFAS in groundwater consist of anyone who may consume groundwater from potable water supply wells within the PFAS groundwater plume. Additional exposure pathways for PFAS in groundwater include environmental factors such as plant uptake, as well as ingestion or dermal contact from aquatic life.

QAPP WORKSHEET #11: Project/Data Quality Objectives

11.1 Problem Background

Eielson AFB has used aqueous film forming foam (AFFF) firefighting agents containing PFAS in both training exercises and to extinguish petroleum fires on the base. AFFF formulations may contain PFOS, as well as some PFAS-based AFFF constituents that may further degrade into PFOA. Releases of AFFF to the environment have occurred during fire training, equipment maintenance, and storage at Eielson AFB.

In 2014, the USAF conducted screening level site investigations at EAFB to determine the presence of PFOS and PFOA and their relative concentrations. The site investigation report associated with that work was finalized in February 2015 (USACE 2015a) and documented both PFOA and PFOS at concentrations in groundwater above their respective EPA provisional health advisory (PHA) levels that were in place at that time (EPA 2009). In January 2015, the EPA Region 10 requested that Eielson AFB test the drinking water wells located for PFOS and PFOA. PFOS and PFOA are not identified under CERCLA as hazardous substances but are determined to be pollutants or contaminants. Therefore, the USAF conducted site inspections into these emerging contaminants following the CERCLA process. Sampling by the USAF confirmed both chemicals in EAFB drinking water wells, with PFOS exceeding the PHA level that was in place at the time (USAF 2018b). Since PFOS and PFOA are water soluble, an additional site inspection was conducted to determine whether contaminants had migrated in groundwater towards the northern base boundary and to the nearby community of Moose Creek. In April 2015, the USAF tested the groundwater at the northern base boundary and identified PFOS levels exceeding the PHA (USACE 2015a).

The USAF continues to perform monitoring and periodic resampling of wells in the community of Moose Creek. The monitoring and periodic resampling is designed to establish a baseline and evaluate concentration trends. The work outlined in this UFP-QAPP is performed under CERCLA. However, the purpose of this sampling effort is for long-term monitoring and not plume delineation. The biannual sampling will be reported as a secondary document that will be used to support the Remedial Investigation.

11.2 Data Quality Objectives

To further define the systematic planning process, the following data quality objectives (DQOs) have been identified. The project specific DQOs and the seven planning steps are presented in the following table.

STEP 1. STATE THE PROBLEM	
Historical sampling has shown that groundwater is impacted by PFAS, which has spread laterally towards Moose Creek and North Pole. In addition, groundwater is impacted by PFAS at depths up to 200 ft bgs, indicating a downward movement of the contaminant plume.	
STEP 2. GOAL OF THE STUDY	
The goal of the study is to further evaluate the PFAS groundwater contaminant plume within the boundary and northwest of Eielson AFB and to evaluate plume characteristics and characterize plume concentrations. Additional goals include monitoring the center of the plume mass/evaluate plume growth over time, evaluate plume mass, evaluate concentration trends especially in leading edge wells, and evaluate which wells can be removed from the study. Additionally, another goal is to evaluate the groundwater flow direction, with focus at the leading edge of the plume in the direction of the City of North Pole, AK. Eighty existing monitoring wells will be sampled in the spring and fall to document current concentrations and evaluate contaminant plume and groundwater movement. To calculate a trend in a well, the evaluation requires a minimum of four data points with detected results from each well and the trend analysis improves as additional data is collected. The data that is collected and documented will be representative of field conditions and defensible within the Precision, Accuracy, Representativeness, Completeness, and Comparability parameters. Sufficient field samples will be collected to fully characterize field conditions and heterogeneity and sufficient quality control samples to demonstrate data quality. Legally defensible samples will be collected with a known provenance, via an unbroken chain of custody, maintained from sampling through analysis.	
ALTERNATIVE ACTIONS THAT MAY BE TAKEN BASED ON THE DECISIONS	• If concentrations of PFAS are detected at depth, continue bi-annual sampling to evaluate seasonal fluctuations. • If concentrations of PFAS are detected at depth, evaluate hydrogeological parameters that may be impacting vertical migration. • Evaluate the need for future aquifer testing.
STEP 3. IDENTIFY INPUTS TO THE DECISION	
INFORMATIONAL INPUTS NEEDED TO RESOLVE A DECISION	• Historical groundwater analytical data and depth to water for all monitoring wells on the AFB. • New analytical data from up to 80 existing wells, to be sampled in the spring and fall, to document current concentrations and evaluate contaminant plume and groundwater movement.
SOURCES FOR EACH INFORMATIONAL INPUT AND THE INPUTS THAT ARE OBTAINED THROUGH ENVIRONMENTAL MEASUREMENTS	• Historical analytical data will be obtained from the AFB files and database. • Analytical data from the spring and fall sampling events. • Field measurements collected during proposed groundwater sampling (i.e., depth to water, turbidity, conductivity, oxygen reduction potential [ORP], pH, and dissolved oxygen [DO]).

BASIS FOR THE CONTAMINANT SPECIFIC ACTION LEVELS	Generally, this objective does not rely on specific action levels and is based on the relationship and distribution of concentrations over the study area. **Worksheet #15** presents the reference Regional Screening Levels (RSLs) and Project action Level (PAL) criteria for PFAS analytes being investigated. RSLs presented are in accordance with DoD's *PFAS 101 – Regional Screening Levels Used in DoD Cleanups* (https://www.acq.osd.mil/eie/eer/ecc/pfas/pfas101/rsl.html). This criterion exceeds that put forth in 18 Alaska Administrative Code (AAC) 75 (ADEC 2023). The PAL for PFOS+PFOA is in accordance with the 11 July 2023 ASD Memorandum, *Memorandum for Sampling of Per- and Polyfluoroalkyl Substances in DoD-Owned Drinking Water Systems* (DoD 2023). The DoD drinking water guidance in effect at the time of the annual report's pre-draft will be used as the PAL(s).
POTENTIAL SAMPLING TECHNIQUES AND APPROPRIATE ANALYTICAL METHODS	• Low flow groundwater sampling methods will be used to collect current data from monitoring wells. • EPA Draft Method 1633 will be used to analyze for 40 PFAS analytes, listed in **Worksheet #15**, in accordance with DoD QSM Version 5.4, Table B-24 (DoD 2021). • Analytical methods were selected during the planning process to ensure that the laboratory quantitation limits for the various analytes are adequate to make the project decisions. Any compounds for which the laboratory quantitation limits are above the action levels are discussed in **Worksheet #15**. Field instrumentation will be selected to cover the range of variation for the parameters being measured (refer to **Worksheet #22**).
STEP 4. DEFINE THE BOUNDARIES OF THE STUDY	
SPATIAL BOUNDARIES	Spatial boundaries include the primary portion of the PFAS groundwater contaminant plume within the boundaries of the Eielson AFB. The focus will be on the highest concentration portions of the contaminant plume, from source areas in the south to the northern AFB boundary. Historical data have indicated that detectable PFAS concentrations have been detected at depths of 100 ft in this portion of the plume. Monitoring wells to be sampled include well clusters, each consisting of four wells screened at approximate depths of 50, 100, 150, and 200 ft. Additionally, existing monitoring wells will be sampled to determine contaminant concentrations in the shallow portion of the contaminant plume. The full list of proposed monitoring wells to be sampled is presented in **Worksheet #18**.
TEMPORAL BOUNDARIES	Groundwater samples will only be collected in the spring and fall to provide data for evaluation of seasonal variations. Winter weather conditions prevent practical data collection during the winter season.
PRACTICAL CONSTRAINTS ON DATA COLLECTION	Potential constraints on data collection include delay of work plan approval, as well as inclement weather or field conditions.

STEP 5. DEVELOP THE ANALYTIC APPROACH	
THE PARAMETER THAT CHARACTERIZES THE POPULATION OF INTEREST	• The groundwater concentrations of PFAS analytes at each sample location will be compared to the RSLs and PAL presented in **Worksheet #15**. The latest EPA RSLs and DoD PAL(s) published at the time of the annual report's pre-draft shall be used. • Water level measurements. • Field water parameters will be used to evaluate the quality of the groundwater sample and general groundwater characteristics.
ACTION LEVEL FOR DECISION MAKING	• Analytical data will be used to evaluate the contaminant plume.
STEP 6. SPECIFY THE PERFORMANCE ACCEPTANCE CRITERIA	
DETERMINE THE POSSIBLE RANGE OF THE PARAMETER OF INTEREST	PFAS concentrations in groundwater samples may range from non-detectable to greater than the specified RSL/PAL. The range of concentrations is inconsequential, as all data (regardless if it is non-detectable or above action levels) will be evaluated to provide characterization of the contaminant plume.
DEFINE BOTH TYPES OF DECISION ERRORS AND IDENTIFY THE POTENTIAL CONSEQUENCES OF EACH	This section evaluates the consequences of making incorrect decisions and considerations and/or actions taken to mitigate decision error. Decision makers are interested in knowing the true value of the physical and chemical characteristic analyses. Since analytical data can only estimate these values, decisions that are based on measurement data could be in error (i.e., decision error). ***Decision Error and Potential Consequences:*** The acceptable limits for false positive or false negative decision errors will be based on evaluating the potential consequences of these decision errors (i.e., risks to human health and the environment or unnecessary expenditures for additional sampling) if specific contaminants are detected or are not detected above action levels. Two potential decision errors could be made based upon interpreting sampling and analytical data: 1) Concluding that the concentration of a specific chemical at a sample location within an area is below the action level when it truly is above the action level. 2) Concluding that the concentration of a specific chemical at a sample location within an area is greater than the action level when it truly is below the action level. The consequences of the first error would have severe implications because the contamination would be left undetected and leave risk at the site due to contaminant concentrations. The consequences of the second error would result in unnecessary expenditure and diversion of resources that could be used for

	cleanup of other contaminated areas. The consequences of the first error are deemed more serious because of the potential risk. The baseline condition, therefore, is established such that the contaminant concentration is truly greater than or equal to the action level. The baseline condition is defined as the null hypothesis (H_0). The alternative is defined as the alternative hypothesis (H_a). This may be summarized as follows: H_0: [concentration] ≥action level H_a: [concentration] <action level A false positive error, also known as a Type I error, occurs when the null hypothesis is falsely rejected (i.e., the sample data show that the concentration of a substance is below the action level when it actually exceeds the action level). The measurement of the size of this error is called alpha (α), the level of significance. Alpha is expressed numerically as a probability or the tolerance for uncertainty. A false negative error, also known as a Type II error, occurs when the null hypothesis is falsely accepted (i.e., the sample data show that the concentration of a substance is above the action level when it actually is below the action level). The measurement of the size of this error is called beta (β), or the complement of the power of the hypothesis test. The tolerance limits for decision error have been established at α=5% or 0.05 for false positives and β=20% or 0.2 for false negatives.
SOURCES OF ERROR	Total study error potential is equally attributable to sampling and measurement error because of the steps and sample volume associated with the planned sample collection and analysis. Successfully managing the magnitude of total study error is the result of understanding the error sources, generating an appropriate sampling design, and choosing accurate measurement techniques. The approaches used to manage study error for the planned sampling and analysis are discussed below. The sampling design is straightforward and includes the use of long-term sample collection. The analyses will be performed using the services of an accredited laboratory holding applicable DoD ELAP and Alaska National Environmental Laboratory Accreditation Program (NELAP) certifications. The quality of sampling and analysis must be at a level that results in representative, precise, and reproducible data. The data generated will be sufficient for the intended use. “Good” data will be defined as data that are produced following the specified SOPs and meeting the established criteria in this UFP-QAPP, including precision, accuracy, comparability, representativeness, completeness, and sensitivity. The analytical data that are not qualified or qualified but not rejected are deemed acceptable for project use. The quality of the project data will be assessed by the Project Chemist. Procedures for data quality determination, as well as qualifying criteria, are presented in **Worksheets #34-36**.

STEP 7. PLAN FOR OBTAINING DATA

Eighty existing monitoring wells will be sampled throughout the known plume area of the AFB. Historical data have indicated that PFAS have been detected at depths of 200 ft within the plume. Multiple well clusters, each consisting of four wells screened at approximate depths of 50, 100, 150, and 200 ft, will be sampled as part of the long-term monitoring events during the spring and fall. The sampling rationale and design are presented in **Worksheet #17**.

The resulting analytical data are intended to provide data for the evaluation of potential vertical and horizontal migration of the contaminant plume. The resulting data and historical analytical data will also be used to optimize future sampling events to effectively monitor the contaminant plume.

QAPP WORKSHEET #12: Measurement Performance Criteria

The measurement performance criteria tables are presented below for the methods within the scope of analytical testing presented within this UFP-QAPP. Method and QC requirements will follow the DoD QSM Version 5.4 specifications.

Matrix	Water
Analytical Group	PFAS
Concentration Level	Low

Sampling Procedure	Analytical Method/ SOP	Data Quality Indicators	QC Sample and / or Activity Used to Assess Measurement Performance	Measurement Performance Criteria	QC Sample Assesses Error for Sampling (S), Analytical (A) or both
See **Worksheet #21**	Draft Method 1633 WS-LC-0039	Precision	Field duplicate	Relative percent difference (RPD) ≤30%	S&A
		Accuracy/Bias/ Contamination	Blanks (method blank [MB], instrument blank [IB], and field blank)	No target analytes ≥ ½ limit of quantitation (LOQ) or for MBs, >1/3rd the regulatory limit, or >1/10th the amount measured in any sample, whichever is greater.	S&A
		Accuracy/bias	Initial calibration verification (ICV) and continuing calibration verification (CCV)	≤30 percent difference (%D)	A
		Instrument Performance	Mass spectrometer tuning	Tune criteria consistent with liquid chromatography tandem mass spectrometry (LC/MS/MS) Compliant with QSM 5.4 Table B-24	A
		Sensitivity	Extracted and injected internal standard	Consistent with Table 6 of the 4th Draft Method; Isotopically labeled analogs of analytes must be used when they are commercially available; QC samples and field samples must recover within in-house limits; 20-150% must be used if no in-house limits are generated, but not lower than 20%	A
		Accuracy	Laboratory control sample (LCS), matrix spike (MS), and matrix spike duplicate (MSD)	Consistent with Table 5 of the 4th Draft Method	A
		Precision	MS and MSD	RPD≤30%	A

QAPP WORKSHEET #13: Secondary Data Uses and Limitations

Secondary Data	Data Source (Originating Organization, Report Title, and Date)	Data Generator(s) (Originating Organization, Data Types, Data Generation/Collection Dates)	Limitations on Data Use	How Data Will Be Used
Previous groundwater PFAS data	*2022 Annual Groundwater Monitoring Report for Per- and Polyfluoroalkyl Substances, Eielson Air Force Base, Alaska* (USAF 2023)	North Wind. MAROS PFAS database generated during the spring and fall of 2022, report issued in January 2023. Database includes data collected from 2019 to 2022.	None identified	Evaluate plume characteristics and characterize plume concentrations.

QAPP WORKSHEET #14: Project Tasks

The tasks of this project will be performed in accordance with the approved scope of work. These tasks include the following:

- Sampling of 80 existing groundwater monitoring wells twice a year, once in the spring and once in the fall, to be analyzed for PFAS via EPA Draft Method 1633; and
- Groundwater plume evaluation for PFAS. The Groundwater Plume Evaluation Work Plan is provided in Appendix B.

Field activities will be conducted in accordance with the approved APP/SSHP, as well as the SOPs presented in **Worksheet #21**. Field activities that will be carried out to complete the above-mentioned tasks include:

- Mobilization and demobilization;
- Sampling equipment calibration;
- Groundwater sample collection, including PFAS specific protocol;
- Field decontamination;
- Field documentation; and
- Sample custody and shipment.

These tasks are discussed in detail in the following sections. Note that any provisions of the EA and North Wind corporate SOPs included in **Appendix C** and listed on **Worksheet #21** are superseded by specific activities outlined in this UFP-QAPP. The EA and North Wind corporate SOPs are applicable to a variety of projects across the country, are general in nature, and thus may not cover all possible project-specific requirements. Rather, any deviations from these SOPs are addressed under the specific tasks below, where necessary.

14.1 PFAS Precautions

PFAS constituents are present in a vast array of commercial and industrial products, increasing the likelihood of cross-contamination during environmental sampling procedures and field tasks (EPA 2014). As a result, special prohibitions and restrictions will be put in place for field supplies, clothing, and other categories to minimize the potential of introducing PFAS into source media. Although some information is provided in the following subsections, a full list of instructions is provided in Environmental Procedure (ENVP)-2019 (**Appendix C**). The Daily PFAS Protocol Checklist, provided in **Appendix A**, shall be filled out each day to affirm continued compliance with the protocols put forth in this UFP-QAPP and ENVP-2019.

14.1.1 PFAS Personnel Personal Protective Equipment (PPE), Clothing, and Personal Hygiene

Field personnel will avoid wearing clothing or materials that are water resistant, waterproof, or stain-treated during field sampling activities. Ideally, PPE and personal clothing should be made of cotton and be "well laundered" or washed a minimum of six times since purchase and without fabric softeners, as these are known to contain PFAS. To avoid potential for cross-contamination from touch surfaces, nitrile gloves must always be worn during sampling activities or during the handling of sampling equipment and sampling kits. Nitrile gloves should be changed frequently, including, but not limited to, when moving between sampling locations, after the handling of any non-dedicated sampling equipment, or if contact with non-decontaminated surfaces is made.

14.1.2 Field Equipment and Decontamination

Field equipment will exclude materials known to contain polytetrafluoroethylene, low-density polyethylene, or Teflon®. Instead, high-density polyethylene (HDPE), stainless steel, or silicon materials should be used. Water resistant paper (i.e., Rite-in-the-Rain™) or other waterproof field books will not be used on site; loose paper or a composition notebook will be used instead. Additionally, plastic clip boards, binders, or spiral hard cover notebooks are not acceptable; instead, Masonite or metal clipboards may be used. For writing, pens or Sharpie® brand markers will be used; dry-erase markers will not be used.

14.1.3 Summary of Acceptable and Prohibited Items

Per ENVP-2019, the following table provides a list of acceptable and prohibited items, based on category, for ensuring PFAS sampling integrity.

Acceptable	Prohibited
Field	
HDPE materials	Teflon® containing materials
Acetate liners	LDPE materials
Silicon tubing	Waterproof field books
Loose paper (non-waterproof) or composition notebook with cardboard cover	Binders, spiral or plastic cover notebooks, Post-It Notes
Aluminum or Masonite Clipboards	Plastic clipboards
Sharpies®, pens	Markers or dry erase pens
Regular ice (Double bagged)	Chemical (blue) ice packs
Field Clothing /Personnel Hygiene	
Well-laundered clothing made of natural fibers (preferably cotton).	New cotton clothing or synthetic water resistant, waterproof, or stain-treated clothing, clothing containing Gore-Tex™, Clothing laundered using fabric softener
Boots made with polyurethane and PVC	Boots containing Gore-Tex ™ or Tyvek®
Sunscreens - Alba Organics Natural Sunscreen, Yes To Cucumbers, Aubrey Organics, Jason Natural Sun Block, Kiss my face, Baby sunscreens that are "free" or "natural" Insect Repellents - Jason Natural Quit Bugging Me, Repel Lemon Eucalyptus Insect repellant, Herbal Armor, California Baby Natural Bug Spray, BabyGanics Sunscreen and insect repellant - Avon Skin So Soft Bug Guard Plus - SPF 30 Lotion	No cosmetics, moisturizers, hand cream, or other related products as part of personal cleaning/showering routine on the morning of sampling.

Acceptable	Prohibited
Samples	
HDPE or polypropylene	LDPE or glass containers
Unlined polypropylene or HDPE caps	Teflon®-lined caps
Rain	
Gazebo/tent that is only touched with gloves and moved prior to and following sampling activities	Waterproof or water-resistant rain gear
Equipment	
Alconox® and/or Liquinox®	Decon 90
Laboratory certified PFAS free water for final rinse	Water from an on-site well
Food	
Bottled water and hydration drinks (i.e., Gatorade® and Powerade®) to be brought and consumed only in the staging area	All food and drink, with exceptions noted on the left

Abbreviations:
HDPE – High-density Polyethylene
LDPE – Low-density Polyethylene
PVC – Polyvinyl Chloride
SPF – Sun Protection Factor

14.2 Monitoring Well Sampling

Eighty existing monitoring wells (listed in **Worksheet #18**) will be sampled once in the spring and once in the fall using low flow sampling methods, as described in ENVP-2006, Groundwater Sampling (**Appendix C**). The well locations are illustrated on **Figure 4**. Prior to sampling, the depth to groundwater and total depth of the well will be gauged. The wells will be purged at a maximum flow rate of 0.23 gallons/minute until water quality parameters have stabilized for three consecutive measurements. Well purge and sampling data will be recorded on the field sheet provided in **Appendix A**. A representative groundwater sample will be collected when the groundwater parameters have stabilized according to the criteria indicated in ENVP-2006, Groundwater Sampling (**Appendix C**). Groundwater parameters will be considered stable after purging when three successive readings are within four of the following parameters (temperature being used as an indicator):

- ± 0.2 degrees Celsius (°C) temperature,
- ± 0.1 pH,
- ± 3% conductivity,
- ± 10 millivolts (mV) ORP,
- ± 10% DO, and
- ± 10% turbidity or ≤10 nephelometric turbidity unit (NTUs).

Following purging, groundwater samples will be collected without moving or adjusting the position of the submersible pump, peristaltic pump or sample intake line and the flow through cell will be disconnected. Purge water should be containerized and managed as investigation-derived waste (IDW) in accordance with **Section 14.6**. Samples will be collected directly into the appropriate sample container and analyzed for PFAS. After collection, samples will be placed in a cooler, chilled with ice, and shipped under chain-of-custody (CoC) protocol to Eurofins Sacramento Laboratories for analysis. Eurofins is a DoD ELAP and NELAP accredited laboratory and their certifications are provided in **Appendix D**.

14.3 PFAS Plume Evaluation

Once monitoring well sampling results have been received, verified, and validated, per the requirements in **Worksheets #34-37**, the PFAS plume will be evaluated to:

- Determine if the plume is expanding, contracting, or stable;
- Determine the center of the plume mass in the upper aquifer; and
- Determine if concentrations in individual well points are showing an increase, decrease, or no trend (i.e., stable).

The evaluation will help determine if the plume has been delineated, and if not, recommendations will be derived as to whether monitoring wells need to be added or eliminated from the sampling program, as well as any recommendations to optimize sample timing and/or frequency.

A MAROS evaluation will be performed annually for wells near the top of the water table (i.e., shallowest depth near the water table [within 20-25 ft of water table]), and the output included in the groundwater monitoring reports. Trend analyses will be performed annually for all wells (regardless of depth) to determine if individual well concentrations are changing over time. The results of both the MAROS evaluation and trend analyses shall be included in the associated groundwater monitoring reports

14.4 Waste Management

Expected waste streams that will be generated as IDW during the Eielson-Moose Creek groundwater sampling include purge and decontamination water, as well as disposable PPE and sampling equipment. This section discusses the management and handling of IDW to ensure that these materials are stored and removed in accordance with applicable federal, state, and local regulations. The full Waste Management Plan associated with this project's field activities is included as **Appendix E**.

IDW will be managed in consideration of the following general goals:

- Minimize the production of IDW;
- Containerize the IDW with appropriate containers and labels;
- Classify IDW based on generator knowledge;
- Sample and analyze, if additional classification is needed, to further determine IDW characteristics;
- Transport and dispose of IDW; and
- Document waste streams (determination, transportation, and disposal).

When required, the project team will provide any pertinent waste profiles and analytical results pertaining to IDW to the installation waste management office and the USACE COR for review prior to the generation of associated waste shipping manifests.

14.4.1 Monitoring Well Purge and Decontamination Water

Purge water generated from monitoring well sampling, as well as water generated from decontamination procedures, will be stored at a centralized location during field activities. This area will be identified during the field kickoff meeting. If needed, a decontamination area will be set up that is large enough for temporary storage of cleaned sampling equipment and materials prior to use, as well as to prevent overspray of decontamination into the surrounding areas.

IDW generated during purging and decontamination procedures will be properly labeled and containerized in Department of Transportation (DOT)-approved containers and transported to the Eielson AFB LF03 storage site pending characterization. DOT-approved containers will be secured appropriately to prevent unauthorized access. All IDW purge water generated during the sampling events will be treated by the PFAS Wastewater Treatment System (PWTS). The PWTS is located at the Hazardous Waste Facility (HWF) at Eielson AFB (**Appendix E**).

14.4.2 Disposal Decontamination Sampling Equipment and PPE

Spent sampling equipment, decontamination supplies, PPE, as well as general trash shall be classified as non-regulated solid waste. These materials will have been decontaminated to remove potential gross/cross-contamination, will be containerized, and will be disposed of in an onsite municipal dumpster. Potential spent sampling equipment and decontamination supplies may include, but are not limited to, secondary containment (i.e., buckets or plastic sheeting), as well as plastic waste bags. Given the nature of the field activities, it is assumed that these waste materials will be non-hazardous after decontamination procedures are performed.

14.5 Data Handling and Management

Throughout field activities and at the conclusion of each mobilization, field sampling logs, daily reports, and other data will be verified for completeness and stored in the North Wind-EA JV database. Data handling and management will be performed in accordance with contract requirements to maintain integrity of any potential Controlled Unclassified Information, as well as any other sensitive data (i.e., analytical results).

14.5.1 Documentation and Records

Field activities will be recorded in a field notebook, including, but not limited to, site conditions and sampling activities. Photographs, where permitted, will also be collected to document activities. Respective field sampling forms will be filled out for each monitoring well sampled, and each sample will be tracked using secure CoC protocol until receipt at the laboratory. The USACE NPDL project number, 24-028, will also be referenced on each CoC. Air bills for overnight courier service will be retained.

An administrative record will be maintained in accordance with EPA policy and guidelines. An index of documents shall be maintained in the administrative records on a quarterly basis if changes have occurred. The documents to be retained are indicated in **Worksheet #29** of this UFP-QAPP. Data and report records will be retained for a minimum of 10 years and offered to ADEC prior to disposal per the Eielson AFB FFA.

14.5.2 Project Reports

Sampling data will be presented in a Groundwater Sampling Report and will include a detailed narrative of each field activity and a summary of the sampling conducted and analyses performed. Figures, laboratory analytical reports, field forms, and photographs documenting field activities will be included as appendices to the report. The analytical data will be reviewed (i.e., verified, validated, and assessed) and reported in tabular format as summary tables to facilitate data review. The Groundwater PFAS Plume Evaluation Report will be included as an appendix to the Groundwater Sampling Report.

The Groundwater Sampling Reports and associated appendices will be submitted as pre-draft, draft, red line strike out draft final, and final versions. These reports will be developed with input provided by the USACE, USAF, and appropriate regulators.

14.5.3 Data Submittals and Storage

The data will be saved in existing electronic formats (e.g., spreadsheets and/or databases, and PDF) in project archives at the contractor's office. Electronic deliverables will be uploaded electronically in the AFCEC database. Additional information (i.e., digital photographs) will be stored in an electronic format that is efficiently transmittable. Data compression, image quality, and content will be in conformance with AFCEC deliverable requirements.

Moreover, analytical data will meet the Environmental Restoration Program Information Management System (ERPIMS) data deliverable requirements for this Task Order. The field and laboratory data will be recorded and entered into a computerized submission format in accordance with the most recent version of the ERPIMS Data Loading Handbook. Data uploaded to ERPIMS will include, but are not limited to, sampling data, relevant QA/QC data, groundwater levels, and groundwater stabilization parameters.

The electronic data deliverables (EDDs) and the laboratory data reports will be collected in project archives in existing electronic formats provided by the analytical laboratory. These will include the executable files delivered by the laboratory.

A series of software applications will be utilized to handle chemical data from the time of sample collection to processing for the report. At the end of the project, the chemical data and associated location information, field sample information, and CoC information will be stored in the USAF ERPIMS database.

QAPP WORKSHEET #15: Regional Screening Levels/Project Action Levels and Laboratory-Specific Detection/Quantitation Limits

This worksheet presents the RSLs and PAL criteria for water samples collected. The RSLs for each analyte in water were derived from the RSLs presented are in accordance with DoD's *PFAS 101 – Regional Screening Levels Used in DoD Cleanups* (https://www.acq.osd.mil/eie/eer/ecc/pfas/pfas101/rsl.html. Accessed on 19 March 2024). RSLs listed below account for the May 2024 EPA Residential Scenario Screening Levels for Tap Water. These RSLs are based on residential receptor scenarios for direct ingestion of groundwater and utilizes the default exposure assumptions for each potential receptor scenario, as contained in EPA's RSL calculator. In addition to the RSLs, the analytical results for the sampling events for PFOS+PFOA will be compared to 70 ppt, the DoD PAL for providing alternative drinking water sources (Assistant Secretary of Defense 2023).

The most current EPA RSLs and DoD PAL(s) published at the time of the annual report's pre-draft will be used when evaluating against project criteria.

In addition to the criteria presented above, ADEC also maintains groundwater cleanup levels for both PFOS and PFOA in Table C of 18 AAC 75 (ADEC 2023). However, both ADEC cleanup levels for PFOS and PFOA are 400 nanograms per liter (ng/L), which are significantly higher than their EPA counterparts of 4 ng/L and 6 ng/L, respectively. As a result, it should be noted that the ADEC cleanup level criteria for PFOS and PFOA will be achieved by adhering to the RSLs put forth in the DoD's PFAS 101 Guidance.

Matrix	Aqueous – Groundwater						
Analytical Group	PFAS, EPA 1633 - Draft						
					Laboratory-specific[3]		
Analyte	CAS Number	Regional Screening Levels/Project Action Levels[1] (ng/L)	Regional Screening Levels/Project Action Level Reference[1]	Project Quantitation Limit Goal[2] (ng/L)	Limit of Quantitation (ng/L)	Limit of Detection (ng/L)	Detection Limit (ng/L)
11-Chloroeicosafluoro-3-oxaundecane-1-sulfonic acid	763051-92-9	*NE*	*NE*	*NE*	8	3.01	0.818
1H,1H,2H,2H-Perfluorodecane sulfonic acid (8:2 FTS)	39108-34-4	*NE*	*NE*	*NE*	8	3.06	1.41
1H,1H,2H,2H-Perfluorohexane sulfonic acid (4:2 FTS)	757124-72-4	*NE*	*NE*	*NE*	8	4.79	1.65
1H,1H,2H,2H-Perfluorooctane sulfonic acid (6:2 FTS)	27619-97-2	*NE*	*NE*	*NE*	8	3.04	1.07
3-Perfluoroheptylpropanoic acid (7:3 FTCA)	812-70-4	*NE*	*NE*	*NE*	50	20	6.53
3-Perfluoropentylpropanoic acid (5:3 FTCA)	914637-49-3	*NE*	*NE*	*NE*	50	20	5.54
3-Perfluoropropylpropanoic acid (3:3 FTCA)	356-02-5	*NE*	*NE*	*NE*	10	4	1
4,8-Dioxa-3H-perfluorononanoic acid (ADONA)	919005-14-4	*NE*	*NE*	*NE*	8	4.82	1.67
9-Chlorohexadecafluoro-3-oxanonane-1-sulfonic acid	756426-58-1	*NE*	*NE*	*NE*	8	2.98	0.757
Hexafluoropropylene oxide dimer acid (HFPO-DA)	13252-13-6	1.5	EPA Tap Water RSL HQ = 0.1	0.5	8	5.12	1.85
N-ethylperfluorooctane sulfonamide (NEtFOSA)	4151-50-2	*NE*	*NE*	*NE*	2	0.8	0.365
N-ethylperfluorooctane sulfonamidoethanol (NEtFOSE)	1691-99-2	*NE*	*NE*	*NE*	20	8	2
N-ethylperfluorooctanesulfonamidoacetic acid (NEtFOSAA)	2991-50-6	*NE*	*NE*	*NE*	2	1.28	0.554
N-methylperfluorooctane sulfonamide (NMeFOSA)	31506-32-8	*NE*	*NE*	*NE*	4	1.28	0.453
N-methylperfluorooctane sulfonamidoethanol (NMeFOSE)	24448-09-7	*NE*	*NE*	*NE*	20	8	2.33
N-methylperfluorooctanesulfonamidoacetic acid (NMeFOSAA)	2355-31-9	*NE*	*NE*	*NE*	4	1.6	0.735
Nonafluoro-3,6-dioxaheptanoic acid (NFDHA)	151772-58-6	*NE*	*NE*	*NE*	4	1.6	0.63
Perfluoro (2-ethoxyethane) sulfonic acid (PFEESA)	113507-82-7	*NE*	*NE*	*NE*	4	2.28	0.731
Perfluoro-3-methoxypropanoic acid (PFMPA)	377-73-1	*NE*	*NE*	*NE*	4	1.6	0.578
Perfluoro-4-methoxybutanoic acid (PFMBA)	863090-89-5	*NE*	*NE*	*NE*	4	1.6	0.608
Perfluorobutanesulfonic acid (PFBS)	375-73-5	600	EPA Tap Water RSL HQ = 0.1	200	2	0.707	0.289
Perfluorobutanoic acid (PFBA)	375-22-4	1,800	EPA Tap Water RSL HQ = 0.1	600	8	3.2	0.942
Perfluorodecanesulfonic acid (PFDS)	335-77-3	*NE*	*NE*	*NE*	2	0.77	0.328
Perfluorodecanoic acid (PFDA)	335-76-2	*NE*	*NE*	*NE*	4	2.4	0.81
Perfluorododecanesulfonic acid (PFDoS)	79780-39-5	*NE*	*NE*	*NE*	2	1.24	0.431
Perfluorododecanoic acid (PFDoA)	307-55-1	*NE*	*NE*	*NE*	4	1.28	0.603

Matrix	Aqueous – Groundwater						
Analytical Group	PFAS, EPA 1633 - Draft						
					Laboratory-specific[3]		
Analyte	CAS Number	Regional Screening Levels/Project Action Levels[1] (ng/L)	Regional Screening Levels/Project Action Level Reference[1]	Project Quantitation Limit Goal[2] (ng/L)	Limit of Quantitation (ng/L)	Limit of Detection (ng/L)	Detection Limit (ng/L)
Perfluoroheptanesulfonic acid (PFHpS)	375-92-8	*NE*	*NE*	*NE*	2	1.23	0.395
Perfluoroheptanoic acid (PFHpA)	375-85-9	*NE*	*NE*	*NE*	2	1.28	0.501
Perfluorohexanesulfonic acid (PFHxS)	355-46-4	39	EPA Tap Water RSL HQ = 0.1	13	2	1.15	0.393
Perfluorohexanoic acid (PFHxA)	307-24-4	990	EPA Tap Water RSL HQ = 0.1	330	2	1.28	0.454
Perfluorononanesulfonic acid (PFNS)	68259-12-1	*NE*	*NE*	*NE*	2	1.23	0.402
Perfluorononanoic acid (PFNA)	375-95-1	5.9	EPA Tap Water RSL HQ = 0.1	2	2	1.6	0.657
Perfluorooctanesulfonamide (PFOSA)	754-91-6	*NE*	*NE*	*NE*	4	0.8	0.346
Perfluorooctanesulfonic acid (PFOS)	1763-23-1	0.2	EPA Tap Water RSL HQ = 0.1	1.3	2	1.18	0.441
Perfluorooctanoic acid (PFOA)	335-67-1	0.0027	EPA Tap Water RSL HQ = 0.1	2	2	0.8	0.367
Perfluoropentanesulfonic acid (PFPeS)	2706-91-4	*NE*	*NE*	*NE*	2	0.75	0.352
Perfluoropentanoic acid (PFPeA)	2706-90-3	*NE*	*NE*	*NE*	4	1.6	0.553
Perfluorotetradecanoic acid (PFTeDA)	376-06-7	*NE*	*NE*	*NE*	2	1.28	0.554
Perfluorotridecanoic acid (PFTrDA)	72629-94-8	*NE*	*NE*	*NE*	2	1.28	0.478
Perfluoroundecanoic acid (PFUnA)	2058-94-8	*NE*	*NE*	*NE*	4	1.28	0.61
PFOS+PFOA	NA	70*	ASD Memorandum, July 2023	23.33	*NA*	*NA*	*NA*

Notes:

[1] RSLs presented are in accordance with DoD's *PFAS 101 – Regional Screening Levels Used in DoD Cleanups* (https://www.acq.osd.mil/eie/eer/ecc/pfas/pfas101/rsl.html. Accessed on 19 March 2024). RSLs account for the May 2024 EPA Residential Scenario Screening Levels for Tap Water. This criterion exceeds that put forth in 18 AAC 75 (ADEC 2023). The PAL for PFOS+PFOA is presented in the ASD Memorandum, dated 11 July 2023. The most current EPA RSLs and DoD PAL(s) published at the time of the annual report's pre-draft will be used when evaluating against project criteria.

[2] Project Quantitation Limit goal is approximately 1/3 of the associated RSL/PAL.

[3] Laboratory-specific limits are achievable under optimal conditions and may fluctuate throughout the course of the project. Fluctuations in laboratory limits may result from, but are not limited to, sample volume, dilution requirements, and matrix interference of non-target analytes.

Abbreviations:

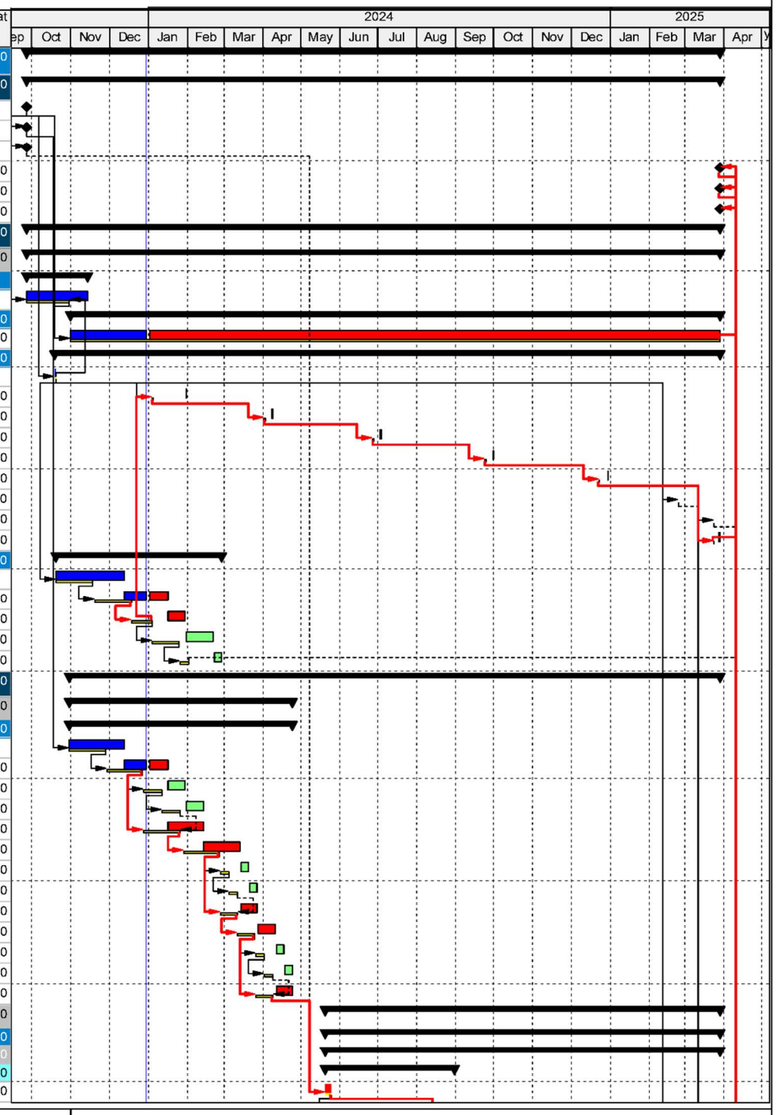
Shaded – Exceeds Associated RSL/PAL
ASD – Assistant Secretary of Defense
EPA – U.S. Environmental Protection Agency
HQ – Hazard Quotient
NA – Not applicable
NE – No established criteria
ng/L – Nanogram per Liter
PAL* – Project Action Level (PFOS+PFOA only)
PFAS – Per- and Polyfluoroalkyl Substances
RSL – Residential Screening Level

QAPP WORKSHEET #16: Project Schedule/Timeline

North Wind-EA JV, LLC

Moose Creek Long-Term Water Supply Monitoring

Activity ID	Activity Name	BL Project Duration	Remaining Duration	Performance % Complete	Start	Finish	Total Float
Moose Creek Long-Term Water Supply Monitoring		376.0	312.0	5.27%	27-Sep-23 A	28-Mar-25	0.0
Milestones		376.0	0.0	0%	27-Sep-23 A	28-Mar-25	0.0
MIL1000	Notice of Base Award	0.0	0.0	100%	27-Sep-23 A		
MIL1010	Notice of Optional Task 4 Award	0.0	0.0	100%	27-Sep-23 A		
MIL1020	Notice of Optional Task 5 Award	0.0	0.0	100%	27-Sep-23 A		
MIL1030	Completion Base Award and Optional Task 4	0.0	0.0	0%		28-Mar-25	0.0
MIL1040	Completion Optional Task 5	0.0	0.0	0%		28-Mar-25	0.0
MIL2000	Projected Completion	0.0	0.0	0%		28-Mar-25	0.0
Base Tasks		376.0	312.0	33.95%	27-Sep-23 A	28-Mar-25	0.0
Project Management		376.0	312.0	33.95%	27-Sep-23 A	28-Mar-25	0.0
Schedule		23.0	0.0	100%	27-Sep-23 A	13-Nov-23 A	
SCH1000	Prepare and Submit Project Schedule	23.0	0.0	100%	27-Sep-23 A	13-Nov-23 A	
Monthly Status Reporting		353.0	312.0	11.61%	31-Oct-23 A	28-Mar-25	0.0
MSR1000	Base Award Monthly Status Reporting	353.0	312.0	11.61%	31-Oct-23 A	28-Mar-25	0.0
Meetings		357.0	292.0	0%	19-Oct-23 A	28-Mar-25	0.0
MTG1000	Project Kick-Off Meeting	1.0	0.0	100%	19-Oct-23 A	19-Oct-23 A	
MTG1010	Technical Project Planning (TPP) 01	1.0	1.0	0%	31-Jan-24	31-Jan-24	0.0
MTG1020	Technical Project Planning (TPP) 02	1.0	1.0	0%	08-Apr-24	08-Apr-24	0.0
MTG1030	Technical Project Planning (TPP) 03	1.0	1.0	0%	03-Jul-24	03-Jul-24	0.0
MTG1040	Technical Project Planning (TPP) 04	1.0	1.0	0%	30-Sep-24	30-Sep-24	0.0
MTG1050	Technical Project Planning (TPP) 05	1.0	1.0	0%	30-Dec-24	30-Dec-24	0.0
MTG1070	RPM Meeting 01	1.0	1.0	0%	24-Feb-25	24-Feb-25	23.0
MTG1080	RPM Meeting 02	1.0	1.0	0%	24-Mar-25	24-Mar-25	4.0
MTG1060	Technical Project Planning (TPP) 06	1.0	1.0	0%	28-Mar-25	28-Mar-25	0.0
APP/SSHP		70.0	40.0	60.01%	20-Oct-23 A	28-Feb-24	272.0
APP1000	Prepare and Submit Draft APP/SSHP	20.0	0.0	100%	20-Oct-23 A	12-Dec-23 A	
APP1010	USACE/AF Review and Comment on Draft APP/SSHP	20.0	10.0	0%	13-Dec-23 A	16-Jan-24	0.0
APP1020	Respond to USACE/AF Comments on Draft APP/SSHP	10.0	10.0	0%	17-Jan-24	30-Jan-24	0.0
APP1030	USACE/AF Review and Acceptance of Responses to Comments	15.0	15.0	0%	31-Jan-24	21-Feb-24	272.0
APP1040	Prepare and Submit Final APP/SSHP	5.0	5.0	0%	22-Feb-24	28-Feb-24	272.0
Optional Tasks		354.0	312.0	3.44%	30-Oct-23 A	28-Mar-25	0.0
Optional Task 4 - Planning for Groundwater Sampling and Plume Evaluation		110.0	80.0	40%	30-Oct-23 A	24-Apr-24	0.0
Uniform Federal Policy-Quality Assurance Project Plan (UFP-QAPP)		110.0	80.0	40%	30-Oct-23 A	24-Apr-24	0.0
QPP1000	Prepare and Submit Pre-Draft UFP-QAPP	20.0	0.0	100%	30-Oct-23 A	12-Dec-23 A	
QPP1010	USACE/AF Review and Comment on Pre-Draft UFP-QAPP	20.0	10.0	0%	13-Dec-23 A	16-Jan-24	0.0
QPP1020	Respond to USACE/AF Comments on Pre-Draft UFP-QAPP	10.0	10.0	0%	17-Jan-24	30-Jan-24	0.0
QPP1030	USACE/AF Review and Acceptance of Responses to Comments	10.0	10.0	0%	31-Jan-24	13-Feb-24	0.0
QPP1040	Prepare and Submit Draft UFP-QAPP	20.0	20.0	0%	17-Jan-24	13-Feb-24	0.0
QPP1050	USACE/AF Review and Comment on Draft UFP-QAPP	20.0	20.0	0%	14-Feb-24	13-Mar-24	0.0
QPP1060	Respond to USACE/AF Comments on Draft UFP-QAPP	5.0	5.0	0%	14-Mar-24	20-Mar-24	0.0
QPP1070	USACE/AF Review and Acceptance of Responses to Comments	5.0	5.0	0%	21-Mar-24	27-Mar-24	0.0
QPP1080	Prepare and Submit Draft-Final UFP-QAPP	10.0	10.0	0%	14-Mar-24	27-Mar-24	0.0
QPP1090	USACE/AF Review and Comment on Draft-Final UFP-QAPP	10.0	10.0	0%	28-Mar-24	10-Apr-24	0.0
QPP1100	Respond to USACE/AF Comments on Draft-Final UFP-QAPP	5.0	5.0	0%	11-Apr-24	17-Apr-24	0.0
QPP1110	USACE/AF Review and Acceptance of Responses to Comments	5.0	5.0	0%	18-Apr-24	24-Apr-24	0.0
QPP1120	Prepare and Submit Final UFP-QAPP	10.0	10.0	0%	11-Apr-24	24-Apr-24	0.0
Optional Task 5 - Sampling and Groundwater PFAS Plume Evaluation		215.0	215.0	0%	20-May-24	28-Mar-25	0.0
Sampling and Groundwater PFAS Plume Evaluation 01		215.0	215.0	0%	20-May-24	28-Mar-25	0.0
Groundwater Sampling, Data Analysis and Reporting		215.0	215.0	0%	20-May-24	28-Mar-25	0.0
Groundwater Sampling		73.0	73.0	0%	20-May-24	30-Aug-24	0.0
PFAS1000	Perform Spring Groundwater Monitoring Well Sampling	5.0	5.0	0%	20-May-24	24-May-24	0.0



Remaining Level of Effort | Actual Work | Critical Remaining Work
Primary Baseline | Remaining Work | Milestone

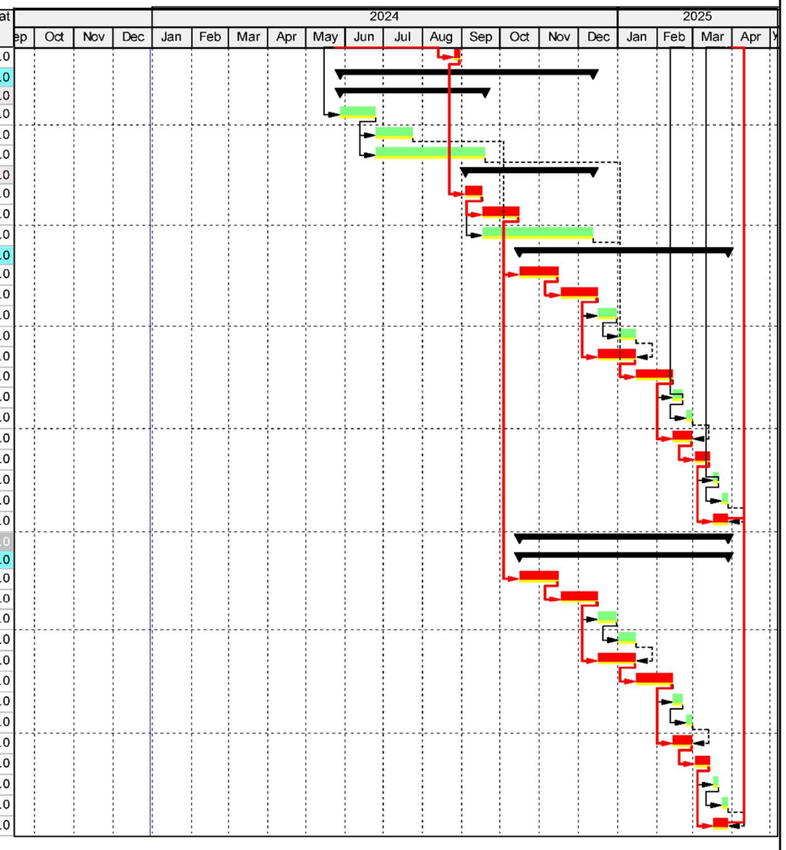
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Data Date 30-Dec-23

North Wind-EA JV, LLC

Moose Creek Long-Term Water Supply Monitoring

Activity ID	Activity Name	BL Project Duration	Remaining Duration	Performance % Complete	Start	Finish	Total Float
PFAS1010	Perform Fall Groundwater Monitoring Well Sampling	5.0	5.0	0%	26-Aug-24	30-Aug-24	0.0
Data Analysis		138.0	138.0	0%	28-May-24	12-Dec-24	22.0
Spring		80.0	80.0	0%	28-May-24	18-Sep-24	80.0
DTA1000	Spring Data Analysis	20.0	20.0	0%	28-May-24	24-Jun-24	58.0
DTA1010	Spring Data Validation	20.0	20.0	0%	25-Jun-24	23-Jul-24	58.0
DTA1020	Submit Spring ERPIMS	60.0	60.0	0%	25-Jun-24	18-Sep-24	80.0
Fall		70.0	70.0	0%	03-Sep-24	12-Dec-24	22.0
DTA1030	Fall Data Analysis	10.0	10.0	0%	03-Sep-24	16-Sep-24	0.0
DTA1040	Fall Data Validation	20.0	20.0	0%	17-Sep-24	15-Oct-24	0.0
DTA1050	Submit Fall ERPIMS	60.0	60.0	0%	17-Sep-24	12-Dec-24	22.0
Groundwater Sampling Report		112.0	112.0	0%	16-Oct-24	28-Mar-25	0.0
GSR1000	Prepare and Submit Pre-Draft GSR	22.0	22.0	0%	16-Oct-24	15-Nov-24	0.0
GSR1010	USACE/AF Review and Comment on Pre-Draft GSR	20.0	20.0	0%	18-Nov-24	16-Dec-24	0.0
GSR1020	Respond to USACE/AF Comments on Pre-Draft GSR	10.0	10.0	0%	17-Dec-24	31-Dec-24	0.0
GSR1030	USACE/AF Review and Acceptance of Responses to Comments	10.0	10.0	0%	02-Jan-25	15-Jan-25	0.0
GSR1040	Prepare and Submit Draft GSR	20.0	20.0	0%	17-Dec-24	15-Jan-25	0.0
GSR1050	ADEC/EPA Review and Comment on Draft GSR	20.0	20.0	0%	16-Jan-25	13-Feb-25	0.0
GSR1060	Respond to ADEC/EPA Comments on Draft GSR	5.0	5.0	0%	14-Feb-25	21-Feb-25	0.0
GSR1070	ADEC/EPA Review and Acceptance of Responses to Comments	5.0	5.0	0%	24-Feb-25	28-Feb-25	0.0
GSR1080	Prepare and Submit Draft-Final GSR	10.0	10.0	0%	14-Feb-25	28-Feb-25	0.0
GSR1090	ADEC/EPA Review and Comment on Draft-Final GSR	10.0	10.0	0%	03-Mar-25	14-Mar-25	0.0
GSR1100	Respond to ADEC/EPA Comments on Draft-Final GSR	5.0	5.0	0%	17-Mar-25	21-Mar-25	0.0
GSR1110	ADEC/EPA Review and Acceptance of Responses to Comments	5.0	5.0	0%	24-Mar-25	28-Mar-25	0.0
GSR1120	Prepare and Submit Final GSR	10.0	10.0	0%	17-Mar-25	28-Mar-25	0.0
Groundwater PFAS Plume Evaluation		112.0	112.0	0%	16-Oct-24	28-Mar-25	0.0
MAROS Reporting		112.0	112.0	0%	16-Oct-24	28-Mar-25	0.0
MRR1000	Prepare and Submit Pre-Draft MAROS Report	22.0	22.0	0%	16-Oct-24	15-Nov-24	0.0
MRR1010	USACE/AF Review and Comment on Pre-Draft MAROS Report	20.0	20.0	0%	18-Nov-24	16-Dec-24	0.0
MRR1020	Respond to USACE/AF Comments on Pre-Draft MAROS Report	10.0	10.0	0%	17-Dec-24	31-Dec-24	0.0
MRR1030	USACE/AF Review and Acceptance of Responses to Comments	10.0	10.0	0%	02-Jan-25	15-Jan-25	0.0
MRR1040	Prepare and Submit Draft MAROS Report	20.0	20.0	0%	17-Dec-24	15-Jan-25	0.0
MRR1050	ADEC/EPA Review and Comment on Draft MAROS Report	20.0	20.0	0%	16-Jan-25	13-Feb-25	0.0
MRR1060	Respond to ADEC/EPA Comments on Draft MAROS Report	5.0	5.0	0%	14-Feb-25	21-Feb-25	0.0
MRR1070	ADEC/EPA Review and Acceptance of Responses to Comments	5.0	5.0	0%	24-Feb-25	28-Feb-25	0.0
MRR1080	Prepare and Submit Draft-Final MAROS Report	10.0	10.0	0%	14-Feb-25	28-Feb-25	0.0
MRR1090	ADEC/EPA Review and Comment on Draft-Final MAROS Report	10.0	10.0	0%	03-Mar-25	14-Mar-25	0.0
MRR1100	Respond to ADEC/EPA Comments on Draft-Final MAROS Report	5.0	5.0	0%	17-Mar-25	21-Mar-25	0.0
MRR1110	ADEC/EPA Review and Acceptance of Responses to Comments	5.0	5.0	0%	24-Mar-25	28-Mar-25	0.0
MRR1120	Prepare and Submit Final MAROS Report	10.0	10.0	0%	17-Mar-25	28-Mar-25	0.0



Remaining Level of Effort | Actual Work | Critical Remaining Work
Primary Baseline | Remaining Work | Milestone

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Data Date 30-Dec-23

QAPP WORKSHEET #17: Sample Design and Rationale

17.1 Sampling Rationale

This worksheet summarizes the sampling rationale for continued groundwater monitoring at Eielson AFB in Moose Creek, Alaska. North Wind-EA JV, LLC will conduct bi-annual sampling, once in the spring and once in the fall, of 80 existing monitoring wells to further evaluate the PFAS groundwater contaminant plume within the boundary and northwest of Eielson AFB. Due to observations from the previous 2022 and 2023 80 monitoring well sampling events, the following wells have been omitted from the 2024 bi-annual sampling events for the following reasons:

- 20PS-MW05 and MW-BKG-11 are blocked or were decommissioned.
- 20PS-MW04, HCMW-04 well nest (HCMW04WT, HCMW04DP, and HCMW04MD), and USAP-2 are relatively far outside the plume and in a direction towards which the plume does not appear to be spreading.
- 20PS-MW16 has been flooded during the spring sampling events and only sampled in the fall.
- North Pole Well-A and North Pole Well-B have had no PFAS exceedances.

The following monitoring wells will replace the wells discussed above and will be sampled in addition to the 70 previously sampled wells:

- NPA-40
- NPB-40
- NPC-20 and NPC-40
- NPD-20 and NPD-40
- NPF-20 and NPF-40
- NPG-20 and NPG-40.

The monitoring wells that have been removed and those that have been added to the 2024 bi-annual groundwater sampling are depicted on Figure 4.

Sites with remedies in place at Eielson AFB that have groundwater contamination are in the sitewide monitoring program to ensure the contaminant plumes are stable or decreasing. Institutional controls, such as restriction of groundwater use in certain areas, treatment systems on drinking water wells, fishing advisories, and dig restrictions, are in place at Eielson AFB to prevent exposure to remaining contamination (ADEC 2022). This sampling rationale falls under the sitewide monitoring program.

17.2 Sampling Design

Groundwater is the only medium of concern and PFAS are the only constituents of concern. The frequency of QA/QC sample collection is discussed on **Worksheet #20**. The monitoring wells will be sampled on a biannual basis from spring 2024 to fall 2024 (sampling is anticipated during the months of May and September, respectively) to document current concentrations and to further evaluate contaminant plume concentrations. Samples will be analyzed for PFAS using EPA Method 1633 - Draft for PFAS by LC/MS/MS compliant with QSM 5.4 Table B-24.

17.3 Sampling Nomenclature

Monitoring well locations will be identified using a unique alphanumeric sample identification (ID) code. In addition to a unique ID code, the USACE North Pacific Division Laboratory (NPDL) project number, 24-028, will be referenced on the label of each sample. The stepwise procedure for coding the samples will be performed as described below; note each step will end by appending a dash ("-") to that sequence in the code.

Samples nomenclature will be in accordance with the following conventions:

Normal Samples:

- The first two characters indicate the year (e.g., the year 2024 would be labeled 24).
- The next characters indicate the monitoring well ID (e.g., 20PS-MW01, 20PS-MW02, and 20PS-MW03).
- The next four characters indicate the date of sampling (e.g., May 24th would be labeled 0524).

Examples:

- 24-19PS-MW01A-0518 indicates the groundwater sample was collected from monitoring well 19PS-MW01A on May 18, 2024.
- 24-20PS-MW01-0920 indicates the groundwater sample was collected from monitoring well 20PS-MW01on September 20, 2024.
- Field Duplicates:
  - Field duplicates should be collected as blind field duplicates. To ensure anonymity, the monitoring well ID should be replaced with "DUP#", where the # indicates the chronological number order in which the duplicate was taken.
  - For example, the first field duplicate taken at 20PS-MW01 on April 5, 2024, would be labeled as "24-DUP01-0405." A second field duplicate would then be labeled as "DUP02", and so on.
- MS/MSD:
  - MS/MSDs should be labeled with the same ID as the normal sample in which the MS/MSD was collected, with "-MS/MSD" appended to the end of the ID.
  - For example, an MS/MSD collected at 20PS-MW01on April 5, 2024, would be labeled as "24-20PS-MW01-0405-MS/MSD."
- Field Blanks:
  - Field blanks should be identified by "FB#-MMDDYY," where the # indicates the chronological number order in which the field blank was collected during that event.
  - Per **Worksheet #20**, one field blank will be collected per 20 samples.
- Equipment Blanks:
  - Equipment blanks should be identified by "EB#-MMDDYY," where the # indicates the chronological number order in which the equipment blank was collected during that event.
  - Per **Worksheet #20**, it is not anticipated that more than one equipment blank will be collected per week.

Record of the parent and duplicate sample pairing will be noted in a field logbook or other sample tracking form.

QAPP WORKSHEET #18: Sampling Locations and Methods

Eighty existing monitoring wells will be sampled biannually, once in the spring and once in the fall, to further evaluate the PFAS groundwater contaminant plume within the boundary and northwest of Eielson AFB (**Figure 4**). The purpose of the sampling is to evaluate plume characteristics and characterize plume concentrations. The monitoring well identifications, coordinates, well depth, and sampling method are included on **Table 18-1**. Monitoring Well Data QA/QC samples are discussed in **Worksheet #20**. Field sampling SOP references are provided in **Worksheet #21**. The sampling design and rationale are included in **Worksheet #17**.

Table 18.1. Monitoring Well Data

Well ID	Northing[a]	Easting[a]	Well Depth (feet bgs)	Screened Interval (feet bgs)	Sampling Frequency	Sampling Method	Comments
Shallow Monitoring Wells							
20PS-MW01	7176581.112	494517.138	13.00	3-13	2x/year (spring & fall)	Low flow	Sample depth may be adjusted based on field observations.
20PS-MW02	7175064.120	495610.731	12.80	2.8-12.8	2x/year (spring & fall)	Low flow	Sample depth may be adjusted based on field observations.
20PS-MW03	7174076.359	496739.466	13.00	3-13	2x/year (spring & fall)	Low flow	Sample depth may be adjusted based on field observations.
20PS-MW06	7173880.735	494001.302	15.50	5.5-15.5	2x/year (spring & fall)	Low flow	Sample depth may be adjusted based on field observations.
20PS-MW07	7174837.889	493352.164	14.00	4-14	2x/year (spring & fall)	Low flow	Sample depth may be adjusted based on field observations.
20PS-MW08	7175365.406	493100.981	13.00	3-13	2x/year (spring & fall)	Low flow	Sample depth may be adjusted based on field observations.
20PS-MW09	7176639.655	490855.088	16.50	6.5-16.5	2x/year (spring & fall)	Low flow	Sample depth may be adjusted based on field observations.
20PS-MW10	7176948.625	490203.009	13.40	3-13	2x/year (spring & fall)	Low flow	Sample depth may be adjusted based on field observations.
20PS-MW11	7177127.788	489673.368	11.83	1.5-11.5	2x/year (spring & fall)	Low flow	Sample depth may be adjusted based on field observations.

Well ID	Northing[a]	Easting[a]	Well Depth (feet bgs)	Screened Interval (feet bgs)	Sampling Frequency	Sampling Method	Comments
20PS-MW12	7177237.566	489308.677	13.40	3-13	2x/year (spring & fall)	Low flow	Sample depth may be adjusted based on field observations.
20PS-MW13	7177423.927	488247.719	15.00	5-15	2x/year (spring & fall)	Low flow	Sample depth may be adjusted based on field observations.
20PS-MW14	7176517.027	487621.596	13.00	3-13	2x/year (spring & fall)	Low flow	Sample depth may be adjusted based on field observations.
20PS-MW15	7176252.153	486757.777	15.00	5-15	2x/year (spring & fall)	Low flow	Sample depth may be adjusted based on field observations.
20PS-MW17	7176270.343	486138.819	13	3-13	2x/year (spring & fall)	Low flow	Sample depth may be adjusted based on field observations.
20PS-MW19	7177438.570	486298.504	13.00	3-13	2x/year (spring & fall)	Low flow	Sample depth may be adjusted based on field observations.
20PS-MW20	7177393.776	486490.384	13.00	3-13	2x/year (spring & fall)	Low flow	Sample depth may be adjusted based on field observations.
20PS-MW22	7178324.143	487374.239	20.00	10-20	2x/year (spring & fall)	Low flow	Sample depth may be adjusted based on field observations.
20PS-MW23	7178321.010	488036.391	13.00	3-13	2x/year (spring & fall)	Low flow	Sample depth may be adjusted based on field observations.
20PS-MW24	7178045.163	488908.570	24.00	4.5-14.5	2x/year (spring & fall)	Low flow	Sample depth may be adjusted based on field observations.
20PS-MW25	7179667.000	489329.811	20.91	4-14	2x/year (spring & fall)	Low flow	Sample depth may be adjusted based on field observations.
20PS-MW27	7176512.106	487623.321	20.80	10.8-20.8	2x/year (spring & fall)	Low flow	Sample depth may be adjusted based on field observations.
20PS-MW29	7176784.518	487078.246	17.00	7-17	2x/year spring & fall)	Low flow	Sample depth may be adjusted based on field observations.

Well ID	Northing[a]	Easting[a]	Well Depth (feet bgs)	Screened Interval (feet bgs)	Sampling Frequency	Sampling Method	Comments
20PS-MW30	7176189.208	485968.943	20.00	10-20	2x/year (spring & fall)	Low flow	Sample depth may be adjusted based on field observations.
DSAP-14*	7177502.89400	486697.52190	21.50	15.1-20.1	2x/year (spring & fall)	Low flow	Sample depth may be adjusted based on field observations.
DSAP-8S	7179793.91270	488525.08690	19.20	13.9-18.9	2x/year (spring & fall)	Low flow	Sample depth may be adjusted based on field observations.
USAP-3	7179418.06490	489753.77290	21.50	12.1-17.1	2x/year (spring & fall)	Low flow	Sample depth may be adjusted based on field observations.
DSAP-10	7178964.52240	486921.30550	15.40	10.2-15.2	2x/year (spring & fall)	Low flow	Sample depth may be adjusted based on field observations.
DSAP-11	7178774.63400	487925.92640	22.00	9.2-19.2	2x/year (spring & fall)	Low flow	Sample depth may be adjusted based on field observations.
DSAP-13	7178256.08510	486111.10940	13.00	7.8-12.8	2x/year (spring & fall)	Low flow	Sample depth may be adjusted based on field observations.
USAP-1	7178769.88610	489195.96240	24.50	14.0-19.0	2x/year (spring & fall)	Low flow	Sample depth may be adjusted based on field observations.
02MW11	7174605.93410	495461.92510	25.00	12.75-22.75	2x/year (spring & fall)	Low flow	Sample depth may be adjusted based on field observations.
MW-2*	7173857.57000	496040.80030	UNKNOWN	UNKNOWN	2x/year (spring & fall)	Low flow	Sample depth may be adjusted based on field observations.
MW-BKG-01	7172270.47810	493967.37210	20.3	7.5-17.5	2x/year (spring & fall)	Low flow	Sample depth may be adjusted based on field observations.
MW-BKG-04	7168297.22410	497261.91110	22.3	10.0-20.0	2x/year (spring & fall)	Low flow	Sample depth may be adjusted based on field observations.
MW-BKG-07	7168342.80290	497643.33610	23.3	11.0-21.0	2x/year (spring & fall)	Low flow	Sample depth may be adjusted based on field observations.

Well ID	Northing[a]	Easting[a]	Well Depth (feet bgs)	Screened Interval (feet bgs)	Sampling Frequency	Sampling Method	Comments
MW-BKG-09	7169418.41210	495589.98610	21.3	9.0-19.0	2x/year (spring & fall)	Low flow	Sample depth may be adjusted based on field observations.
MW-BKG-10	7169969.41490	494603.72310	20	7.5-17.5	2x/year (spring & fall)	Low flow	Sample depth may be adjusted based on field observations.
MW-BKG-12	7170059.0669	498505.6721	14.8	2.5-12.5	2x/year (spring & fall)	Low flow	Sample depth may be adjusted based on field observations.
Intermediate Monitoring Well							
DSAP-8D	7179793.91270	488525.08690	66.50	59.2-64.2	2x/year (spring & fall)	Low flow	Sample depth may be adjusted based on field observations.
Clustered Wells Monitoring Wells							
19PS-MW01A	7177465.413	487703.261	63.33	51.31-61.31	2x/year (spring & fall)	Low flow	Sample depth may be adjusted based on field observations.
19PS-MW01B	7177471.420	487703.958	110.58	99.92-109.58	2x/year (spring & fall)	Low flow	Sample depth may be adjusted based on field observations.
19PS-MW02A	7176688.866	487215.0573	63.33	49-59	2x/year (spring & fall)	Low flow	Sample depth may be adjusted based on field observations.
19PS-MW02B	7176691.293	487220.1053	62.00	101.8-111.8	2x/year (spring & fall)	Low flow	Sample depth may be adjusted based on field observations.
20PS-MW01C	7177474.325	487704.137	160.50	150.3-160.3	2x/year (spring & fall)	Low flow	Sample depth may be adjusted based on field observations.
20PS-MW01D	7177468.345	487703.556	209.53	199-209	2x/year (spring & fall)	Low flow	Sample depth may be adjusted based on field observations.
20PS-MW02C	7176691.614	487222.494	161.24	151-161	2x/year (spring & fall)	Low flow	Sample depth may be adjusted based on field observations.
20PS-MW02D	7176689.902	487219.028	210.00	199.8-209.8	2x/year (spring & fall)	Low flow	Sample depth may be adjusted based on field observations.

Well ID	Northing[a]	Easting[a]	Well Depth (feet bgs)	Screened Interval (feet bgs)	Sampling Frequency	Sampling Method	Comments
HCMW01WT	7174222.4840	493372.7221	17.02	7-17	2x/year (spring & fall)	Low flow	Sample depth may be adjusted based on field observations.
HCMW01MD	7174223.4420	493373.5421	72.8	68-73	2x/year (spring & fall)	Low flow	Sample depth may be adjusted based on field observations.
HCMW01DP	7174224.8230	493374.8041	203.03	198-203	2x/year (spring & fall)	Low flow	Sample depth may be adjusted based on field observations.
HCMW02WT	7174419.824	493836.4556	16.33	6-16	2x/year (spring & fall)	Low flow	Sample depth may be adjusted based on field observations.
HCMW02MD	7174419.105	493833.9764	72.93	68-73	2x/year (spring & fall)	Low flow	Sample depth may be adjusted based on field observations.
HCMW02DP	7174417.687	493832.0488	198.5	193-198	2x/year (spring & fall)	Low flow	Sample depth may be adjusted based on field observations.
HCMW03WT	7174467.120	495297.2664	13.5	4-13	2x/year (spring & fall)	Low flow	Sample depth may be adjusted based on field observations.
HCMW03MD	7174464.513	495297.0429	72	67-72	2x/year (spring & fall)	Low flow	Sample depth may be adjusted based on field observations.
HCMW03DP	7174462.133	495297.0222	199.2	194-199	2x/year (spring & fall)	Low flow	Sample depth may be adjusted based on field observations.
HCMW05WT	7171772.314	497578.6485	12	3-13	2x/year (spring & fall)	Low flow	Sample depth may be adjusted based on field observations.
HCMW05MD	7171774.332	497575.7034	72.64	67-72	2x/year (spring & fall)	Low flow	Sample depth may be adjusted based on field observations.
HCMW05DP	7171773.197	497577.2069	203	197-202	2x/year (spring & fall)	Low flow	Sample depth may be adjusted based on field observations.
HCMW06WT	7167605.292	496723.5434	15.41	5-15	2x/year (spring & fall)	Low flow	Sample depth may be adjusted based on field observations.

Well ID	Northing[a]	Easting[a]	Well Depth (feet bgs)	Screened Interval (feet bgs)	Sampling Frequency	Sampling Method	Comments
HCMW06DP	7167605.896	496721.7453	201.63	196-201	2x/year (spring & fall)	Low flow	Sample depth may be adjusted based on field observations.
MW1-50	7175504.1	493797.83	50	40-50	2x/year (spring & fall)	Low flow	Sample depth may be adjusted based on field observations.
MW1-100	7175501	493798.31	98	88-98	2x/year (spring & fall)	Low flow	Sample depth may be adjusted based on field observations.
MW1-150	7175495	493799.09	150	140-150	2x/year (spring & fall)	Low flow	Sample depth may be adjusted based on field observations.
MW2-50	7172497	495303.1	50	40-50	2x/year (spring & fall)	Low flow	Sample depth may be adjusted based on field observations.
MW2-100	7172500.5	495301.26	100	90-100	2x/year (spring & fall)	Low flow	Sample depth may be adjusted based on field observations.
MW2-150	7172503.9	495300.75	150	140-150	2x/year (spring & fall)	Low flow	Sample depth may be adjusted based on field observations.
MW3-50	7170121.9	496315.66	48	28-48	2x/year (spring & fall)	Low flow	Sample depth may be adjusted based on field observations.
MW3-100	7170122.7	496320.99	100	80-100	2x/year (spring & fall)	Low flow	Sample depth may be adjusted based on field observations.
NPA-40**	7179772.5	484925.8	40	30-40	2x/year (spring & fall)	Low flow	Sample depth may be adjusted based on field observations.
NPB-22**	7178252.45	486190.21	22	11-22	2x/year (spring & fall)	Low flow	Sample depth may be adjusted based on field observations.
NPB-40**	7178379.4	485995.4	40	30-40	2x/year (spring & fall)	Low flow	Sample depth may be adjusted based on field observations.
NPC-20**	7179351.7	486785.3	20	10-20	2x/year (spring & fall)	Low flow	Sample depth may be adjusted based on field observations.

Well ID	Northing[a]	Easting[a]	Well Depth (feet bgs)	Screened Interval (feet bgs)	Sampling Frequency	Sampling Method	Comments
NPC-40**	7179351.7	486785.3	40	30-40	2x/year (spring & fall)	Low flow	Sample depth may be adjusted based on field observations.
NPD-20**	7179860.3	487611.0	20	10-20	2x/year (spring & fall)	Low flow	Sample depth may be adjusted based on field observations.
NPD-40**	7179860.3	487611.0	40	30-40	2x/year (spring & fall)	Low flow	Sample depth may be adjusted based on field observations.
NPF-20**	7180488.1	485510.5	20	10-20	2x/year (spring & fall)	Low flow	Sample depth may be adjusted based on field observations.
NPF-40**	7180488.1	485510.5	40	30-40	2x/year (spring & fall)	Low flow	Sample depth may be adjusted based on field observations.
NPG-20**	7179610.9	483235.8	20	10-20	2x/year (spring & fall)	Low flow	Sample depth may be adjusted based on field observations.
NPG-40**	7179610.9	483235.8	40	30-40	2x/year (spring & fall)	Low flow	Sample depth may be adjusted based on field observations.

Notes:
*Environmental Restoration Atlas (USAF 2021)
**Northing and easting are approximate, based on center point of clusters. The data has not been post processed and well completions are scheduled for 2024 field season. Professional survey will be completed on all wells at the end of field season 2024.
Bold/Highlighted = New monitoring wells to be sampled.
a Coordinate System: WGS 84 UTM Zone 6 North, in Meters.
b Vertical Coordinate System: NAVD88.

QAPP WORKSHEETS #19 AND 30: Sample Containers, Preservation, and Hold Times

Laboratory: Eurofins Sacramento Laboratory Environmental, LLC
880 Riverside Parkway
West Sacramento, CA 95605
Point-of-contact: Nathan Horner, (916) 374-4306
Email: Nathaniel.horner@et.eurofinsus.com

List required accreditations/certifications: DoD Environmental Laboratory Analytical Program (ELAP) and ADEC Environmental Laboratory Certification Program (**Appendix D**).

Back-up Laboratory: SGS North America, Anchorage

Sample Delivery Method: Expedited courier service

Analyte/ Analytical Group	Matrix	Method/SOP	Container Size/Type	Preservation	Preparation Holding Time[1]	Analytical Holding Time[1]	Data Package Turnaround
Perfluorinated Compounds	Water	Draft Method 1633 WS-LC-0039	2 x 500 mL and 1 x 125 mL HDPE Bottles	No chemical preservation. 0 - 6°C Samples should be protected from light from the time of collection until receipt at the laboratory.	28 days from collection to analysis if stored at 0 - 6°C 90 days from collection to analysis if stored at ≤-20°C	28 days from collection to analysis if stored at 0 - 6°C 90 days from collection to analysis if stored at ≤-20°C	Standard

Note:
[1] Samples should be run as soon as possible, as issues have been observed with certain perfluorooctane sulfonamide ethanols and perfluorooctane sulfoamidoacetic acids after 7 days. Similarly, some ether sulfonates have observed issues for extracts analyzed beyond 28 days (EPA 2024).

Abbreviations:
°C = Degrees Celsius
HDPE = high density polyethylene
mL = milliliter

QAPP WORKSHEET #20: Field Quality Control Sample Summary

Matrix	Analytical Group	No. of Field Duplicates	No. of MS/MSDs	No. of Field Blanks	No. of Equipment Blanks
Water	Perfluorinated Compounds	Minimum 10%	5%*	One per 20 samples	For reusable sampling equipment only and daily per use.

*MS/MSD samples will be collected and provided to the laboratory per shipment of 20 samples.

QAPP WORKSHEET #21: Field Standard Operating Procedures

Provisions of the North Wind or EA corporate SOPs included **in Appendix C** are superseded by specific activities outlined in the QAPP. The North Wind or EA corporate SOPs are applicable to a variety of projects across the country, are general in nature, and thus may not cover all possible project-specific requirements. Rather, deviations from these SOPs are addressed under the specific tasks discussed in **Worksheet #14** and addressed in the Comments column of the table below.

Reference Number	Title, Revision Date, and/or Number	Organizing Organization	Equipment Type	Modified for Project Work (Check if yes)	Comments
SOP 001	Labels – November 2018	EA	Supplies, indelible ink pen, documents	No	NA
SOP 002	Chain-of-Custody – November 2018	EA	Supplies, indelible ink pen, documents	No	NA
SOP 009	Fieldwork During Times of High Risk for Wildfire, March 2022	EA	NA	No	NA
SOP 043	Multi-Probe Water Quality Monitoring Instruments	EA	Water quality parameters	Yes	Calibration must be performed or verified daily.
SOP 052	Bear Safety for Fieldwork Occurring in Bear Habitats	EA	NA	No	NA
ENVP-2002	Sample Handling and Shipping, June 2019	North Wind	Chain of custody, sample packing materials, etc.	Yes	PFAS-specific restrictions; See **Section 14.1** of this QAPP and ENVP-2019.
ENVP-2003	Field Documentation, June 2019	North Wind	Logbooks, etc.	Yes	PFAS-specific restrictions; See **Section 14.1** of this QAPP and ENVP-2019. Form ENVF-2003.01 supplements ENVP-2003.
ENVP-2004	Collection of Quality Control Samples, June 2019	North Wind	Low-Flow Sampling	No	As specified in SOP, in accordance with **Worksheet #20.**

Reference Number	Title, Revision Date, and/or Number	Organizing Organization	Equipment Type	Modified for Project Work (Check if yes)	Comments
ENVP-2006	Groundwater Sampling, November 2023	North Wind	Low Flow Sampling	Yes	Do not use fluoropolymer or LDPE tubing or bladders. HDPE or silicon materials are acceptable. Forms ENVF-2006.01 and 2006.02 supplement ENVP-2006.
ENVP-2011	Field Measurements, June 2019	North Wind	Water Level Meter	No	Meter will be calibrated on the manufacturer's recommended schedule.
ENVP-2014	Equipment Decontamination, June 2019	North Wind	All Field Equipment	Yes	Water used for decontamination of sampling equipment must be laboratory certified PFAS-free water.
ENVP-2017	Waste Management for Environmental Investigations, June 2019	North Wind	DOT-approved waste containers, wrench for securing containers, etc.	No	Waste handling should be in accordance with ENVP-2017, **Section 14.6** of this QAPP, and installation specific procedures, as necessary.
ENVP-2019	Per- and Polyfluoroalkyl Substances (PFAS) Sample Collection Guidance, December 2023	North Wind	All Field Equipment	No	Must be applied to all sampling events.
QAP-3121	Control of Measuring and Test Equipment	North Wind	Document Control	No	Forms QAF-3121.01, 3121.02, and 3121.03 supplement QAP-3121.
QAP-3171	Records Management	North Wind	Document Control	No	NA

Abbreviations:
EA – EA Engineering, Science, and Technology, Inc. PBC
ENVF – environmental form
ENVP – environmental procedure
HDPE – High Density Polyethylene
LDPE – Low Density Polyethylene
NA – Not Applicable
North Wind – North Wind Site Services, LLC
SOP – Standard Operating Procedure
QAP – Quality Assurance Procedure

QAPP WORKSHEET #22: Field Equipment Calibration, Maintenance, Testing, And Inspection

Field Equipment	Calibration Activity	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference
Turbidity Meter (HF Scientific or similar)	Calibrate with Gelex Turbidity Standards.	Keep clean and place in hard case between sampling activities.	Field test in accordance with the manual.	Inspect for external damage (i.e., LCD screen, etc.).	Calibrated by supplier. Maintain and inspect daily when used.	Within calibration standard(s) range.	Recalibration	Field personnel	SOP-043 and see equipment manual
pH/Temperature Meter (Hanna pHep®5 or similar)	Follow manufacturer's instructions. Two-point calibration for pH.	Decontaminate and store in water short-term, long-term storage according to the manufacturer.	Field test in accordance with the manual.	Visually inspect probes for cleanliness and wear.	Check calibration daily before use. Maintain and inspect daily when used.	Within calibration standard(s) range.	Cleaning and recalibration	Field personnel	SOP-043 and see equipment manual
Multi-parameter Meter (YSI 556 or similar)	Follow manufacturer's instructions. Calibrate barometer, pH, ORP, and DO meter.	Decontaminate and store in water short-term, long-term storage according to the manufacturer.	Field test in accordance with the manual.	Visually inspect probes for cleanliness and wear.	Check calibration daily before use. Maintain and inspect daily when used.	Within calibration standard(s) range.	Cleaning and recalibration	Field personnel	SOP-043

Abbreviations:
DO – Dissolved Oxygen
SOP – Standard Operating Procedure

QAPP WORKSHEET #23: Analytical Standard Operating Procedures

LABORATORY ANALYTICAL SOP REFERENCES						
Reference Number	**Title, Revision Date, and/or Number**	**Definitive or Screening Data**	**Analytical Group**	**Instrument**	**Organization Performing Analysis**	**Modified for Project Work?**
NA	DoD Quality Systems Manual for Environmental Laboratories, Version 5.4, October 2021	NA	General	NA	DoD Environmental Quality Workgroup	No
WS-LC-0039	Analysis of Per- and Polyfluoroalkyl Substances (PFAS) in Water, Solid, Biosolids and Tissue [Method 1633]; Effective 10/04/2023, Revision 1.5	Definitive	PFAS	LC/MS/MS	Eurofins Sacramento, CA	No

Abbreviations:
DoD – Department of Defense
LC/MS/MS – Liquid Chromatography/Mass Spectrometry
NA – Not Applicable
PFAS – Per- and Polyfluoroalkyl Substances

QAPP WORKSHEET #24: Analytical Instrument Calibration

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action	Person Responsible for Corrective Action	Analytical Method/ SOP
LC/MS/MS	Mass Calibration	Prior to initial use and after any major maintenance is performed.	Calibrate the mass scale of the MS with calibration compounds and procedures described by the manufacturer. Range must bracket the ion masses of interest. Mass calibration verified to 0.5 atomic mass unit of true value by acquiring a full scan continuum of mass spectrum of PFAS stock standard.	If problem found, correct as appropriate, then recalibrate.	Lab Manager /Analyst	Draft Method 1633 WS-LC-0039
	Mass Spectral Acquisition Rate	Each target, extracted internal standard (EIS), and non-extracted internal standard (NIS) compound.	A minimum of 10 spectra scans are acquired across each chromatographic peak	If problem found, correct as appropriate, then recalibrate.	Lab Manager /Analyst	
	Ion transitions (Precursor --> Product)	Every field sample, standard, blank, and QC samples	Use ion transitions from Table 2 of Draft Method EPA 1633.	If problem found, correct as appropriate, then recalibrate.	Lab Manager /Analyst	
	Minimum six-point initial calibration for target analytes, lowest concentration standard at or below the LOQ.	Prior to initial use and after ICV or CCV failure, prior to sample analysis.	S/N ratio $\geq$ 3:1 for all ions used for quantitation. The % relative standard deviation (RSD)/relative standard error (RSE) for all analytes must be $\leq$20%.	Evaluate standards, chromatography, and mass spectrometer response. If problem found with above, correct as appropriate, then repeat initial calibration.	Lab Manager /Analyst	

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action	Person Responsible for Corrective Action	Analytical Method/ SOP
	Instrument blanks	Immediately following the highest standard analyzed, daily prior to sample analysis and after each CCV.	Concentration of each analyte must be $\leq$ 1/2 the LOQ.	If acceptance criteria are not met after the highest standard, the initial calibration (ICAL) must be performed at a lower concentration until the acceptance criteria (<1/2 LOQ) are met. If not met after samples, additional blanks are needed until the acceptance criteria are met. Samples shall not be analyzed until the acceptance criteria are met.	Lab Manager /Analyst	
	Second-source or ICV	Once after each ICAL prior to sample analysis.	All reported analytes and labelled compounds within ±30% of their true value.	Evaluate data. If problem (e.g., concentrated standard, plugged transfer line) found, correct, then repeat second source verification. If it still fails, then repeat initial calibration.	Lab Manager /Analyst	
	Instrument sensitivity check (ISC)	Prior to analysis. ISC can serve as a beginning CCV.	Analyte concentrations must be at the LOQ and within $\pm$ 30% of their true values.	Correct problem, rerun ISC. If problem persists, repeat ICAL.	Lab Manager /Analyst	
	CCV	Before sample analysis, after every 10 field samples, and at the end of the sequence.	All reported analytes and labelled compounds within ±30% of their true values.	Immediately analyze two additional consecutive CCVs. If both pass, samples may be reported without reanalysis. If either fails, take corrective action(s) and re-calibrate; then reanalyze	Lab Manager /Analyst	

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action	Person Responsible for Corrective Action	Analytical Method/ SOP
				all affected samples since the last acceptable CCV. Or evaluate failure and impact on samples. If samples non-detect for analytes which have a high bias, report non-detect results with case narrative comment. For closing CCVs, if compounds are not identified as critical compounds of concern, report results with qualifiers. For closing CCVs, if the compound is identified as a critical compound of concern, then recalibrate, and reanalyze all affected samples since the last acceptable CCV.		
	Bile Salt Standard	Daily, prior to analysis of all matrix types.	The difference in retention time between the bile salt peaks and PFOS must be > 1 minute.	If problem found, correct as appropriate, then recalibrate.	Lab Manager /Analyst	

Abbreviations:

CCV - Continuing calibration verification
EIS - Extracted Internal Standard
EPA – Environmental Protection Agency
ICAL - Initial calibration
ICS - interference check sample
ISC – Instrument Sensitivity Check
ICV - Initial calibration verification
LC/MS/MS – Liquid Chromatography/Mass Spectrometry
LOQ - Limit of quantitation
NIS – Non-Extracted Internal Standard
PFAS – Per- and Polyfluoroalkyl Substances
PFOS – Perfluorooctanesulfonic Acid
QC - Quality control
RSD – Relative Standard Deviation
RSE – Relative Standard Error
S/N – Signal-Noise Ration

QAPP WORKSHEET #25: Analytical Instrument and Equipment Maintenance, Testing, and Inspection

Instrument/ Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	Analytical Method/SOP Reference
LC/MS/MS	Replace columns as needed, check eluent reservoirs	Sensitivity check (**Worksheet #24**)	Instrument performance and sensitivity	Daily or as needed	CCV pass criteria	Recalibrate	Eurofins Chemist	WS-LC-0039

Abbreviations:
CCV – Continuing calibration verification
LC/MS/MS – Liquid Chromatography/Mass Spectrometry

QAPP WORKSHEETS #26 AND #27: Sample Handling, Custody, and Disposal

To ensure sample authenticity and data defensibility, a proper sample handing system will be followed from the time of sample collection to final sample disposal. In addition, sample handling, custody, and disposal will be handled in accordance with the Alaska MED (USACE 2017).

Sampling Organization: North Wind-EA JV

Laboratories: Eurofins Sacramento

Method of sample delivery (shipper/carrier): Hand delivery or overnight courier service from project site (i.e., UPS, Federal Express).

Number of days from reporting until sample disposal: 30 days.

Activity	Organization and Title or Position of Person Responsible for the Activity	SOP Reference
Sample labeling	Field Technician/Contractor	SOP-001
COC form completion	Field Technician/Contractor	SOP-002
Packaging	Field Technician/Contractor	ENVP-2002
Shipping coordination	Field Technician/Contractor	ENVP-2002
Sample receipt, inspection, and log-in	Sample log-in staff and laboratory PM/designated analytical laboratory	Laboratory specific SOP
Sample custody and storage	Laboratory PM/designated offsite laboratory	Laboratory specific SOP
Sample disposal	Laboratory Waste Manager/designated offsite laboratory	Laboratory specific SOP

Notes:
1. Field SOPs are included in **Appendix C**.
2. Samples will be disposed of by the laboratory in accordance with the contract-specific sample disposal protocols.

QAPP WORKSHEET #28: Analytical Quality Control and Corrective Action

Matrix: Aqueous
Analytical Group: PFAS
Analytical Method/SOP: EPA Method 1633 -Draft/WS-LC-0039

QC Sample	Number / Frequency	Method/SOP QC Acceptance Limits	Corrective Action	Title/Position of Person(s) Responsible for Corrective Action	Project-Specific Measurement Performance Criteria
EIS or (Isotope Dilution Analyte, added prior to extraction)	Every sample, spiked sample, standard, and MB	Use in-house limits if project limits are not specified. Prelim limits of 20-150% until in-house limits are generated.	• If EIS out check for errors and correct. Re-analyze sample. • If EIS still out high: ND samples, report and narrate; if detections, but EIS<200% report and narrate; if detections and EIS>200%, dilute, re-analyze, report and narrate. • If EIS still out low; ND samples evaluate S/N of CCVL, report and narrate; if detections report and narrate. • If EIS < 10% re-extract. Samples may be re-extracted and analyzed outside of hold times, as necessary, for corrective action associated with QC failure.	Lab Manager / Analyst	Project or laboratory statistically derived control limits
NIS added following extraction and prior to analysis.	Every sample, spiked sample, standard, and MB	NIS areas must be >40% of the area of the continuing calibration standard in undiluted sample extracts and sample extracts that require NIS to be added.	• If fails, repeat the analysis using a fresh aliquot of the extract. • If the failure confirms, examine project requirements and contact the client.	Lab Manager / Analyst	Results within acceptance limits.
MB	One per preparation batch	No target analytes > ½ LOQ or > 1/10 the amount measured in any sample or 1/10	Verify instrument clean (evaluate calibration blank and samples prior to MB), then reanalyze. Evaluate to determine if systematic issue within	Lab Manager / Analyst	No target analytes > 1/2 LOQ

QC Sample	Number / Frequency	Method/SOP QC Acceptance Limits	Corrective Action	Title/Position of Person(s) Responsible for Corrective Action	Project-Specific Measurement Performance Criteria
		the regulatory limit (whichever is greater).	laboratory, correct, then re-prepare and reanalyze the MB and all samples processed with the contaminated blank.		
Low-level LCS (LLCS)	One LLCS per preparation batch	Use in-house limits if project limits are not specified. Preliminary limits of 40-150% until in-house limits are generated.	Reanalyze LLCS once: • If acceptable, report. Evaluate samples for detections, and LLCS for high bias. • If LLCS has high bias, and samples non-detect, report with case narrative comment. • If LLCS has low bias, or if there are detections for critical chemicals of concern, evaluate and reprep and reanalyze the LLCS and all samples in the associated prep batch for failed analytes, if sufficient sample material is available.	Lab Manager / Analyst	Project or laboratory statistically derived control limits
LCS	One LCS per preparation batch	Use in-house limits if project limits are not specified. Preliminary limits of 40-150% until in-house limits are generated.	Reanalyze LCS once: • If acceptable, report. Evaluate samples for detections, and LCS for high bias. • If LCS has high bias, and samples non-detect, report with case narrative comment. • If LCS has low bias, or if there are detections for critical chemicals of concern, evaluate and reprep and reanalyze the LCS and all samples in the associated prep batch for failed analytes, if sufficient sample material is available.	Lab Manager / Analyst	Project or laboratory statistically derived control limits

QC Sample	Number / Frequency	Method/SOP QC Acceptance Limits	Corrective Action	Title/Position of Person(s) Responsible for Corrective Action	Project-Specific Measurement Performance Criteria
Lab Duplicate (DU)	One DU per preparation batch	RPD ≤ 30%	Examine project specific requirements. Contact the client as to additional measures to be taken. Evaluate the data and re-prepare/reanalyze the native sample and DU pair if laboratory error is indicated.	Lab Manager / Analyst	Project or laboratory statistically derived control limits
MS/MSD	One MS/MSD pair per preparation batch	Use in-house LCS limits if project limits are not specified. Preliminary LCS limits of 40-150% until in-house limits are generated. RPD ≤ 30%	Examine project specific requirements. Contact the client as to additional measures to be taken. Evaluate the data and re-prepare/reanalyze the native sample and MS/MSD pair if laboratory error is indicated.	Lab Manager / Analyst	Project or laboratory statistically derived control limits
Ion Ratio	Each detected analyte (except PFBA, PFPeA, NMeFOSE, NEtFOSE, PFMPA, and PFMBA)	Acceptance window of 50-150% of the ratio in the mid-point calibration standard or daily CCV standard.	Reanalyze affected sample(s) once: • If acceptable, report. • If not, verify instrument performance, and verify that all sample prep steps to alleviate matrix taken (e.g., cleanups, dilutions). • If no improvement, report with qualifier and narrate ion transition ratios outside criteria.	Lab Manager / Analyst	50-150% of daily CCV or ICAL midpoint for compounds with sufficient secondary transitions.

Abbreviations:

CCV – Continuing Calibration Verification
DU – Lab Duplicate
EIS – Extracted Internal Standard
ICAL – Initial Calibration
LCS – Laboratory Control Sample
LLCS – Low-Level Laboratory Control Sample
LOQ – Limit of Quantitation
MS – Matrix Spike
MSD – Matrix Spike Duplicate
NIS -Non-Extracted Internal Standard
RPD – Relative Percent Difference

QAPP WORKSHEET #29: Project Documents and Records

The project documentation and records will be maintained by the Contractor PM or designee.

Sample Collection and Field Records			
Record	**Generation**	**Verification**	**Storage location/archival**
Field Logbook or Data Collection Sheets	Field Staff	North Wind-EA JV PM	North Wind-EA JV Project File
CoC Forms	Field Staff	North Wind-EA JV PM	North Wind-EA JV Project File
Air Bills	Field Staff	North Wind-EA JV PM	North Wind-EA JV Project File
Deviations	QC Officer	North Wind-EA JV PM	North Wind-EA JV Project File
Corrective Action Reports	QC Officer	North Wind-EA JV PM	North Wind-EA JV Project File
Correspondence	Project Team	North Wind-EA JV PM	North Wind-EA JV Project File

Data Assessments			
Record	**Generation**	**Verification**	**Storage location/archival**
Data Validation Report	Project Chemist or Designee	North Wind-EA JV PM	North Wind-EA JV Project File
ADEC Checklist	Project Chemist or Designee	North Wind-EA JV PM	North Wind-EA JV Project File
Data Usability/Data Assessment	Project Chemist or Designee	North Wind-EA JV PM	North Wind-EA JV Project File

Laboratory Records			
Record	**Generation**	**Verification**	**Storage location/archival**
Sample Login Summary	Laboratory Sample Receipt and Laboratory PM	Project Chemist or Designee	North Wind-EA JV Project File and Laboratory Project File
Offsite Laboratory Report and EDD	Laboratory PM	Laboratory QA Manager	North Wind-EA JV Project File and Laboratory Project File
Documentation of Laboratory Method Deviations, Analytical Audit Checklist, and Lab Assessment	Laboratory QA Manager	Laboratory Manager	Offsite Laboratory
Laboratory QA Manual	Laboratory QA Manager	Laboratory Manager	Offsite Laboratory
Laboratory Name and Applicable Accreditations	Laboratory QA Manager	Laboratory Manager	Offsite Laboratory
Limit of Detection (LOD) Study Information	Analyst and Supervisor	Laboratory QA Manager	Offsite Laboratory
Instrument Calibration, Initial Precision, and Accuracy Tests	Analyst and Supervisor	Laboratory QA Manager	Offsite Laboratory

Laboratory Records			
Documentation of Manual Integrations including Chromatograms Showing the Before and After with the Analyst Name and Reason for the Manual Integration.	Analyst and Supervisor	Laboratory QA Manager	Offsite Laboratory
Sample Chronology (Time of Receipt, Tracking, Extraction, and Analysis) and Associated Forms	Analyst and Supervisor	Laboratory QA Manager	Offsite Laboratory

NOTE: The offsite laboratory report will include the information specified in the DoD QSM Version 5.4, or the latest version the laboratory is accredited for at the time of reporting, including the information necessary for data review, as appropriate to the analytical methodology.

Abbreviations:
ADEC – Alaska Department of Environmental Conservation
PM – Project Manager
QA – Quality Assurance
QC – Quality Control

QAPP WORKSHEETS #31, #32, AND #33: Assessments and Corrective Action

ASSESSMENT					
Assessment Type	**Responsible Party and Organization**	**Frequency**	**Estimated Dates**	**Assessment Deliverable**	**Deliverable Due Date**
Field Sampling and Documentation Audit	PM or designee	After the start of sampling; as needed	1 week after the start of sampling	Corrective action plan or letter	Immediate correction- written documentation within 1 week
Onsite Laboratory Systems Audit	DoD ELAP/NELAP	As required by DoD	Dependent upon certification	DoD ELAP Certification	Dependent upon accrediting authorities
Performance Evaluation Sample	USACE Performance Evaluation PM	As required by USACE	1 week after assessment	Audit Memorandum	1 week after assessment
Data Review Technical Systems Audit	North Wind-EA JV QA/QC Manager or designee	Upon data review	30 days after review	Data Evaluation Summary Report	30 days after review
Health and Safety Compliance Audit	North Wind-EA JV Safety Manager	Once	TBD	Quarterly Project Review Summary	Immediate correction- written documentation within 1 week
Management Systems Review	North Wind-EA JV QA/QC Manager	Once	TBD	Quarterly Project Review Summary	Immediate correction- written documentation within 1 week
Laboratory Technical Systems Audit (may be documentation review or onsite)	Project Chemist	Before the start of sampling	TBD	Documentation Review	Immediate correction- written documentation within 1 week

ASSESSMENT RESPONSE AND CORRECTIVE ACTION					
Assessment Type	**Responsibility for Responding to Assessment Findings**	**Assessment Response Documentation**	**Timeframe for Response**	**Responsibility for Implementing Corrective Action**	**Responsible for Monitoring Corrective Action Implementation**
Field Sampling and Documentation Audit	PM or designee	Corrective Action Response (email or memorandum)	1 week from receipt of memorandum	PM or designee	QA Manager or designee
Onsite Laboratory Systems Audit	Laboratory QA Manager	Corrective action plan or letter	Dependent upon accrediting authorities	Laboratory QA Manager	DoD ELAP/NELAP accrediting authorities
Laboratory Technical Systems Audit (may be documentation review or onsite)	Laboratory QA Manager	Corrective Action Response (email or memorandum)	Immediate correction-written documentation within 1 week of receipt of memorandum	Laboratory Manager	North Wind-EA JV Project Chemist
Performance Evaluation Sample	Laboratory QA Manager	Corrective Action Response	1 week after receipt of memorandum	Laboratory Technical Director	North Wind-EA JV Project Chemist
Data Review Technical Systems Audit	Appropriate persons depending on the area of the findings, Contractor	Corrective Action Response (email or memorandum)	21 days for reissuance	Appropriate persons depending on the area of the findings, Contractor	North Wind-EA JV QA/QC Manager or designee
Health and Safety Compliance Audit	North Wind-EA JV Safety Manager	Corrective action plan or letter	Immediate correction-written documentation within 1 week	As assigned in response	North Wind-EA JV Safety Manager
Management Systems Review	North Wind-EA JV PM or designee	Corrective Action Response	1 week after receipt of memorandum	As assigned in response	North Wind-EA QA/QC Manager or designee

Abbreviations:
DoD – Department of Defense
ELAP – Environmental Laboratory Accreditation Program
NELAP – National Environmental Laboratory Accreditation Program
QA – Quality Assurance
QC – Quality Control
TBD – To Be Determined (project schedule dependent)
USACE – United States Army Corps of Engineers

QAPP WORKSHEET #34: DATA VERIFICATION AND VALIDATION INPUT

This worksheet is used to list the inputs that will be used during data verification and validation. Inputs include planning documents, field records, and laboratory records. To ensure that scientifically-sound data of known and documented quality are used in making environmental decisions, the following three-step data review will be performed:

- Step I (verification) will confirm that the sampling and analytical requirements have been met.
- Step II (validation) will assess whether the sampling and analytical processes comply with the contract-specific and project-specific requirements.
- Step III (usability assessment) will determine whether the resulting data are suitable as a basis for the decision being made.

Records subject to verification and validation are listed below:

Item	Description	Verification (completeness)	Validation (conformance to specifications)
Planning Documents/Records			
1	Approved planning documents (i.e., QAPP)	**X**	–
2	Contract	**X**	–
4	Field SOPs	**X**	–
5	Laboratory SOPs	**X**	–
Field Records			
6	Field logbooks and forms (presented in **Appendix A**)	**X**	**X**
7	Equipment calibration records	**X**	**X**
8	CoC records	**X**	**X**
9	Sampling diagrams/surveys	**X**	**X**
10	Relevant correspondence	**X**	**X**
11	Change orders/deviations	**X**	**X**
Analytical Data Package and Reporting Forms			
12	Cover sheet (laboratory identifying information)	**X**	**X**
13	Case narrative	**X**	**X**
14	Internal laboratory CoC	**X**	**X**
15	Sample receipt records	**X**	**X**
16	Sample chronology (i.e., dates and times of receipt, preparation, and analysis)	**X**	**X**
17	Communication records	**X**	**X**

Item	Description	Verification (completeness)	Validation (conformance to specifications)
18	LOQ verification	**X**	**X**
19	Standards traceability	**X**	**X**
20	Instrument calibration records	**X**	**X**
21	Definition of laboratory qualifiers	**X**	**X**
22	Results reporting forms	**X**	**X**
23	QC sample results	**X**	**X**
24	Corrective action reports	**X**	**X**
25	Raw data	**X**	**X**
26	EDD	**X**	**X**
27	Contractor data reporting forms (presented in **Appendix A**)	**X**	–

Abbreviations:
LOQ – Limit of Quantitation
QAPP – Quality Assurance Project Plan
QC – Quality Control
SOP – Standard Operating Procedure

QAPP WORKSHEET #35: Data Verification Procedures

This worksheet establishes the procedures that will be followed to verify project data. Data verification is a completeness check to confirm that the required activities were conducted, the specified records are present, and the contents of the records are complete. Note that verification often is performed at more than one step by more than one person.

Records Reviewed	Required Documents	Process Description	Responsible Person, Organization
CoC Records and Shipping Forms	QAPP, field SOP 004, and EPA-540-R-014-013	COC records and shipping documentation will be reviewed internally upon their completion and verified against the packed sample coolers they represent to verify their completeness and accuracy and consistency with the field logbook. The review will include verification of appropriate analytical methods, preservation, sufficient volume for analyses, and the required signatures and dates. A check for transcription errors will occur. A copy of the CoC will be retained in the project file, and the original and remaining copies taped inside the cooler for shipment.	Daily – PM or designee; at the conclusion of field activities – Project Chemist or designee.
Field Notes and Forms/Logbook	QAPP and field ENVP-2003	Field notes will be reviewed internally for completeness. The review will include verification that records are present and complete for each day of field activities, the planned samples were collected, sample collection locations are documented, and meteorological data were provided for each day of field activities. The review will also include verification that changes/exceptions are documented and were reported in accordance with requirements. If field data are collected, the review will verify that results are documented.	Daily – PM or designee; at the conclusion of field activities – Project QA Manager or designee.
Analytical Data Package Deliverables	QAPP	The laboratory deliverable will be reviewed to verify that content contains the records specified in the planning documents. Verification will include check of sample receipt records to ensure sample condition upon receipt was noted, and that missing/broken sample containers were noted and reported according to planning documents. The data package will be compared to COC records to verify that results were provided for the collected samples. The narrative will be reviewed to ensure that QC exceptions are described. The review will verify that necessary signatures and dates are present.	Before release of data package – Laboratory QA Manager Upon receipt – Project Chemist or designee.
Data Reporting Forms	QAPP	The results presenting in the data reporting summary will be reviewed to verify that the results are consistent with the laboratory EDD and complete laboratory report.	Weekly – PM or designee prior to release of data to project stakeholders identified in **Worksheet #2.**

NOTES:
COC = Chain-of-custody
QA = Quality Assurance
QAPP = Quality Assurance Project Plan
QC = Quality Control
SOP = Standard Operating Procedure

QAPP WORKSHEET #36: Data Validation Procedures

Data validation is an analyte and sample-specific process for evaluating compliance with contract requirements, methods/SOPs, and method performance criteria. Including the information presented in this UFP-QAPP, external validation criteria that will be used to evaluate project data include:

- DoD QSM Version 5.4 (or the latest version the laboratory is accredited for at the time of sample collection).
- Analytical method requirements.
- DoD General Data Validation Guidelines (2019), including associated modules.
- National Functional Guidelines (EPA 2017a and 2017b).
- Alaska MED (USACE 2017).

The personnel that will evaluate the project data include the Contractor Project Chemists independent of data generation and/or a third-party validator. The planned data validation will follow the required activities for a Stage 2B validation, as described in the General Data Validation Guidelines (DoD 2019). A review of raw data will be performed only when issues are identified in the laboratory case narrative or if information presented in the laboratory report requires verification.

A data validation report and a completed ADEC Laboratory Data Review Checklist will be completed for every offsite laboratory data package. The Laboratory Data Review Checklist is located online at https://dec.alaska.gov/media/20872/laboratory-data-review-check-list.docx and will be completed, signed, and dated by the North Wind-EA JV Project Chemist, designee, or data validator. A data validation summary report that tabulates results qualified by the data reviewer, along with the sample ID, reported result, laboratory and review qualifiers, and a justification narrative explaining the qualifiers, will be appended to each ADEC Checklist where qualifications are made.

The objective of the data validation is to assess the performance associated with the analysis in order to determine the quality of the data. This will be accomplished by evaluating whether the collected data comply with the pre-defined requirements of the project, including method, procedural, or contractual requirements, and by comparing the collected data with established criteria.

36.1 Data Review Requirements for Definitive Data

Scientifically sound data of known and documented quality that meet established criteria are essential for use in the decision-making process. Data review is the process whereby data are examined and evaluated to varying levels of detail and specificity by a variety of personnel who have different responsibilities within the data management process. It includes verification, validation, and usability assessment. There must be persuasive records that document data review activities to afford effective assessment of the data for quality and usability. The data can then move forward with associated qualifiers indicating the overall usability of the data.

Data verification is the first step in data review. Data verification is performed to confirm that the specified requirements have been performed.

Data validation extends data verification and is used to confirm that the requirements for a specific intended use are fulfilled. Data validation is the systematic process of evaluating the compliance of the data with the pre-defined requirements of the project, including method, procedural or contractual requirements, and the comparison of the data with criteria based on the quality objectives documented in the project planning documents. The purpose of data validation is to assess the performance associated with the analysis in order to determine the quality of the data. Data validation includes a determination, to the extent possible, of the reasons for any failure to meet performance requirements, and an evaluation of the impact of such failures on the usability of the data.

Data usability assessment is an evaluation based on the results of data validation and verification in the context of the overall project decisions or objectives, as described in **Worksheet #37**. Both the sampling and analytical activities must be considered, with the ultimate goal of assessing whether the final, qualified results support the decisions to be made with the data.

36.2 Laboratory Requirements

The analytical data package must contain adequate information and be presented in a clear and concise manner. Minimum requirements are presented in the DoD QSM Version 5.4, Appendix A, "Reporting Requirements" and include the following:

- Cover sheet, which identifies the project.
- Table of contents.
- Case narrative, which summarizes samples, analyses, and discusses issues that may affect data usability.
- Analytical results.
- Sample management records.
- Internal laboratory QC information.
- Data reports for third party review or validation.

The laboratory data package should be organized such that the analytical results are reported on a per analytical batch basis, unless otherwise specified.

A reviewer should be able to determine the precision, accuracy, representativeness, comparability, completeness, and sensitivity of the data, based on the information contained in the data package. Additional information may be required, depending on the detail of the data review performed.

36.2.1 Laboratory Data Reporting Requirements

The case narrative of the analytical data package will include, but is not limited to, the following:

- Summary of samples received, correlating field sample numbers, laboratory sample numbers, and laboratory tests completed.

- Discussion of sample appearance and integrity issues that may affect data usability (i.e., temperature, preservation, pH, sample containers, air bubbles, and multi-phases).
- Discussion of holding time excursions for sample preparation and analyses.
- Analysis of the out-of-control or discrepancies of calibrations, continuing calibrations or QC sample results, raw data/chromatograms and corrective actions taken, and discussion and justifications for using minimal exceedances.
- Identification of samples and analytes for which manual integration was necessary.
- Discussion of qualified data and definition of qualifying flags.

Non-detectable results should be reported to the LOD. During data validation, non-detects will be reported as "ND [LOD]".

36.2.2 Manual Integrations

Manual integrations are an integral part of the chromatographic analysis process and will be completed only as a corrective action measure. Examples of instances where manual integration would be warranted include, but are not limited to, co-eluting compounds resulting in poor-peak resolution, a misidentified peak, an incorrect retention time, or a problematic baseline.

When manual integrations are used, the following procedures will be implemented for documenting the event and for consistency in performing the manual integration:

- A laboratory SOP will be followed for manual integrations. This SOP will specify:
  - When automated integrations by the instrument are likely to be unreliable,
  - What constitutes an unacceptable automated integration,
  - How the problems should be resolved by the analyst, and
  - The procedures for the analyst to follow in documenting required manual integrations.
- Raw data records will include a complete audit trail for those manipulations, including the following:
  - Results of both the automated and manual integrations,
  - Notation of the cause and justification for performing the manual integrations,
  - Date, and
  - Signature or initials of person performing the manual operations.
- Manual integrations must be reviewed and approved by the section supervisor and/or the laboratory QA Officer.
- Manual integrations must be identified in the case narrative.

36.2.3 Laboratory Data Review Requirements

The analytical data generated by the laboratory will be verified before submittal as final. This internal, multi-tiered data review process will include complete aspects of data generation, reduction, and QC assessment. The definitive data will be reviewed first by the analyst and then by the supervisor of the respective analytical section using the same criteria.

Elements for review or verification at each level must include, but are not limited to, the following:

- Sample receipt procedures and conditions.
- Sample preparation.
- Appropriate use of SOPs and methodologies.
- Accuracy and completeness of analytical results.
- Correct interpretation of the raw data, including manual integrations.
- Appropriate application of QC samples and compliance with established control limits.
- Verification of data transfers.
- Documentation completeness.
- Accuracy and completeness of data deliverables (hard copy and electronic).

36.2.4 Laboratory Data Evaluation

The laboratory QA section will perform a review of a subset of the completed data packages, and the laboratory project representative will complete a final review on the completed data packages.

Data qualifiers will be applied by the laboratory as part of their internal validation activities. These flags shall be clearly defined without the data package. Flagging criteria apply when acceptance criteria are not met and corrective actions were not successful or not performed. The data qualifiers will be reviewed by the supervisor of the respective analytical sections.

The NW-EA JV Project Chemist (or designee) will subsequently evaluate the flags applied by the laboratory as part of their data validation and usability assessment activities. The flags may be accepted, modified, or rejected. For data qualifiers that are changed, clear justification must be provided. Data that are flagged by the laboratory will be evaluated and either accepted without qualification, accepted with qualification, or rejected; these data validation guidelines are discussed further in **Section 36.3.2**.

36.2.5 Method Blank Evaluation Guidance

The contract laboratory will follow MB guidance in the DOD QSM 5.4, as well as blank qualification guidance from the Alaska MED (USACE 2017). The source of contamination observed in MBs will be investigated. If half of the LOQ is exceeded, the laboratory will evaluate whether reprocessing of the samples is necessary, based on the following criteria:

1 The method blank contamination exceeds a concentration greater than 1/10 of the measured concentration of a sample in the associated preparation batch, or

2 There is evidence that the blank contamination otherwise affects the sample results.

Except when the sample analysis resulted in a nondetectable result, the samples associated with MB contamination and meeting these criteria will be reprocessed in a subsequent preparation batch. A B-flag will be applied to all sample results with a detection of < 10x the concentration in the MB. If an analyte is found only in the MB, but not in any batch samples, no flagging is necessary. MB contamination shall be addressed in the case narrative.

36.3 Contractor Responsibilities

NW-EA JV has responsibility for data quality and may be assisted in its review by external organizations. Regardless of who performs the data review, the individual(s) should possess the disciplinary expertise, experience, and theoretical knowledge to perform the task, and shall have a complete understanding of the intended use of the data and the relationship of the QC results to the usability of the data. When a third party is contracted for data validation, the project planning documents and procedures, as well as sample collection information, will be made available to the individuals assigned to the task.

36.3.1 Data Verification Guidelines

The data verification performed by the laboratory should be reviewed for completeness and accuracy. Data verification may be performed electronically or manually, or by a combination of both. Data verification may include, but is not limited to, the following:

- Sampling documentation (i.e., the CoC record).
- Preservation summary and holding times.
- Presence of the analyses and analytes requested.
- Use of required sample preparation and analysis procedures.
- Detection limits (DLs).
- Correctness of concentration units.
- Case narrative.

36.3.2 Data Validation Guidelines

The data validation process builds on data verification. The laboratory case narrative and data validation results should be reviewed, with data qualifiers removed or added if needed. Validation will be performed on an analytical batch basis by assessing QC samples and associated field sample results. Data validation guidelines have been developed according to:

- DoD QSM Version 5.4 (or the latest version the laboratory is accredited for at the time of sample collection).
- Analytical method requirements.
- DoD General Data Validation Guidelines (2019), including associated modules.

- National Functional Guidelines (EPA 2017a and 2017b).
- Alaska MED (USACE 2017)

General data qualifying conventions derived from the abovementioned validation guidelines for Method 1633 – Draft are presented in **Table 36-1** and are subject to professional judgment throughout the project. The following information will be reviewed as part of a Stage 2B summary data validation (review of raw data is generally not included):

- Data package completeness.
- Case narrative review and other method-specific criteria.
- Sample management (including sample preservation, handling, transport, CoC protocol, holding times, and condition at laboratory receipt).
- Field QC sample frequencies and results.
- Initial and continuing calibrations.
- Instrument tuning and performance.
- DLs.
- Blanks results.
- Blank spike recoveries.
- MS recoveries and RPDs.
- Reported DLs.
- Serial dilutions.
- Surrogate and internal standard recoveries.
- Field and laboratory duplicate RPDs.
- Post-digestion spike results.
- Interference check sample results.
- Second column confirmation results.
- Target analyte list verification.
- Compound identification and quantification.
- Data qualifiers.
- Verification of a subset of the electronic data report.

Data flags, as well as the reason for each flag, will be entered into an electronic database and made available to the data users. A final flag is applied to the data by the data validator/chemist after evaluating the flags entered into the database and selecting the most conservative flags.

36.3.2.1 Raw Data Review

Data review can involve an in-depth review of the raw data to verify accuracy followed by analysis and interpretation of the data in the context of the project objectives and end-use as part of the usability assessment. In addition to the elements discussed above, the review, which may be called a Level IV-type, may include, but is not limited to, the following:

- Method-specific instrument calibration and QC parameters.
- Raw data and chromatograms.
- System performance.
- Proper integration (if applicable).
- Spectral matches and/or retention times to verify analyte identification (where applicable).
- Random check of calculations.
- Interference problems or system performance problems.

36.3.2.2 Data Analysis and Interpretation

The last phase of the data validation process may include, but is not limited to, the following:

- Laboratory-flagged data and a final determination of its usability.
- B-flagged data and a final determination of its usability.
- Laboratory and field blank contamination and parallel contamination in samples.
- Duplicate, replicate, and split sample analyses.
- Potential LCS failure where minimal exceedance criteria may apply.
- Impact of multiple data issues on the final analytical results.
- Deficiencies identified during data verification and assessment of their impact on the sample results.
- Incorporation of site-specific factors and assessment of their impact on the data.
- Assessment of data usability and assignment of final data qualifiers, as necessary.
- Discussion of completeness, representativeness, and comparability.

A data validation report will be prepared summarizing the findings and discussing their impact on the overall data usability. This report will be incorporated into the final usability assessment.

36.3.2.3 Blank Evaluation Guidelines

NW-EA JV's Project Chemist (or designee) will evaluate laboratory B-qualified data (i.e., MBs), as well as other field blanks, based on the concentration of the analyte in the samples in relation to the concentration in the blank. The concentration of contamination in the blanks will be compared to any concentrations in the field samples. If an analyte is detected in the field blank, but not in the associated samples, no action is taken. If the analyte concentrations in the field samples are higher (≥ 5×) than in the blank (≥ 10× in case of common laboratory contaminants), the data validator will apply validation qualifiers following the DoD Data Validation Guidelines (2019) and Alaska MED (USACE 2017).

Blank contamination that may impact data usability must be discussed by in conjunction with project-specific goals. When a data set contains low-level detects in field samples and has associated field or laboratory blanks that have detects at similar concentrations, this suggests that the low-level detects in these field samples may be artifacts because of either field or laboratory practices. A sample detect that is ≤ 5× the blank contamination (≤ 10× for common laboratory contaminants) and flagged "B" at the detected concentration.

36.3.2.4 Duplicate Evaluation Guidance

QC measures for precision include field duplicates, field replicates, laboratory duplicates, MSDs, analytical replicates, and surrogates. These measures will be evaluated by the laboratory and qualified according to applicable procedures, except for field duplicates.

Specifically, field duplicates should be sent to the laboratory as blind samples and should be given unique sample ID numbers. These sample results can be used to assess field sampling precision, laboratory precision, and, potentially, the representativeness of the matrix sampled. Flagging of results associated with field duplicates should be assigned such that the level of uncertainty required, as provided by the project-specific objectives, is considered.

Poor overall precision may be the result of one or more of the following: field instrument variation, analytical measurement variation, poor sampling technique, sample transport problems, or spatial variation (heterogeneous sample matrices). To identify the cause of imprecision, the project team should evaluate the field sampling design rationale and sampling techniques, and review both field and analytical duplicate sample results. If poor precision is indicated in both the field and analytical duplicates, then the laboratory may be the source of error. If poor precision is limited to the field duplicate results, then the sampling technique, field instrument variation, sample transport, and/or spatial variability may be the source of error. If data validation reports indicate that analytical imprecision exists for a particular data set or SDG, then the impact of that imprecision on usability must be discussed in the report.

36.3.2.5 Matrix Interference Evaluation Guidance

In the case of matrix interference, flags should be applied to additional samples from the same site and same matrix, as applicable.

36.3.3 Flagging Conventions

The allowable final data qualifiers for definitive data and the hierarchy of data qualifiers, listed in order of the most severe through the least severe, are QL/QH/QN, H, B, and J. Their definitions are summarized in Table 36-2 and are derived from the Alaska MED (USACE 2017). Note that third-party data validation will not include the rejection of data (noted by the designation of the "R" data qualifier) but will rather state when the performance criteria are not met. The final rejection of data and their use is a decision reserved specifically for the project team.

Table 36-1 General Data Qualifying Conventions for Method 1633			
QC Requirement	**Criteria**	**Flag**	**Flag Applied To**
Holding Time	Time exceeded	H for the detected results, R or H for non-detects*.	Analytes in the sample
Sample Preservation	Improper sample preservation	QN detected results, R or QN for non-detects*.	Sample
	Temperature out of control	QN for detected results, R or QN for non-detects*.	Sample
Instrument Tuning	Ion abundance method-specific criteria not met	QN for detected results, QN or R for non-detects* if does not meet criteria.	Associated samples in analytical batch
ICAL	Target analytes outside method-specified criteria	QN for detected results, QN or R for non-detects* if does not meet criteria.	Associated samples in analytical batch
Second Source Check or Continuing Calibration	Target analytes outside method-specified criteria	QN for detected results, QN or R for non-detects* if does not meet criteria.	Associated samples in analytical batch
Ion Ratio(s)	Target analytes outside method-specified criteria	QN detected results, no flag for non-detects	The specific analyte(s) in the sample
LCS	• %R > upper control limit (UCL) • %R ≥ 10%* < lower control limit (LCL) • %R < 10%* • LCS RPD > control limit	• QH for the detected results, no flag for non-detects. • QL for the detected results, QN for the non-detects. • QL for the detected results, R for the non-detects. • QN for detected results, no flag for non-detects	The specific analyte(s) in samples in the associated analytical batch
Internal Standards	• Area > 150% • Area < 50 but ≥20% • Area < 20%	• QL for detected results; no flag for non-detects. • QH for detected results; QN for non-detects. • R or QN for all results*.	Sample
EIS	• %R > UCL • %R < LCL and >2%* • %R ≤20%* • Excessive dilution	• QL for detected results; no flag for non-detects • QH for detected results; QN for non-detects. • QH for detected results; R for non-detects. • QN detects; R or QN non-detect results	Sample
Blanks (method, trip, field, equipment)	Analyte detected above the DL in blank	• No qualification if no analytes are detected in associated samples. • B flag applied to results ≤ LOQ if analyte is detected in associated blank (method, trip, equipment). • B flag applied or professional judgment QH if results > LOQ but ≤ 5x the detection in the blank. • Results > LOQ and > 5x the detection in the blank, no qualification.	The associated samples in analytical batch, whichever applies

Table 36-1 General Data Qualifying Conventions for Method 1633			
QC Requirement	**Criteria**	**Flag**	**Flag Applied To**
MS/MSD	• MS or MSD %R<LCL but ≥10*% • MS or MSD %R<10*% • MS or MSD %R>UCL or MS/MSD RPD>CL • Sample concentration > 3×* spike concentration	• QL for the detected results and QN for the nondetectable results. • QL for the detected results and R for the nondetectable results. • QN for the detected results and no flag for non-detects. • No flag required.	Parent Sample*
Field Duplicates	• <30% RPD for aqueous or air matrices • <50% RPD for solid/soil matrices	QN for detected results above the LOQ; Professional judgment or no qualification for results below the LOQ.	Sample
Retention Time Window	Analyte outside established window	Professional judgment QN or R for associated results.	Sample

* = Based on analytical method and analyte-specific review
DL = detection limit
LOD = limit of detection
LOQ = limit of quantitation
LCL = lower control limit
LCS = laboratory control sample
MS = matrix spike
MSD = matrix spike duplicate
ND = not detected
QC = quality control
RPD = relative percent difference
RSD = relative standard deviation
UCL = upper control limit

TABLE 36-2. Usability Assessment Data Qualifiers (USACE 2017)	
Qualifier	**Description**
J	Analyte result is considered an estimated value because the level is below the laboratory LOQ but above the DL.
B	Analyte result is considered a high estimated value due to contamination present in the method, trip, or equipment blank.
H	Analyte result is considered a low estimate due to a hold time exceedance.
QH, QL, QN	Analyte result is considered an estimated value biased (high, low, uncertain) due to a QC failure.
R*	Analyte result is rejected - result is not usable. Note that “R” replaces the chemical result (no result shall be reported with an “R” flag).

QAPP WORKSHEET #37: Usability Assessment

This worksheet documents procedures that will be used to perform the data usability assessment (DUA). The DUA is performed at the conclusion of data collection activities, using the outputs from data verification and data validation. It is the data interpretation phase that involve a qualitative and quantitative evaluation of environmental data to determine if the project data are of the right type, quality, and quantity to support the decisions that need to be made. It involves a retrospective evaluation of the systematic planning process and, like the systematic planning process, involves participation by key members of the project team.

The DUA will consider whether data meet project quality objectives (PQOs) as they relate to the decision(s) to be made and evaluates whether data are suitable for making that decision. The DUA is a data review and will be performed only on data of known and documented quality (i.e., verified data collected as part of the confirmation sampling; no data validation will be performed). The results of the DUA will be included as a section in each report that presents project data.

To accomplish this step of data review, the project team will do the following:

- Perform data validation as described below and complete the ADEC Laboratory Data Review Checklist (available online at the hyperlink in **Worksheet #36**).
- Perform the usability assessment process and the usability assessment procedures, including interim steps and any statistics, equations, and computer algorithms that will be used to assess data.
- Describe the documentation that will be generated during the usability assessment.
- Identify the personnel responsible (by title and organizational affiliation) for performing the usability assessment.
- Describe how usability assessment results will be presented so that they identify trends, relationships (i.e., correlations), and anomalies.
- Describe the evaluative procedures used to assess overall measurement error associated with the project and include the data quality indicators (DQIs).

The DUA evaluates whether underlying assumptions used during systematic planning are supported, sources of uncertainty have been accounted for and are acceptable, data are representative of the population of interest, and the results can be used as intended, with the acceptable level of confidence. The personnel that are responsible for participating in the DUA include the following, as applicable to project scope:

- North Wind-EA JV PM,
- North Wind-EA JV QA/QC Manager,
- North Wind-EA JV Senior Technical Reviewer, and
- North Wind-EA JV Project Chemist or designee.

The following steps will be followed during the DUA process, as applicable:

Step 1	**Review the project's objectives and sampling design** Review the key outputs defined during systematic planning (i.e., PQO or DQOs) to make sure they are still applicable. Review the sampling design for consistency with stated objectives. This provides the context for interpreting the data in subsequent steps.
Step 2	**Review the data verification and data validation outputs** Review available QA reports, including the data verification and data validation reports. Perform basic calculations and summarize the data (using maps, tables, etc.). Look for patterns, trends, and anomalies (i.e., unexpected results). Review deviations from planned activities (e.g., number and locations of samples, holding time exceedances, damaged samples, and SOP deviations) and determine their impacts on the data usability.
Step 3	**Verify the assumptions of the selected statistical methods** Verify whether underlying assumptions for selected statistical methods (if documented in the QAPP) are valid. Common assumptions include the distributional form of the data, independence of the data, dispersion characteristics, homogeneity, etc. Depending on the robustness of the statistical method, minor deviations from assumptions usually are not critical to statistical analysis and data interpretation. If serious deviations from assumptions are discovered, then another statistical method may need to be selected.
Step 4	**Implement the statistical method** Implement the specified statistical procedures for analyzing the data and review underlying assumptions. For decision projects that involve hypothesis testing (e.g., "concentrations of lead in groundwater are below the action level"), consider the consequences for selecting the incorrect alternative; for estimation projects (e.g., establishing a boundary for surface soil contamination), consider the tolerance for uncertainty in measurements.
Step 5	**Document data usability and draw conclusions** Determine if the data can be used as intended, considering implications of deviations and CAs. Discuss DQIs. Assess the performance of the sampling design and identify limitations on data use. Update the conceptual site model and document the conclusions. Evaluate the laboratory and data validation qualifiers associated with the sample data and make decisions regarding data usability, rejection, and qualification. Prepare the data usability summary report, which can be in the form of text and/or a table.

37.1 Data Validation

The procedures to be followed for data validation are presented in **Worksheet #36**.

37.1.1 Summary of Data Quality Indicators

Precision, accuracy/bias, representativeness, comparability, completeness, and sensitivity are the DQIs used to assess the data produced during the project. Each DQI is described below, including a definition of the terminology, the referenced process for calculating the indicator, and the referenced measurement performance criteria for this project. A description of how the DQIs should be incorporated into the usability section is found under each parameter heading.

37.1.1.1 Precision

Precision is the degree to which a set of observations or measurements of the same property, obtained under similar conditions, conform to themselves. Precision is usually expressed as standard deviation, variance, %D, or range, in either absolute or relative terms. The QC measures for precision include field duplicates, laboratory duplicates, MSs, MSDs, analytical replicates, and surrogates. To meet the needs of the data users, project data must meet the measurement performance criteria for precision specified in QAPP **Worksheet #12** and supporting worksheets.

Precision may be the result of one or more of the following: field instrument variation, analytical measurement variation, poor sampling technique, sample transport problems, or spatial variation (heterogeneous sample matrices). To identify the cause of imprecision, the field sampling design rationale and sampling techniques will be evaluated by the reviewer, and both field and analytical duplicate/replicate sample results will be reviewed. The process for calculating precision is detailed in, and will be in accordance with, the UFP-QAPP Manual, Section 2.6.2.1 (EPA 2005).

If poor precision is indicated in both the field and analytical duplicates/replicates, then the laboratory may be the source of error. If poor precision is limited to the field duplicate/replicate results, then the sampling technique, field instrument variation, sample transport, and/or spatial variability may be the source of error. Validation will be performed on the definitive data packages; however, no data validation will be performed on screening data packages.

The usability assessment will:

- Compare overall field duplicate/replicate precision data from data collected for the project for each matrix, analytical group, and concentration level.
- Evaluate the limitations on the use of project data when overall precision is poor or when poor precision is limited to a specific sampling or laboratory (analytical) group, data set or SDG, matrix, analytical group, or concentration level.

37.1.1.2 Accuracy/Bias

Accuracy is the degree of agreement between an observed value and an accepted reference value. Accuracy includes a combination of random error (precision) and systematic error (bias) that are due to sampling and analytical operations. Examples of QC measures for accuracy include MSs, LCSs, and equipment blanks. To meet the needs of the data users, project data must meet the measurement performance criteria for accuracy/bias specified in QAPP **Worksheet #12**. The process for calculating accuracy/bias is detailed in, and will be in accordance with, the UFP-QAPP Manual, Section 2.6.2.2 (EPA 2005). The usability assessment will:

- Compare overall contamination and accuracy/bias for data collected for the project for each matrix, analytical group, and concentration level.
- Evaluate the limitations on the use of project data if extensive contamination and/or inaccuracy or bias exists, or when inaccuracy is limited to a specific sampling or laboratory group, data set or SDG, matrix, analytical group, or concentration level.
- Evaluate the impact of any qualitative and quantitative trends in bias on the sample data.

37.1.1.3 Representativeness

Representativeness is the measure of the degree to which data accurately and precisely represent a characteristic of a population, a parameter variation at a sampling point, a process condition, or an environmental condition. To meet the needs of the data users, project data must meet the measurement performance criteria for sample representativeness specified in QAPP **Worksheet #12**. The process for calculating representativeness is detailed in, and will be in accordance with, the UFP-QAPP Manual, Section 2.6.2.4 (EPA 2005).

If field duplicate precision checks indicate potential spatial variability, additional scoping meetings and subsequent re-sampling may be needed to collect data that are more representative of a non-homogeneous site.

The usability assessment will:

- Compare overall sample representativeness for each matrix, analytical group, and concentration level.
- Evaluate the limitations on the use of project data when overall non-representative sampling has occurred, or when non-representative sampling is limited to a specific sampling, group, data set or SDG, matrix, analytical group, or concentration level.

37.1.1.4 Comparability

Comparability is the degree to which different methods, data sets, and decisions agree or can be represented as similar. Comparability describes the confidence (expressed qualitatively or quantitatively) that two data sets can contribute to a common analysis and interpolation. To meet the needs of the data users, project data must meet the measurement performance criteria for comparability specified in QAPP **Worksheet #12**.

Additional detail regarding the process of assessing comparability is detailed in, and will be in accordance with, UFP-QAPP Manual, Section 2.6.2.5 (EPA 2005). Different situations require different assessments of comparability, as in the following examples:

- If two or more sampling procedures or sampling teams will be used to collect samples, describe how comparability will be assessed for each matrix, analytical group, and concentration level.
- If two or more analytical methods or SOPs will be used to analyze samples of the same matrix and concentration level for the same analytical group, the comparability will be assessed between the two data sets and discussed.
- If replicate samples are analyzed, the specific method and %D formula that will be used to assess replicate sample comparability for individual data points will be discussed.

The usability assessment will:

- Compare overall comparability for the project for each matrix, analytical group, and concentration level.
- Evaluate if screening data will be confirmed by definitive methods and document the specific method and %D formula that will be used to assess comparability for individual data points.

- Evaluate overall comparability, describe the procedures used to perform overall assessment of comparability, and include mathematical and statistical formulas for evaluating screening and confirmatory data comparability.
- Determine if the project involves long-term monitoring and whether project data should be compared with previously generated data to ascertain the possibility of false positives and false negatives, and positive and negative trends in bias. Data comparability is extremely important in these situations.
- Evaluate anomalies detected in the data that may reflect a changing environment or indicate sampling and/or analytical error. Comparability criteria should be established to evaluate these data sets to identify outliers and the need for re-sampling, as warranted.
- Determine the limitations on the use of project data when project-required data comparability is not achieved for the overall project or when comparability is limited to a specific sampling or laboratory group, data set or SDG, matrix, analytical group, or concentration level.
- Determine if qualitative results from non-correlated laboratory sources have similar procedural and analytical bounds, including LOD, range of detection, and sensitivity.
- Document the failure to meet replicate sampling comparability criteria and discuss the impact on usability.
- If data are not usable to adequately address environmental questions or support project decision-making, address how this problem will be resolved and discuss the potential need for re-sampling.
- If long-term monitoring data are not comparable, address whether the data indicate a changing environment or are a result of sampling or analytical error.

37.1.1.5 Sensitivity and Quantitation Limits

Sensitivity is the capability of a test method or instrument to discriminate between measurement responses representing different levels (e.g., concentrations) of a variable of interest. Examples of QC measures for determining sensitivity include laboratory fortified blanks, DLs, LOD and LOQ studies, and low-level calibration standards. To meet the needs of the data users, the project data must meet the measurement performance criteria for sensitivity and project detection limits specified in **Worksheet #12**. The process for assessing sensitivity is detailed in the UFP-QAPP Manual, Section 2.6.2.3 (EPA 2005).

The laboratory will establish a DL, typically the method detection limit (MDL), using a scientifically valid and documented procedure. The MDL is the minimum concentration of a substance that can be measured and reported with 99% confidence that the analyte concentration is greater than zero. The DL is the laboratory's "best case" sensitivity for a given analytical method. The laboratory may establish MDLs for each method, matrix, and analyte for each instrument the laboratory plans to use for the project using the statistical method presented in the 40 Code of Federal Regulations (CFR) Part 136, Appendix B.

The LOD will be established quarterly by spiking a blank matrix at two to three times the DL for single analyte standards or one to four times the DL for multi-analyte standards. This spike concentration is the LOD for each analyte and is specific for each matrix, method, and instrument.

The LOQ will be determined at least quarterly for each analyte of concern following a documented procedure at the laboratory. The validity of the LOQ will be determined by the analysis of a QC sample containing the analyte at one to two times the estimated LOQ and within the calibration range of the

instrument. The LOQ is valid if the recovery of the analyte is within the test methods acceptance recovery limits for accuracy.

A general summary of the relationship between the DL terms used above is presented below:

DL<LOD≤LOQ<Reporting Limit

The following requirements apply to the determination of DLs, LODs, and LOQs:

- The apparent signal to noise ratio at the LOD must be at least three, and in the results must meet all method requirements for analyte identification (e.g., ion abundance, second column confirmation, or pattern recognition). If no measurement of noise is available for a given method, then the LOD must yield a result that is at least three standard deviations greater than the mean blank concentration.
- If multiple instruments are used, the laboratory must verify the DL, LOD, and LOQ on each.
- If the LOD verification fails, then the laboratory must repeat the DL and LOD determinations at higher concentrations.
- The laboratory will maintain documentation of the DL, LOD, and LOQ studies, and these measures of instrument sensitivity will be performed at least quarterly.
- A non-detectable result will be reported as less than the LOQ. The "J" flag will be applied to the detectable results that fall between the DL and the LOQ, indicating the variability associated with the result. No detectable results will be reported below the DL.

The usability assessment will:

- Compare overall sensitivity from multiple data sets collected for the project for each matrix, analytical group, and concentration level.
- Determine the impact of that lack of sensitivity or higher DLs on data usability; if information is available, indicate that sensitivity or project-specific DLs were not achieved.
- Evaluate the limitations on the use of project data if project-required sensitivity and DLs are not achieved for the project data, or when sensitivity is limited to a specific sampling or laboratory group, data set or SDG, matrix, analytical group, or concentration level.

The offsite laboratories' LODs are capable of meeting sensitivity requirements, and the compounds of potential concern can be detected below the project evaluation criteria unless otherwise noted in **Worksheet #15**.

37.1.1.6 Completeness

Completeness is a measure of the amount of valid data obtained from a measurement system compared with the amount that was expected to be obtained under correct, normal circumstances. Completeness is calculated and reported for each method, matrix, and analyte combination. The number of valid results divided by the number of possible individual analyte results, expressed as a percentage, determines the completeness of the data set. The completeness target is 90%. Completeness measures the effectiveness in sample collection, analysis, and result reporting of the entire investigation, and is calculated on a per-analyte basis by the following equation:

$$\%Completeness = \frac{Number\ of\ valid\ results}{Number\ of\ possible\ results} \times 100$$

For instances of samples that could not be analyzed for any reason (holding time violations in which resampling and analysis were not possible, samples spilled or broken, etc.), the numerator of this calculation becomes the number of possible results minus the number of possible results not reported.

A completeness check will be performed on the data generated by the laboratory. For each analyte, completeness will be calculated as the number of data points for each analyte that meets the measurement performance criteria for precision, accuracy/bias, and sensitivity, divided by the total number of data points for each analyte. A discussion will follow summarizing the calculation of data completeness. Any conclusions about the completeness of the data for each analyte will be drawn, and any limitations on the use of the data will be described.

For this project, 90% of usable sample data is considered the minimal acceptance criteria for completeness; the goal is to achieve 100% completeness.

The usability assessment will:

- Compare overall completeness for each matrix, analytical group, and concentration level.
- Determine the limitations on the use of project data if project-required completeness is not achieved for the overall project, or when completeness is limited to a specific sampling or laboratory group, data set or SDG, matrix, analytical group, or concentration level.

37.1.1.7 Activities

The entire project team will reconvene to perform the usability assessment to ensure that the PQOs are understood and the full scope is considered. If, for whatever reason (precision, accuracy/bias, comparability, sensitivity, completeness), measurement performance criteria are not achieved and it has been determined that certain project data are not usable, then the project team will determine if it is necessary to take further action (i.e., resampling) to ensure that the DQOs have been met.

The items listed under Considerations for Usability Assessment below are examples of specific items that will be considered during the project under the usability assessment.

Evaluative Procedures used to Assess Overall Measurement Error with the Project:

- ***Precision***—The precision of the data will be determined by a comparison to other similar data, as well as with field duplicates, laboratory duplicates/replicates, and MSDs.
- ***Accuracy/Bias***—The accuracy of data will be assessed by comparing observed values with reference values using MSs, LCSs, and equipment blanks.
- ***Representativeness***—Although sample size somewhat limits the statistical confidence for applying contaminant levels to the entire population, it does conform to currently accepted methods.
- ***Comparability***—The results of this study will be used as a benchmark for determining comparability for data collected during any future sampling events using the same or similar sampling and analytical SOPs.

- ***Completeness***—A completeness check will be performed on the data generated by the laboratory. For each analyte, completeness will be calculated as the number of data points for each analyte that meets the measurement performance criteria for precision, accuracy/bias, and sensitivity, divided by the total number of data points for each analyte. A discussion will follow summarizing the calculation of data completeness. Any conclusions about the completeness of the data for each analyte will be drawn and any limitations on the use of the data will be described.

- ***Reconciliation***—Each of the PQOs presented in **Worksheet #11** will be examined to determine if the objective was met. This examination will include a combined overall assessment of the results of each analysis pertinent to an objective. Each analysis will first be evaluated separately in terms of the major impacts observed from the DQIs and measurement performance criteria assessments. Based on the results of these assessments, the quality of the data will be determined. Based on the quality determined, the usability of the data for each analysis will be determined. Based on the combined usability of the data from all analyses for an objective, it will be determined if the PQO was met and whether PALs were exceeded. The final report will include a summary of all the points that went into the reconciliation of each objective. As part of the reconciliation of each objective, conclusions will be drawn and any limitations on the usability of any of the data will be described.

The laboratory PM, North Wind/EA Project Chemist (or designee), and Project QA/QC Manager will participate in this activity.

37.2 Assessment Documentation

A usability report will be written that discusses precision, accuracy/bias, representativeness, comparability, and completeness, as detailed within this worksheet. This narrative report will include worksheets and supporting documentation to assess the PQOs and any conclusions and limitations of the associated data and discuss the qualified results in comparison to the PALs listed in Worksheet #15. The specific details of each section of the usability assessment documentation can be found above under the individual DQIs.

Considerations for the usability assessment are as follows:

- **Data Deliverables and QAPP, Deviation—**Ensure that the necessary information was provided.

- **Deviations—**Determine the impact of deviations on the usability of data.

- **Sampling Locations—**Determine if alterations to sample locations continue to satisfy the project objectives.

- **CoC Record—**Establish that problems with documentation or custody procedures do not prevent the data from being used for the intended purpose.

- **Holding Times—**Determine the acceptability of data if holding times were exceeded.

- **Damaged Samples—**Determine whether the data from damaged samples are usable. If the data cannot be used, determine whether resampling is necessary.

- **SOPs and Methods—**Evaluate the impact of deviations from SOPs and specified methods on data.

- **QC Samples—**Evaluate the implications of unacceptable QC sample results on the data usability for the associated samples. For example, consider the effects of observed blank contamination.
- **Matrix—**Evaluate matrix effects (interference or bias). For example, consider the effects of observed MS recoveries.
- **Meteorological Data and Site Conditions—**Evaluate the possible effects of meteorological (e.g., wind, rain, or temperature) and site conditions on sample results. Review field reports to identify whether any unusual conditions were present and how the sampling plan was executed.
- **Comparability—**Ensure that results from different data collection activities achieve an acceptable level of agreement.
- **Completeness—**Evaluate the impact of missing information. Ensure that enough information was obtained for the data to be usable (completeness as defined in PQOs documented in the QAPP).
- **Background—**Determine if background levels have been adequately established (if appropriate).
- **Critical Samples—**Establish that critical samples and critical target analytes, as defined in the QAPP, were collected and analyzed. Determine if the results meet criteria specified in the QAPP.
- **Data Restrictions—**Describe the exact process for handling data that do not meet PQOs (i.e., when measurement performance criteria are not met). Depending on how those data will be used, specify the restrictions on the use of those data for environmental decision making.
- **Usability Decision—**Determine if the data can be used to make a specific decision considering the implications of all deviations and corrective actions.
- **Usability Report—**Discuss and compare overall precision, accuracy/bias, representativeness, comparability, completeness, and sensitivity for each matrix, analytical group, and concentration level. Describe limitations on the use of project data if criteria for DQIs are not met.

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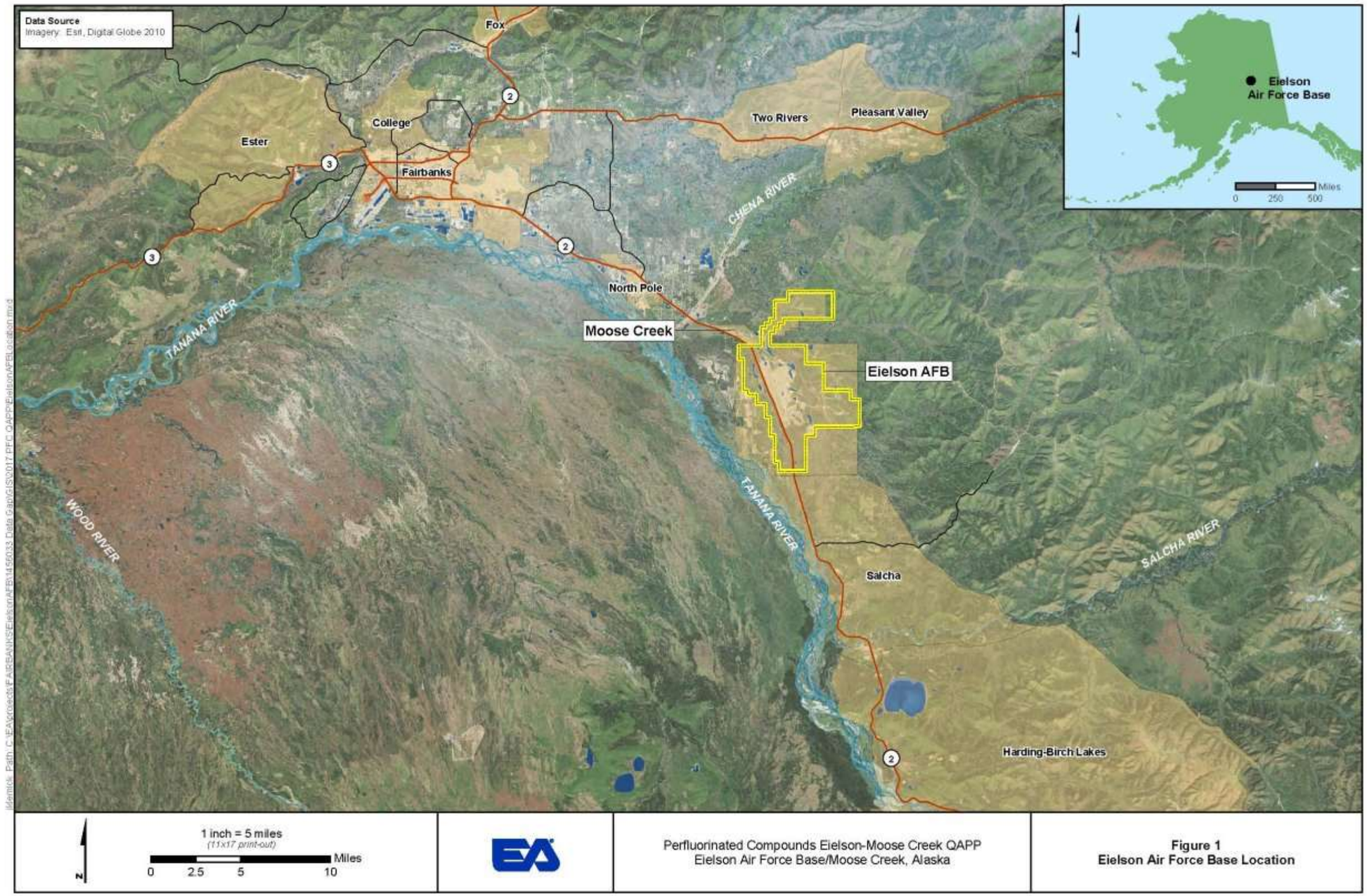
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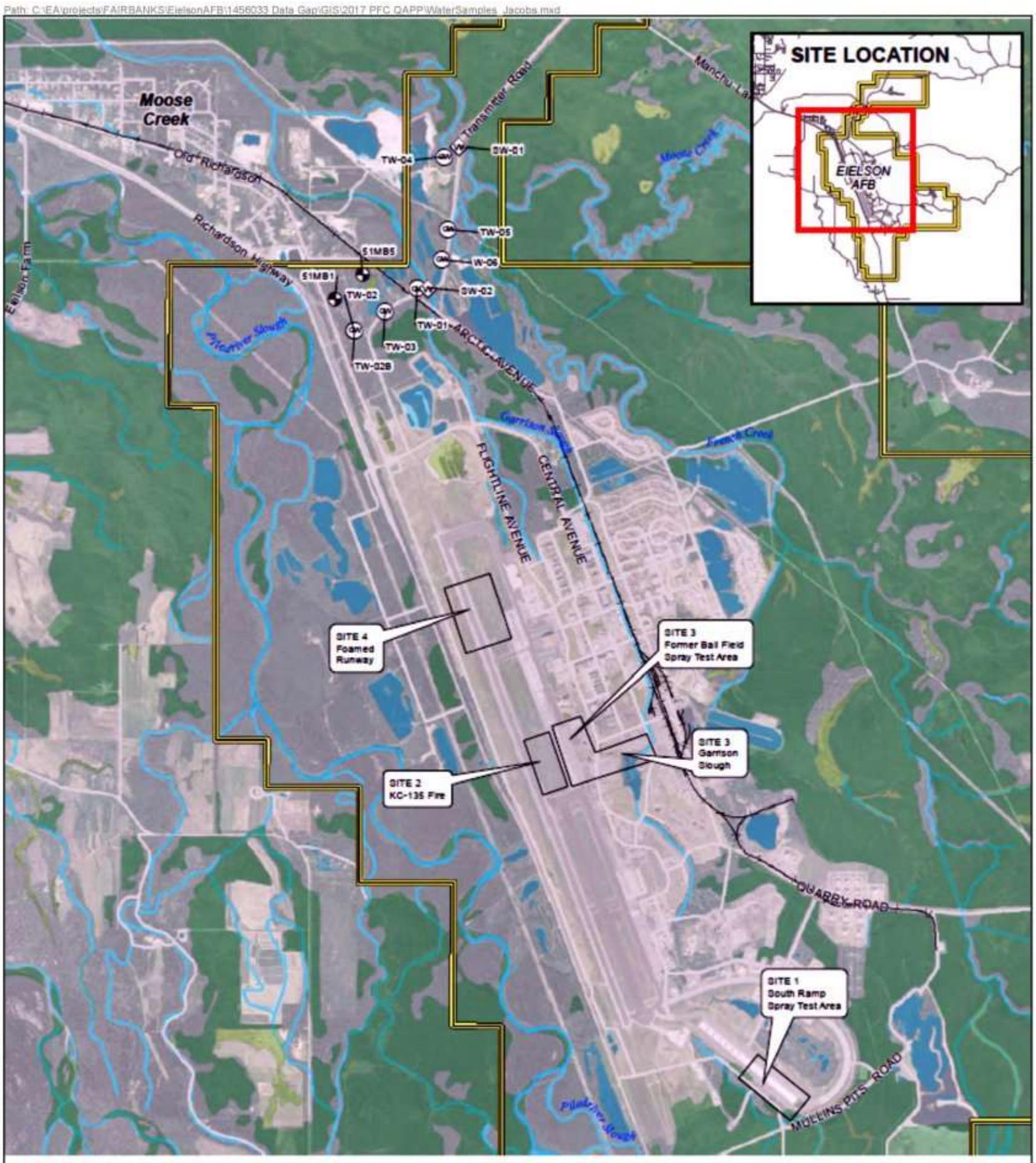
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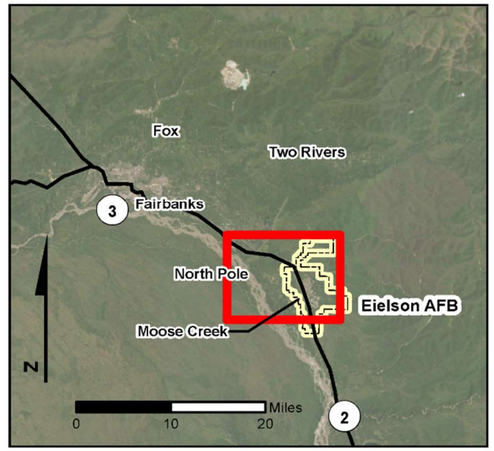
USAF, 2023. *2022 Annual Groundwater Monitoring Report for Per- and Polyfluoroalkyl Substances, Eielson Air Force Base, Alaska.*

FIGURES


Data Source
Imagery: Esri, Digital Globe 2010
Fox
College
Ester
Fairbanks
Two Rivers
Pleasant Valley
CHENA RIVER
North Pole
Moose Creek
Eielson AFB
TANANA RIVER
WOOD RIVER
Salcha
SALCHA RIVER
Harding-Birch Lakes
Eielson
Air Force Base
Miles
0 250 500
1 inch = 5 miles
(11x17 print-out)
Miles
0 2.5 5 10
Perfluorinated Compounds Eielson-Moose Creek QAPP
Eielson Air Force Base/Moose Creek, Alaska
Figure 1
Eielson Air Force Base Location


Path: C:\EA\projects\FAIRBANKS\EielsonAFB\1456033 Data Gap\GIS\2017 PFC QAPP\WaterSamples_Jacobs.mxd
SITE LOCATION
EIELSON AFB
Moose Creek
Old Richardson
Richardson Highway
Eielson Farm
Transmitter Road
Manchu-La
Moose Creek
Piledriver Slough
Garrison Slough
Tributary Creek
FLIGHTLINE AVENUE
CENTRAL AVENUE
ARCTIC AVENUE
QUARRY ROAD
MULLINS POINT ROAD
TW-04
SW-01
TW-05
TW-06
51MB5
51MB1
TW-02
SW-02
TW-01
TW-03
TW-02B
SITE 4
Foamed
Runway
SITE 3
Former Ball Field
Spray Test Area
SITE 3
Garrison
Slough
SITE 2
KC-135 Fire
SITE 1
South Ramp
Spray Test Area
Legend
Surface Water Sample
Temporary Well Sample
Existing Monitoring Well
Eielson AFB Boundary
Railroad
Freshwater Emergent Wetland
Freshwater Forested/Shrub Wetland
Surface Water
Data Source: Addendum #1 to the Final Perfluorinated Compounds Investigations Work Plan (Final), Jacobs, 27 May 2015.
N
0 0.25 0.5 0.75 1
Miles
Perfluorinated Compounds
Eielson-Moose Creek QAPP
Eielson Air Force Base/Moose Creek, Alaska
Figure 2
Eielson North Boundary
Water Sample Locations





Legend

Fall 2022 PFOA+PFOS Contours

- 0.007 µg/L (≥ 10% of LHA)
- 0.035 µg/L (≥ 50% of LHA)
- 0.07 µg/L (≥ EPA LHA)

Dashed lines indicate inferred plume boundaries

Approximate Groundwater Flow Direction

Figure 3
Monitoring Well Sampling PFAS Plume

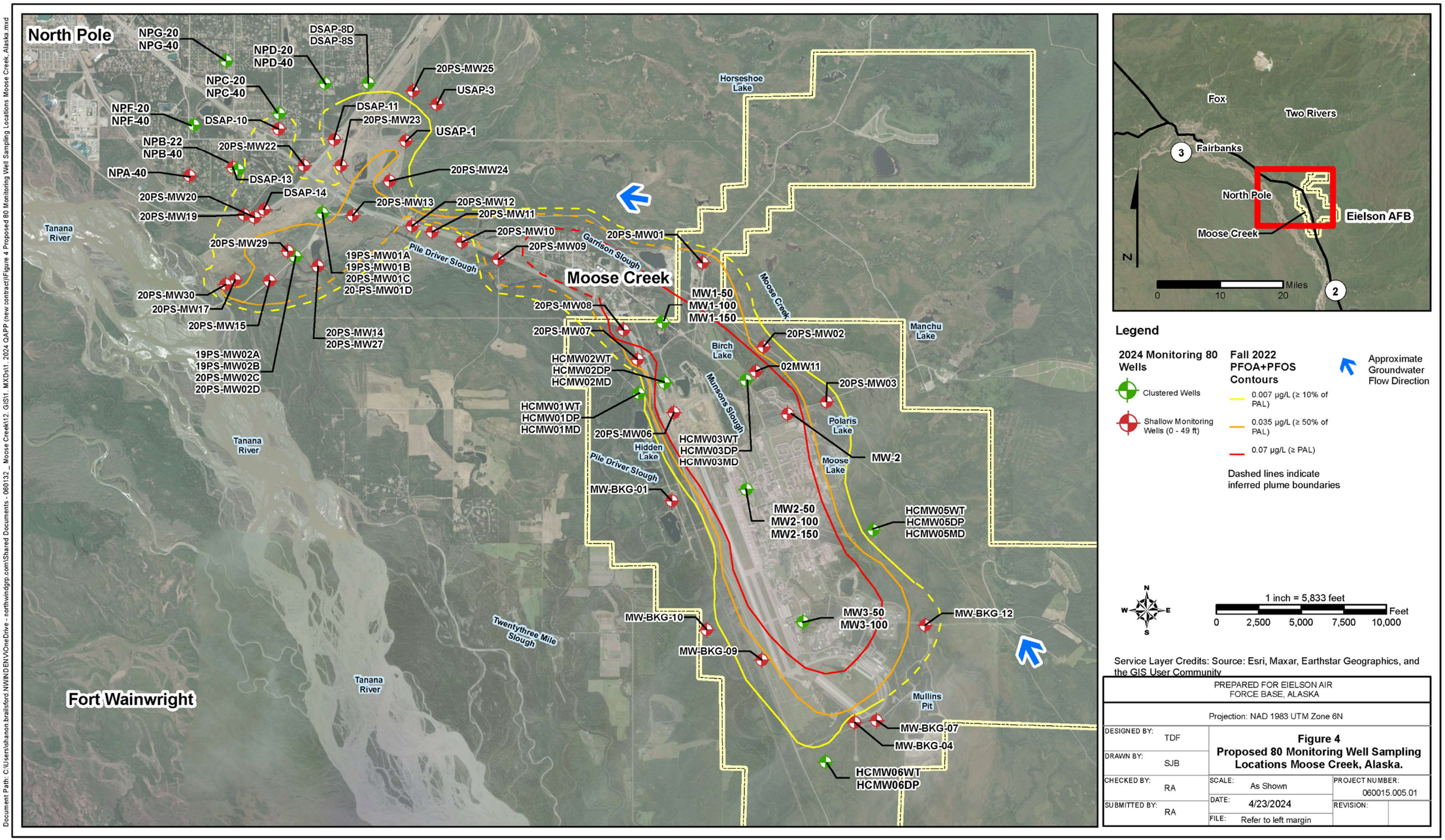
1 inch = 5,833 feet

0 2,500 5,000 7,500 10,000 Feet

Service Layer Credits: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

PREPARED FOR EIELSON AIR FORCE BASE, ALASKA		
Projection: NAD 1983 UTM Zone 6N		
DESIGNED BY: TDF	PERFLUORINATED COMPOUNDS EIELSON-MOOSE CREEK 2022 BI-ANNUAL GROUNDWATER SAMPLING PROJECT NO. WC1JUW70252620 MOOSE CREEK, ALASKA	
DRAWN BY: SJB		
CHECKED BY: RA	SCALE: As Shown	PROJECT NUMBER: 060015.005.01
SUBMITTED BY: RA	DATE: 1/29/2024	REVISION:
	FILE: Refer to left margin	

Document Path: Q:\Alaska-Files\Projects - Active\60\G0001.001 Moose Creek\GIS\1_MXDs\MooseCreek2024\Figure 3 Monitoring Well Sampling PFAS Plume.mxd


North Pole
NPG-20
NPG-40
DSAP-8D
DSAP-8S
NPD-20
NPD-40
NPC-20
NPC-40
NPF-20
NPF-40
DSAP-10
DSAP-11
20PS-MW25
USAP-3
20PS-MW23
USAP-1
NPB-22
NPB-40
20PS-MW22
NPA-40
DSAP-13
20PS-MW24
20PS-MW20
DSAP-14
20PS-MW19
20PS-MW13
20PS-MW12
20PS-MW11
20PS-MW10
20PS-MW09
20PS-MW01
20PS-MW29
19PS-MW01A
19PS-MW01B
20PS-MW01C
20-PS-MW01D
Pile Driver Slough
Garrison Slough
Moose Creek
20PS-MW30
20PS-MW17
20PS-MW15
20PS-MW14
20PS-MW27
MW1-50
MW1-100
MW1-150
20PS-MW08
20PS-MW07
20PS-MW02
02MW11
20PS-MW03
19PS-MW02A
19PS-MW02B
20PS-MW02C
20PS-MW02D
HCMW02WT
HCMW02DP
HCMW02MD
HCMW01WT
HCMW01DP
HCMW01MD
20PS-MW06
HCMW03WT
HCMW03DP
HCMW03MD
MW-2
MW-BKG-01
MW2-50
MW2-100
MW2-150
HCMW05WT
HCMW05DP
HCMW05MD
MW-BKG-10
MW-BKG-09
MW3-50
MW3-100
MW-BKG-12
MW-BKG-07
MW-BKG-04
HCMW06WT
HCMW06DP
Fort Wainwright
Tanana River
Twentythree Mile Slough
Horseshoe Lake
Manchu Lake
Birch Lake
Munsons Slough
Polaris Lake
Hidden Lake
Moose Lake
Mullins Pit
Fox
Two Rivers
Fairbanks
Eielson AFB
Moose Creek
N
Miles
0
10
20
2
3
Legend
2024 Monitoring 80 Wells
Clustered Wells
Shallow Monitoring Wells (0 - 49 ft)
Fall 2022 PFOA+PFOS Contours
0.007 µg/L (≥ 10% of PAL)
0.035 µg/L (≥ 50% of PAL)
0.07 µg/L (≥ PAL)
Dashed lines indicate inferred plume boundaries
Approximate Groundwater Flow Direction
1 inch = 5,833 feet
0
2,500
5,000
7,500
10,000
Feet
Service Layer Credits: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community
PREPARED FOR EIELSON AIR FORCE BASE, ALASKA
Projection: NAD 1983 UTM Zone 6N
DESIGNED BY: TDF
DRAWN BY: SJB
CHECKED BY: RA
SUBMITTED BY: RA
Figure 4
Proposed 80 Monitoring Well Sampling Locations Moose Creek, Alaska.
SCALE: As Shown
DATE: 4/23/2024
FILE: Refer to left margin
PROJECT NUMBER: 060015.005.01
REVISION:
Document Path: C:\Users\shanon.brailsford.NWINDEN\OneDrive - northwindgrp.com\Shared Documents - 060132_ Moose Creek\12. GIS\1. MXDs\1. 2024 QAPP (new contract)\Figure 4 Proposed 80 Monitoring Well Sampling Locations Moose Creek, Alaska.mxd

Appendix A

Field and Data Reporting Forms

Field Change Form

Project Name and Location Moose Creek, Alaska	Project/Task Order Number	Client Name USACE
Date prepared		Prepared by
Title and version of work plan		
Reason for action		
Existing plan or procedure		
Proposed change		
External Review		
Regulatory or contractual conditions:		
Signatures		
The proposed change, with the stated conditions if applicable, is hereby approved.		
ADEC RPM	EPA RPM	USAF RPM
Date	Date	Date

NORTHWIND
A CDI COMPANY

Applicability: ES&H
Owner: ES&H Director

For the most recent version, refer to the Document Management System

GROUNDWATER PURGING & SAMPLE COLLECTION

For use with ENVP-2006

ENVF-2006.02
Revision: 1
Effective Date: 11/28/2023
Page 1 of 2

Site/Unit Name:		Well ID:	
Static DTW (w/o pump; btoc):		Sample ID:	
Measuring point:		Sample Date/Time:	
Depth meter:		Pump model:	
Multiparameter meter:		Pump inlet (btoc):	

		Δ < 0.33 ft	± 0.2 °C	± 0.2 mg/L (or 10%)	± 3%	± 0.1 SU	± 10mV	± 10% (or < 10 NTU)	< 1L/min
Time	**Purge Volume (L or mL)**	**Dynamic DTW (feet btoc)**	**Temp (°C)**	**DO (mg/L)**	**Specific Conductance (µS/cm)**	**pH**	**ORP (mV)**	**Turbidity (NTU)**	**Flow Rate (L/min or mL/min)**

Observations:			
Analyses:			
Weather Samplers Names Visitors			
Casing type:	Casing diameter (in):	Screen interval (btoc or bgs):	TOC Elevation (ft amsl):

NORTHWIND
A CMI COMPANY

Applicability: ES&H
Owner: ES&H Director

For the most recent version, refer to the Document Management System

GROUNDWATER PURGING & SAMPLE COLLECTION
For use with ENVP-2006

ENVF-2006.02
Revision: 1
Effective Date: 11/28/2023
Page 2 of 2

Form Instructions

1. Stabilization criteria vary by State and site-specific permits and plans. Verify before use.
2. Record equipment model and/or serial numbers as needed to tie to calibration log.
3. Record static depth to water in top section prior to start of sampling.
4. Note measuring point for water level measurements, top of casing V-notch or N-side
5. Circle the units being using.
6. List all sampler's names under personnel.
7. Record any visitor's names and organization or write "None".
8. Line through unused rows and initial and date.
9. Well information at bottom can be left blank if not needed or not known.
10. Temperature and ORP should be recorded but are not used as stabilization indicators at most sites.

NORTH WIND

GROUNDWATER SAMPLING FORM NO._____

Site Location _____ Well ID _____

Project Number _____ Well Type ☐ Monitoring ☐ Extraction ☐ Probe

Weather _____ Well Material [

Field Crew _____ Date _____

_____ Sample Time _____

PURGE VOLUME

Casing Diameter

☐ 2-inch ☐ 4-inch ☐ 8-inch ☐ Other

Total Depth of Casing (TD in feet BTOC) _____ Water Level Depth (WL in feet BTOC) _____

Screen Interval (feet BTOC) from _____ to _____

Purge Volume (gal) = Total Well Depth (ft.) – Depth to Water (ft) x gallon/feet of casing = Casing Volume (gal X No. of Volumes

(1 ½" = 0.092; 2" = 0.163; 4" = 0.653)

PURGE METHOD

Bailer Type: ☐ Teflon ☐ Stainless Steel ☐ Other

Pump Type: ☐ Peristaltic ☐ Submersible ☐ Centrifugal ☐ Other

PURGE TIME

Start _____ Stop_____ Elapsed _____Minutes _____Gallons Flow Rate _____gpm

FIELD PARAMETER MEASUREMENTS

TIME	VOLUME (gallons)	pH (+/- 0.1 pH units)	Temperature (+/- 0.2 C)	Conductivity (+/- 3%)	DO (+/- 0.1 mg/L or 10%)	REDOX (+/- 10 mV)	Turbidity (+/- 10% NTU)	Depth to Water

Color: ☐ Clear ☐ Amber ☐ Tan ☐ Brown ☐ Gray ☐ Milky White ☐ Other

Odor: ☐ None ☐ Low ☐ Medium ☐ High ☐ Very Strong ☐ Sulfur Hydrocarbon ☐ Other

Turbidity: ☐ Clear ☐ Low ☐ Medium ☐ High ☐ Very Turbid ☐ Other

SAMPLING METHOD

Bailer—Type: ☐ Teflon ☐ Stainless Steel ☐ Disposable ☐ Other

Pump—Type: ☐ Peristaltic ☐ Submersible ☐ Centrifugal ☐ Other

SAMPLE INFORMATION

Sample ID	# of Sample Containers/Volume	Analysis	Preservative	Lab	QA/QC	Comments

Purge Water Disposal _____ Disposal Facility _____ Method

NOTE: This completed form is a record and shall be completed entirely and maintained in accordance with project/program records management requirements.

NORTHWIND A CIRI COMPANY	Field Calibration Log									
Project										
Operator's Name										
Date and Time										
Instrument Type										
Serial Number										
Owner of Instrument										
Calibration Solution (s)										
Field Parameter	**DO**	**ORP**	**Cond**	**pH**			**Turbidity**			
				1st Pt.	**2nd pt**	**3rd pt**	**1st pt**	**2nd pt**	**3rd pt**	**4th pt**
Standard Value										
Units										
Solution Lot Number										
Solution Expiration Date										
Temperature°C										
Calibration Value pre-calibration										
Calibration Value post-calibration										
Comments										

INVESTIGATION-DERIVED WASTE INVENTORY SHEET

Site: _____ No. of Drums: _____

Inventory Date: _____

Waste Source	Drum/Container ID Number	Date Generated	Contents (Solid, Liquids, etc.)	Approximate Volume	Drum Location/ Comments

NORTHWIND SITE SERVICES

PER- AND POLYFLUOROALKYL SUBSTANCES (PFAS) SAMPLE COLLECTION GUIDANCE	Identifier: ENVP-2019 Revision: 0 Page: 13 of 13

Attachment 1
Daily PFAS Protocol Checklist

Date: _____ Project Name: _____
Weather (temp./precipitation): _____ Personnel on Site: _____

Field Clothing and PPE:

☐ No clothing or boots containing Gore-Tex™

☐ Clothing being worn is well laundered (washed a minimum of six times.

☐ All safety boots made from polyurethane and PVC

☐ No materials containing Tyvek®

☐ Field crew has not used fabric softener on clothing

☐ Field crew has not used cosmetics, moisturizers, hand cream, or other related products this morning.

☐ Field crew has not applied unauthorized sunscreen or insect repellant.

Field Equipment

☐ No Teflon® or LDPE containing materials on-site.

☐All sampling materials made from stainless steel, HDPE, acetate, silicon, or polypropylene.

☐ No waterproof field books on-site.

☐ No plastic clipboards, binders, or spiral hard cover notebooks on-site.

☐ No adhesives (Post-It Notes) on-site.

Sample Containers:

☐All sample containers made of HDPE or polypropylene.

☐Caps are unlined and made of HDPE or polypropylene.

Wet Weather:

☐Wet weather gear made of polyurethane and PVC only.

Equipment Decontamination:

☐"PFA-free" water on-site for decontamination of sample equipment. No other water sources to be used.

☐Alconox and Liquinox to be used as decontamination materials.

Food Considerations:

☐No food or drink on-site with exception of bottled water and/or hydration drinks (i.e., Gatorade and Powerade) that is available for consumption only in the staging area.

If any applicable boxes cannot be checked, the Field Manager shall describe the noncompliance issues below and work with field personnel to address noncompliance issues prior to commencement of that day's work. Corrective action shall include removal of noncompliance items from the site or removal of worker offsite until in compliance. Repeated failure to comply with PFA sample protocols will result in the permanent removal of worker(s) from the site.

Describe the noncompliance issues (include personnel not in compliance) and action/outcome of noncompliance:

_____

_____

Field Manager Name: _____
Field Manager Signature: _____
Date: _____

Appendix B

Groundwater Plume Evaluation Work Plan

THE UNITED STATES AIR FORCE INSTALLATION RESTORATION PROGRAM



Final
Groundwater Plume Evaluation Work Plan

Per- and Polyfluoroalkyl Substances (PFAS) Plume Monitoring
Eielson AFB, Alaska

Prepared for:
U.S. Army Corps of Engineers and Air Force Civil Engineer Center

July 2024

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2. SCOPE OF WORK 2
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3. STATISTICAL EVALUATION TOOLS AND LIMITATIONS 2
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3.2 Evaluation Approach 3
4. REPORTING 5
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ACRONYMS AND ABBREVIATIONS

AFCEC	Air Force Civil Engineer Center
AFCEE	Air Force Center for Engineering and the Environment
AFB	Eielson Air Force Base
bgs	below ground surface
COV	coefficient of variation
EPA	U.S. Environmental Protection Agency
ERPIMS	Environmental Resources Program Information Management System
FFA	Federal Facility Agreement
FNSB	Fairbanks North Star Borough
ID	identification
JV	Joint Venture
MAROS	Monitoring and Remediation Optimization System
PFAS	per- and polyfluoroalkyl substances
RSL	regional screening level
USACE	United States Army Corps of Engineers
USAF	United States Air Force

1. INTRODUCTION

The United States Army Corps of Engineers (USACE) has contracted North Wind-EA Joint Venture (JV) to provide environmental restoration support at Eielson Air Force Base (AFB), Alaska, in the continuation of Interim Remedy implementation for the sampling of 80 existing groundwater monitoring wells associated with the per- and polyfluoroalkyl substances (PFAS) release from Eielson AFB in Moose Creek, Alaska under Contract No. W911KB-20-D-0012 for the Air Force Civil Engineering Center (AFCEC). North Wind-EA JV prepared this Groundwater Plume Evaluation Work Plan, which details the work to be completed under Contract Number W911KB-20-D-0012.

1.1 Site Background

The Eielson AFB is an active military installation that has been used for military operations since its establishment in 1944. Eielson AFB is located within the Fairbanks North Star Borough (FNSB), a county-scale municipality. Fairbanks is the urban center of the FNSB. North Pole, Moose Creek, and Salcha are other nearby suburban/rural areas located within the FNSB. North Pole is located approximately 7 miles northwest of Eielson AFB, while Moose Creek is located approximately 3 miles north of Eielson AFB (Figure 1). Eielson AFB encompasses 19,790 acres of the FNSB. Approximately 3,651 acres of Eielson AFB is improved or partially improved land, and 16,139 acres is undeveloped land encompassing forests, wetlands, lakes, and ponds.

Historical operations at Eielson AFB have generated varying quantities of hazardous and nonhazardous wastes from industrial and airfield operations, and fuel management. On 21 November 1989, Eielson AFB was listed on the National Priorities List of federal Superfund sites by the U.S. Environmental Protection Agency (EPA). The United States Air Force (USAF), the EPA, and the State of Alaska Department of Environmental Conservation entered into a Federal Facility Agreement (FFA) for Eielson AFB, which became effective in May 1991. Eielson AFB contains 66 source areas identified in the FFA, or prior to the FFA, that are regulated under the Comprehensive Environmental Response, Compensation, and Liability Act and managed under Eielson AFB's Installation Restoration Program. Of these 66 source areas, 21 have enforceable Institutional Controls specified along with the selected remedy, as outlined in the Record of Decision documents.

During 2019, North Wind–EA JV was contracted by the USACE to conduct biannual sampling of 20 monitoring wells (including 12 nested wells installed by North Wind – EA) for PFAS analysis. In 2021, the biannual sampling was increased to 40 monitoring wells and then 80 existing monitoring wells during 2022 and 2023. Beginning in 2022, the groundwater analytical data for shallow wells was used to evaluate plume characteristics and characterize the plume concentrations using Monitoring and Remediation Optimization System (MAROS) software version 2.2. The intermediate and deeper wells were evaluated by trend analysis utilizing the EPA's statistical software ProUCL version 5.2.

Per this contract (W911KB-20-D-0012), North Wind-EA JV will conduct biannual groundwater sampling of 80 existing monitoring wells. The groundwater plume will also be evaluated annually using MAROS and ProUCL software to determine if the plume is expanding, contracting, or stable; determine the center of the plume mass in the upper aquifer; and determine if individual well point concentrations are increasing, decreasing, or remaining stable.

2. SCOPE OF WORK

North Wind-EA JV will complete the following tasks to achieve the project objectives:

- Perform an annual MAROS evaluation of the wells near the top of the water table (generally within 20 to 25 feet below ground surface [bgs] or the shallowest available interval of nested wells);
- Perform an annual trend analysis of all 80 monitoring wells to determine if individual well concentrations are changing over time; and
- Prepare an annual groundwater monitoring report discussing the output of the MAROS evaluation and trend analyses and provide recommendations to add or eliminate wells from the current well sampling program and/or provide recommendations to optimize sample timing and/or frequency.

2.1 Objectives of the Plume Evaluation

The objectives of the plume evaluation include:

- Determine if the overall plume is expanding, contracting, or is stable and evaluate the position and trends of the center of the mass of the plume; and
- Determine if concentrations in individual well points are showing an increase, decrease, or no trend.

3. STATISTICAL EVALUATION TOOLS AND LIMITATIONS

The most recent version of MAROS, version 3.0, will be the primary tool used to evaluate the existing PFAS plume at Eielson AFB. The MAROS software was developed by GSI Environmental Inc. on behalf of the Air Force Center for Engineering and the Environment (AFCEE) as a data management and evaluation tool specifically designed to improve long-term groundwater monitoring programs. The software includes several statistical modules that allow for a determination of overall plume trends, center of mass, and trends at individual wells; and the determination of suggested modifications to long-term monitoring programs. MAROS also includes a linear regression trend analysis, as well as the nonparametric Mann-Kendall statistical method, which will be the primary statistical tool used to determine trend status.

Due to software limitations and site-specific conditions, only shallow wells near the top of the water table (within 20 to 25 feet bgs or shallowest available result in a nested series) will be evaluated using MAROS. The intermediate and deeper wells will be evaluated by trend analysis utilizing the EPA's statistical software ProUCL version 5.1. ProUCL was developed by the EPA for the analysis of environmental data sets with and without non-detect data. The software also includes a Trend Analysis option of the Statistical Test module. The trend module performs Mann-Kendall tests with a Theil-Sen estimator to analyze data collected over time for consistently increasing or decreasing trends.

The following are requirements and/or guidelines in using MAROS and the Mann-Kendall analyses:

- A minimum of four detected results are required to conduct valid Mann-Kendall tests. The confidence in the trend predictions with a small data set is low. However, as the data set grows over time, the power and confidence of the trend predictions increase.

- PFAS are not included in the pre-set list of constituents within MAROS. Therefore, the MAROS source files will be modified by inserting the Environmental Resources Program Information Management System (ERPIMS) name and identification (ID) for each PFAS analyte modeled.

- The MAROS tool is designed for use on sites where an assessment has been completed and long-term monitoring is occurring. An established well network with relatively consistent sampling data is best, although the statistical modules can handle periodic missing monitoring events. Large fluctuations in data coverage will increase the uncertainty with overall mass calculations and overall trend analyses.

3.1 Data Set to be Evaluated

Existing PFAS data available for the selected wells that were sampled biannually in 2019 through 2023 (a total of 10 monitoring events) will be used for the evaluation. Additionally, the 80 monitoring well biannual sampling data (two datasets per year) will be incorporated into the evaluation as additional data are obtained. Individual PFAS compounds exceeding the applicable EPA regional screening levels (RSLs) (Assistant Secretary of Defense, 2023) anywhere within the monitoring well network will be evaluated for each monitoring well. PFAS compounds without RSL exceedances in the monitoring well network and without established RSLs will not be evaluated.

Per the 2024 Uniform Federal Policy – Quality Assurance Project Plan, the 80-well monitoring well network has been revised from the 2022-2023 monitoring well network (USAF, 2024). Municipal supply wells North Pole Well-A and North Pole Well-B and monitoring wells 20PS-MW04, 20PS-MW05, 20PS-MW16, MW-BKG-11, USAP-2, and the HCMW04 well nest were removed from the biannual sampling program and replaced with monitoring wells NPA-40, NPB-40, NPC-20, NPC-40, NPD-20, NPD-40, NPF-20, NPF-40, NPG-20, and NPG-40 (Figure 1). No data from the wells removed from the monitoring well network will be included in the data set analyzed.

A minimum of four sample events will be needed before individual well trends can be analyzed at the newly added wells in the 80-well monitoring well network. In addition, a degree of uncertainty in the plume analysis at Moose Creek is expected until the newly added wells have at least four sample events. The plume analysis at Eielson AFB is expected to remain largely unaffected by the changes in the monitoring well network.

3.2 Evaluation Approach

The existing well network monitors contamination in groundwater from Eielson AFB to Moose Creek and North Pole, Alaska (Figure 1). The distance and general low density of wells between Eielson AFB (e.g., near 20PS-MW08 and 20PS-MW01) and Moose Creek/North Pole (e.g., 20PS-MW09 and beyond) includes a fairly substantial area with no monitoring wells. Rather than have the MAROS interpolate and estimate concentrations for this area, two discrete MAROS input files will be used to evaluate the on-site and off-site shallow groundwater, separately. For the purposes of the MAROS evaluation, the shallowest available wells will be included in the following "shallow" groupings to represent water table conditions:

- **Eielson AFB Shallow Wells:** 22 wells located within the Eielson AFB boundary; and

- **Moose Creek/North Pole Area Shallow Wells**: 31 wells north and west from 20PS-MW09.

Table 1 included at the back of this report identifies the specific wells to be included in the MAROS evaluation. All the wells, regardless of depth, that will be evaluated for trends using the Mann-Kendall module of ProUCL will also be included, primarily because well clusters cannot be evaluated using MAROS. The Mann-Kendall trend test is the same regardless of well coordinates and depths.

Table 2 summarizes the required technical MAROS inputs and proposed values for the evaluation. These values were, for the most part, provided from the Groundwater Model Summary and Quality Report (Ahtna, 2020). The MAROS analysis for both groupings of wells (Eielson Shallow and Moose Creek Shallow) will be run with two different plume thickness values – 50 feet and 25 feet. When the analysis is performed with a thickness of 25 feet, wells deeper than 25 feet will be removed from the data set (three wells in Eielson Shallow and one well in Moose Creek Shallow). The effect of the plume thickness input value, if any, will be discussed in the report.

Upon creating the MAROS input files, the analysis tool will be executed with the following assumptions/settings:

- No data consolidation will be required due to the limited time frame and size of the data set;
- "Non-Detects" will be included using the limit of detection as the assigned value;
- Duplicates will use the maximum result; and
- Trace (J-flagged) values will be included using the actual value reported by the laboratory.

The individual well trend analysis module and plume analysis module will provide the results of the Mann-Kendall trend analyses. Additionally, the plume module will complete spatial analyses providing coordinates of the center of mass coordinates, square feet of plume area, and the overall plume mass.

The output of the Mann-Kendall test is the S-statistic. Positive and negative S-statistics are indicators of increasing and decreasing concentration trends, respectively. To differentiate whether a trend finding from the S-statistic is statistically significant, a decision matrix based on the S-statistic, the confidence in the trend, and the coefficient of variation (COV) is used. The confidence level, expressed as a percentage, is calculated by subtracting the probability (p) from 1 (e.g., confidence = [1-p] x 100). The p-value indicates whether the association between the response and predictor (i.e., analyte concentration versus time) is statistically significant at the given level of confidence. The COV is defined as the standard deviation of the sample set divided by the average of the sample set. Based on the results of calculating these three statistics using the decision matrix presented in Table A, the concentration trend indicated by the S-statistic is determined to be:

- Increasing,
- Probably increasing,
- No trend,
- Stable,
- Likely decreasing, or
- Decreasing

This decision matrix will be used in both the MAROS and the Pro-UCL analyses.

Table A. Mann-Kendall Analysis Decision Matrix

Mann-Kendall Statistic	Confidence in Trend (COV)	Statistical Trend
S > 0	>95%	Increasing
S > 0	90-95%	Probably Increasing
S > 0	<90%	No Trend
S ≤ 0	<90% and COV ≥1	No Trend
S ≤ 0	<90% and COV <1	Stable
S < 0	90-95%	Probably Decreasing
S < 0	>95%	Decreasing

4. REPORTING

The statistical evaluations will be used to determine if the plume for each PFAS constituent analyzed is expanding, decreasing, or has remained stable and if the PFAS constituent concentrations in individual well points are increasing, decreasing, or are stable. Additionally, the evaluation will be utilized to determine the plume mass in the shallow aquifer. The findings of the MAROS evaluation and trend analyses will be provided in each annual groundwater monitoring reports prepared as pre-draft, red line strike out draft final, and final versions. Based on the findings, recommendations may be made to add/eliminate monitoring wells from the sampling event(s) and/or optimize the timing and/or frequency of sampling. The reports will also include the relevant ProUCL and MAROS data input files in MS Excel format.

5. REFERENCES

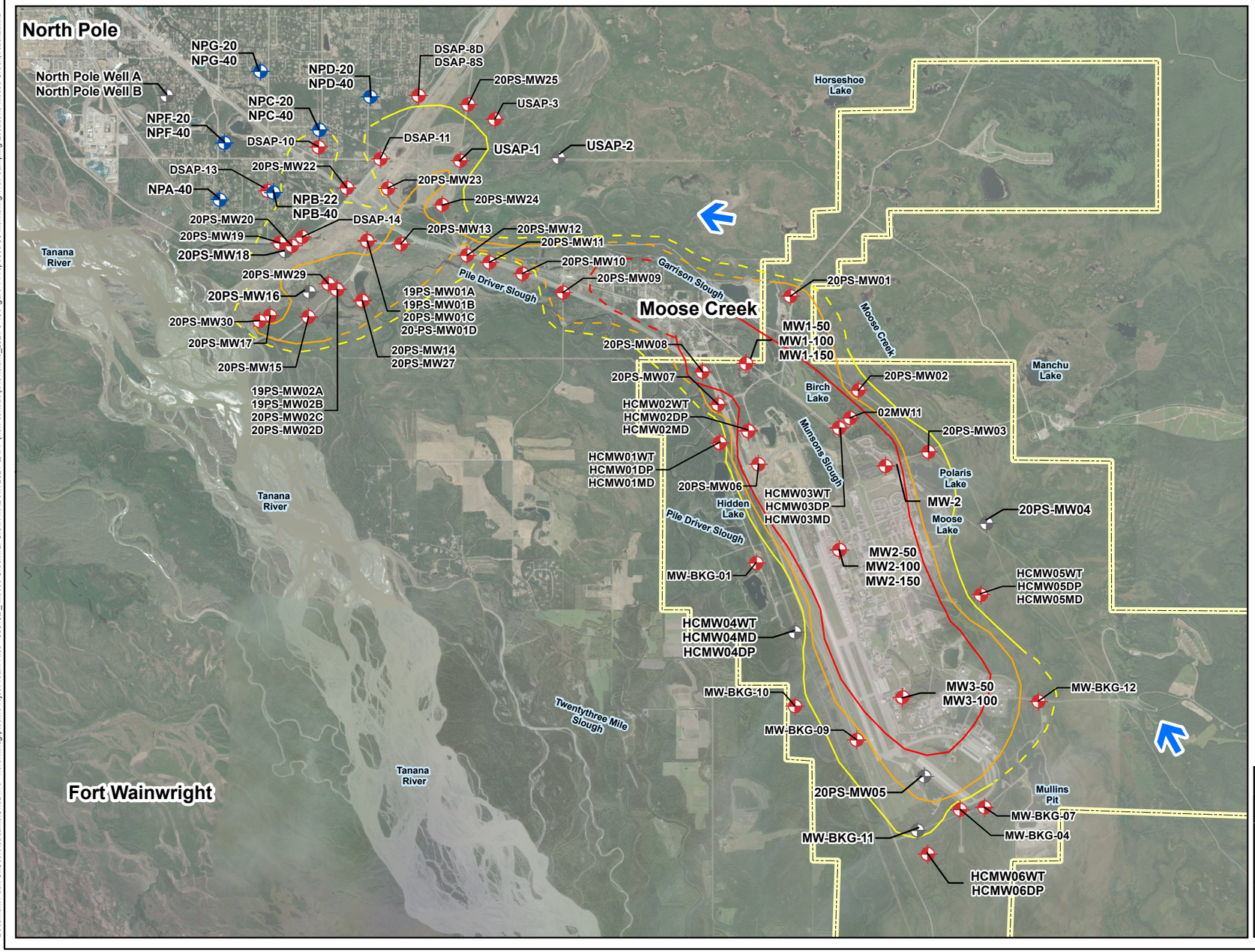
Ahtna, 2020. *Final Groundwater Model Summary and Quality Report, Eielson Air Force Base, Alaska*. June.

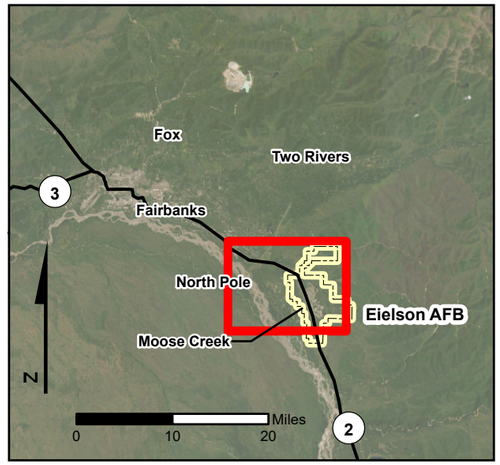
Assistant Secretary of Defense, 2023. *Memorandum – Investigating Per- and Polyfluoroalkyl Substances within the Department of Defense Cleanup Program*. May.

USAF, 2023. *Final Environmental Restoration Program Atlas, Eielson Air Force Base, Alaska*, November.

USAF, 2024. *Per- and Polyfluoroalkyl Substances (PFAS) Plume Monitoring, Eielson Air Force Base, Alaska, Quality Assurance Project Plan (QAPP).*

FIGURES





Legend

- Monitoring Wells Added to Sampling Network in 2024
- Monitoring Wells Removed from Sampling Network in 2024
- Monitoring Wells
- Eielson Air Force Base Location
- Approximate Groundwater Flow Direction

Fall 2022 PFOA+PFOS Contours

- 0.007 µg/L (≥ 10% of PAL)
- 0.035 µg/L (≥ 50% of PAL)
- 0.07 µg/L (≥ PAL)

Dashed lines indicate inferred plume boundaries

N W E S

1 inch = 6,000 feet

0 3,000 6,000 9,000 12,000 Feet

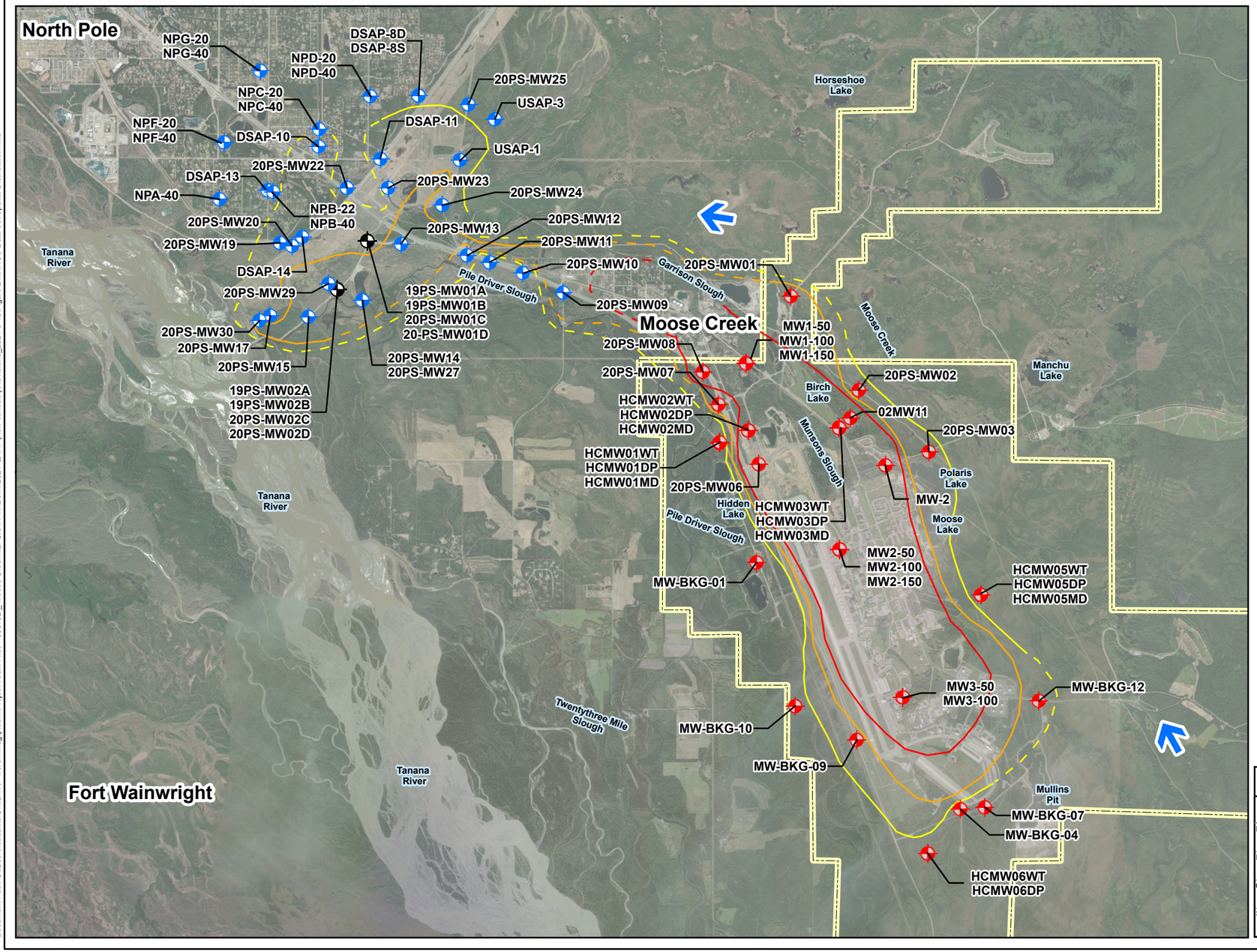
Service Layer Credits: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

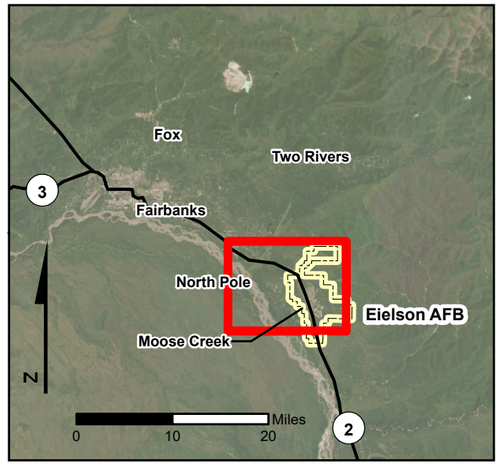
PREPARED FOR EIELSON AIR FORCE BASE, ALASKA

Projection: NAD 1983 UTM Zone 6N

DESIGNED BY: TDF	**Figure 1 Proposed 80 Monitoring Well Sampling Locations Moose Creek, Alaska.**		
DRAWN BY: ERA			
CHECKED BY: RA	SCALE: As Shown	PROJECT NUMBER: 060132	
SUBMITTED BY: RA	DATE: 5/14/2024	REVISION:	
	FILE: Refer to left margin		

Document Path: C:\Users\eadams\OneDrive - northwindgrp.com\Project Team Files - 060132 _ Moose Creek\12. GIS\1. MXDs\1. 2024 QAPP (new contract)\Revisions_2024-5-13\Figure 1 Proposed 80 Monitoring Well Sampling Locations Moose Creek, Alaska.mxd





Legend

- Moose Creek Shallow Well MAROS Plume Analysis Wells
- Eielson AFB Shallow Well MAROS Plume Analysis Wells
- Individual Trend Analysis
- Approximate Groundwater Flow Direction

Fall 2022 PFOA+PFOS Contours

- 0.007 µg/L (≥ 10% of PAL)
- 0.035 µg/L (≥ 50% of PAL)
- 0.07 µg/L (≥ PAL)

Dashed lines indicate inferred plume boundaries

Note:
At well clusters, only the shallowest well in each cluster will be included in the MAROS plume trend analysis. Individual trends will be analyzed for intermediate and deep wells.

N W E S

1 inch = 6,000 feet

0 3,000 6,000 9,000 12,000 Feet

Service Layer Credits: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

PREPARED FOR EIELSON AIR FORCE BASE, ALASKA

Projection: NAD 1983 UTM Zone 6N

DESIGNED BY: TDF	**Figure 2** **MAROS Data Set Spatial Distribution Moose Creek, Alaska.**		
DRAWN BY: ERA			
CHECKED BY: RA	SCALE: As Shown	PROJECT NUMBER: 060132	
SUBMITTED BY: RA	DATE: 5/16/2024	REVISION:	
	FILE: Refer to left margin		

Document Path: C:\Users\eadams\OneDrive - northwindgrp.com\Project Team Files - 060132 _ Moose Creek\12. GIS\1. MXDs\1. 2024 QAPP (new contract)\Revisions_2024-5-13\Figure 2 MAROS Data Set Spatial Distribution.mxd

TABLES

Table 1. Summary of Proposed Well Data Groupings for Plume Analysis

Well ID	Northing[a]	Easting[b]	Well Depth (feet bgs)	Fall 2023 Water Level (feet btoc)	Screened Interval (feet bgs)
	Eielson AFB Boundary - Shallow Wells (22 wells)				
20PS-MW01	7176581.112	494517.138	13.00	10.37	3-13
20PS-MW02	7175064.120	495610.731	12.80	6.72	2.8-12.8
20PS-MW03	7174076.359	496739.466	13.00	5.57	3-13
20PS-MW06	7173880.735	494001.302	15.50	6.62	5.5-15.5
20PS-MW07	7174837.889	493352.164	14.00	10.36	4-14
20PS-MW08	7175365.406	493100.981	13.00	9.21	3-13
02MW11	7174605.93410	495461.92510	25.00	15.88	12.75-22.75
MW-2*	7173857.57000	496040.80030	10.0	3.63	5.0-10.0
MW-BKG-01	7172270.47810	493967.37210	20.3	12.62	7.5-17.5
MW-BKG-04	7168297.22410	497261.91110	22.3	11.28	10.0-20.0
MW-BKG-07	7168342.80290	497643.33610	23.3	13.74	11.0-21.0
MW-BKG-09	7169418.41210	495589.98610	21.3	9.23	9.0-19.0
MW-BKG-10	7169969.41490	494603.72310	20	14.08	7.5-17.5
MW-BKG-12	7170059.0669	498505.6721	14.8	4.07	2.5-12.5
HCMW01WT	7174222.4840	493372.7221	17.02	10.22	7-17
HCMW02WT	7174419.824	493836.4556	16.33	9.27	6-16
HCMW03WT	7174467.120	495297.2664	13.5	4.87	4-13
HCMW05WT	7171772.314	497578.6485	12	6.00	3-13
HCMW06WT	7167605.292	496723.5434	15.41	8.28	5-15
MW1-50[1]	7175504.1	493797.83	50	7.82	40-50
MW2-50[1]	7172497	495303.1	50	9.75	40-50
MW3-50[1]	7170121.9	496315.66	48	11.52	28-48

Table 1. Summary of Proposed Well Data Groupings for Plume Analysis (cont.)

Well ID	Northing[a]	Easting[b]	Well Depth (feet bgs)	Fall 2023 Water Level (feet btoc)	Screened Interval (feet bgs)
Moose Creek/North Pole Off-Site Wells - Shallow Wells (31 wells)					
20PS-MW09	7176639.655	490855.088	16.50	13.03	6.5-16.5
20PS-MW10	7176948.625	490203.009	13.40	9.98	3-13
20PS-MW11	7177127.788	489673.368	11.83	7.91	1.5-11.5
20PS-MW12	7177237.566	489308.677	13.40	9.52	3-13
20PS-MW13	7177423.927	488247.719	15.00	12.21	5-15
20PS-MW14	7176517.027	487621.596	13.00	7.98	3-13
20PS-MW15	7176252.153	486757.777	15.00	14.03	5-15
20PS-MW17	7176270.343	486138.819	13.00	6.36	3-13
20PS-MW19	7177438.570	486298.504	13.00	10.6	3-13
20PS-MW20	7177393.776	486490.384	13.00	11.43	3-13
20PS-MW22	7178324.143	487374.239	20.00	8.87	10-20
20PS-MW23	7178321.010	488036.391	13.00	5.52	3-13
20PS-MW24	7178045.163	488908.570	24.00	14.22	4.5-14.5
20PS-MW25	7179667.000	489329.811	20.91	13.5	4-14
20PS-MW27	7176512.106	487623.321	20.80	8.21	10.8-20.8
20PS-MW29	7176784.518	487078.246	17.00	1.73	7-17
20PS-MW30	7176189.208	485968.943	20.00	5.91	10-20
DSAP-8S	7179793.91270	488525.08690	19.20	14.4	13.9-18.9
DSAP-10	7178964.52240	486921.30550	15.40	11.27	10.2-15.2
DSAP-11	7178774.63400	487925.92640	22.00	14.98	9.2-19.2
DSAP-13	7178256.08510	486111.10940	13.00	8.45	7.8-12.8
DSAP-14*	7177502.89400	486697.52190	21.50	12.79	15.1-20.1
NPA-40[1,c]	7178140.87	485321.24	39.3	–	29.3-39.3
NPB-22[c]	7178252.45	486190.21	22	–	12-22
NPC-20[c]	7179262.31	486928.74	20.5	–	10.5-20.5
NPD-20[c]	7179800.6	487748.21	21.7	–	11.7-21.7
NPF-20[c]	7179058.8	485399.04	20.5	–	10.5-20.5
NPG-20[c]	7180205.94	485979.98	20	–	10-20
USAP-1	7178769.88610	489195.96240	24.50	19.73	14.0-19.0
USAP-3	7179418.06490	489753.77290	21.50	16.44	12.1-17.1

Table 1. Summary of Proposed Well Data Groupings for Plume Analysis (cont.)

Well ID	Northing[a]	Easting[b]	Well Depth (feet bgs)	Fall 2023 Water Level (feet btoc)	Screened Interval (feet bgs)
Intermediate and Deep Wells (Trend Analysis - 27 wells)					
DSAP-8D	7179793.91270	488525.08690	66.50	14.42	59.2-64.2
19PS-MW01A	7177465.413	487703.261	63.33	5.57	51.31-61.31
19PS-MW01B	7177471.420	487703.958	110.58	5.29	99.92-109.58
19PS-MW02A	7176688.866	487215.0573	63.33	7.05	49-59
19PS-MW02B	7176691.293	487220.1053	110	6.74	101.8-111.8
20PS-MW01C	7177474.325	487704.137	160.50	4.85	150.3-160.3
20PS-MW01D	7177468.345	487703.556	209.53	4.99	199-209
20PS-MW02C	7176691.614	487222.494	161.24	6.41	151-161
20PS-MW02D	7176689.902	487219.028	210.00	6.12	199.8-209.8
HCMW01MD	7174223.4420	493373.5421	72.8	10.36	68-73
HCMW01DP	7174224.8230	493374.8041	203.03	10.85	198-203
HCMW02MD	7174419.105	493833.9764	72.93	9.77	68-73
HCMW02DP	7174417.687	493832.0488	198.5	9.35	193-198
HCMW03MD	7174464.513	495297.0429	72	4.38	67-72
HCMW03DP	7174462.133	495297.0222	199.2	3.75	194-199
HCMW05MD	7171774.332	497575.7034	72.64	5.06	67-72
HCMW05DP	7171773.197	497577.2069	203	5.78	197-202
HCMW06DP	7167605.896	496721.7453	201.63	7.45	196-201
MW1-100	7175501	493798.31	98	7.46	88-98
MW1-150	7175495	493799.09	150	8.28	140-150
MW2-100	7172500.5	495301.26	100	9.33	90-100
MW2-150	7172503.9	495300.75	150	9.04	140-150
MW3-100	7170122.7	496320.99	100	11.41	80-100
NPB-40[c]	7178252.45	486190.21	41	–	31-41
NPC-40[c]	7179262.31	486928.74	40	–	30-40
NPD-40[c]	7179800.6	487748.21	39.7	–	29.7-39.7
NPF-40[c]	7179058.8	485399.04	40	–	30-40
NPG-40[c]	7180205.94	485979.98	40	–	30-40

*****Final Environmental Restoration Atlas (USAF, 2023)
– information unavailable
[1] Wells will be excluded from the MAROS analysis when the plume thickness input is 25 feet.
[a] Coordinate System: WGS 84 UTM Zone 6 North, in meters.
[b] Vertical Coordinate System: NAVD88.
[c] Preliminary information; table will be updated as information becomes available.

Table 2. Proposed Site Specific MAROS Input Parameters

Item	Unit	Value	Comments/Source
Seepage Velocity	ft/yr	973	Calculated using conductivity of 400 ft/day (lower end of range for alluvium (Ahtna, 2020), porosity of 15% (see below), and gradient of 0.001 (Ahtna, 2020).
Plume Length and Width	ft	26,000 x 11,000 (Eielson); 26,000 x 11,000 (Moose Creek)	Estimated from area exceeding the 0.007 µg/L plume line, as shown on Figure 1.
Distance from Source to Receptors	ft	20,000	Value used in the 2020 groundwater model (Ahtna, 2020) - distance from approximate center of Eielson AFB to Moose Creek/North Pole.
Flow Direction		NW (onsite) W (off-site)	Estimate from water level data provided in 2019, 2020, and 2021 reports.
X and Y coordinate of Source	ft	TBD	The South Ramp Spray Test Area, which is located in the far southeast (most upgradient) plume area, will be selected as coordinates.
Porosity	%	10	Within the range used for alluvium in the 2024 groundwater model update.
Plume Thickness	ft	25-50	Estimated from on-site monitoring results. Same thickness assumed at all locations. Analysis will be run once with a thickness of 25 feet and once with a thickness of 50 feet. The results will be compared.
Cleanup Level	µg/L	Varies	EPA RSL (Assistant Secretary of Defense, 2023)

Abbreviations:
µg/L – micrograms/liter
ft – feet
NW – northwest
TBD – to be determined
W – west
yr – year

Appendix C

EA and North Wind Field Sampling Standard Operating Procedures

- EA SOP No. 001 – Labels
- EA SOP No. 002 – Chain-of-Custody
- EA SOP No. 009 – Fieldwork During Times of High Risk for Wildfire
- EA SOP No. 043 – Multi-Probe Water Quality Monitoring Instruments
- EA SOP No. 052 – Bear Safety for Fieldwork Occurring in Bear Habitats
- NW ENVP-2002 – Sample Handling and Shipping
- NW ENVP-2003 – Field Documentation
    - NW ENVF-2003.01
- NW ENVP-2004 – Collection of Quality Control Samples
- NW ENVP-2006 – Groundwater Sampling
    - NW ENVF-2006.01
- NW ENVP-2011 – Field Measurements
- NW ENVP-2014 – Field Equipment Decontamination
- NW ENVP-2017 – Waste Management for Environmental Investigations
- NW ENVP-2019 – Per- and Polyfluoroalkyl Substances (PFAS) Sample Collection Guidance
- NW QAP-3121 – Control of Measuring and Test Equipment
    - QAF-3121.01
    - QAF-3121.02
    - QAP-3121.03
- NW QAP-3171 – Records Management

Standard Operating Procedure No. 001
for
Sample Labels

Prepared by

EA Engineering, Science, and Technology, Inc., PBC
225 Schilling Circle, Suite 400
Hunt Valley, Maryland 21031

Revision: 01
November 2018

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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. 001	
SOP Section	**Variance**

Project Manager (Name)

Project Manager (Signature) Date

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3. PROCEDURE 1

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3.2 ROUTINE CHECK 2
3.3 RECORD INFORMATION 2

3.3.1 Logbook Entry 3

4. MAINTENANCE 3

5. PRECAUTIONS 3

6. REFERENCES 3

DOCUMENT REVISION HISTORY

ORIGINAL (MASTER) DOCUMENT REVISION HISTORY				
Revision Number	**Revision Date**	**Revision Summary**	**Revised By**	**Reviewed By**
1	November 2018	Systematic review and update	Dan Hinckley Sheena Styger Sanita Corum	Matthew Bowman

1. SCOPE AND APPLICATION

The purpose of this Standard Operating Procedure (SOP) is to delineate protocols for the use of sample labels. Every sample will have a sample label uniquely identifying the sampling point and analysis parameters. An example label is provided below. Other formats with similar levels of detail are acceptable. Some project software including Scribe (U.S. Environmental Protection Agency (EPA)-associated projects) and FUDSchem (U.S. Army Corps of Engineers-associated projects) can generate pre-prepared labels thus minimizing efforts in the field.

NOTE: It is important to review with the Project/Program Manager to determine if client or project-specific modifications to this SOP are required. For example, if using EPA laboratories, case numbers may be assigned in lieu of having site or project names on the label.

PROJECT NAME _____ PROJECT NUM. _____
SAMPLE LOCATION/SITE ID _____
DATE: ____/____/____ TIME: _____:_____
ANALYTES: METALS VOC EXPLOSIVES ORGANICS OTHER
FILTERED: [NO] [YES]
PRESERVATIVE: [NONE] [HNO_3] [OTHER _____]
SAMPLER: _____

2. MATERIALS

The following materials may be required:

- Sample label
- Indelible marker.

3. PROCEDURE

The following sections describe how to use the sample labeling system.

3.1 LABEL INFORMATION

As each sample is collected/selected, fill out a sample label. Enter the following information on each label:

- Project name (do not include if there is a project or client-specific requirement to exclude)
- Project Number (or Case Number, as applicable)
- Location/site identification—enter the media type (i.e., well number, surface water, soil, etc.) sampling number, and other pertinent information concerning where the sample was taken
- Date of sample collection
- Time of sample collection
- Analyses to be performed (NOTE: Due to number of analytes, details of analysis should be arranged with laboratory *prior to start of work)*
- Whether filtered or unfiltered (water samples only)
- Preservatives (water samples only)
- Number of containers for the sample (e.g., 1 of 2, 2 of 2).

3.2 ROUTINE CHECK

Double-check the label information to make sure it is correct. Detach the label, remove the backing, and apply the label to the sample container. Cover the label with clear tape, ensuring that the tape completely encircles the container.

3.3 RECORD INFORMATION

Record the sample number and designated sampling point in the field logbook, along with the following sample information:

- Time of sample collection (each logbook page should be dated)
- Location of the sample
- Organic vapor meter or photoionization meter readings for the sample (when appropriate)
- Any unusual or pertinent observations (oily sheen on groundwater sample, incidental odors, soil color, grain size, plasticity, etc.)
- Number of containers required for each sample

- Whether the sample is a quality assurance sample (split, duplicate, matrix spike/matrix spike duplicate, or blank).

3.3.1 Logbook Entry

A typical logbook entry might look like this:

- 7:35 a.m. Sample No. MW-3. Photoionization Detector = 35 parts per million.
- Petroleum odor present. Sample designated MW-3-001.

NOTE: Duplicate samples may be given a unique sample designation rather than the actual sample number with an added prefix or suffix. This will prevent any indication to the laboratory that this is a duplicate sample thus making it "blind" to the laboratory. This fictitious sample number must be listed in the logbook along with the actual location of the sample.

4. MAINTENANCE

Not applicable.

5. PRECAUTIONS

If "blind" field duplicate samples have been called for, then no indication of which samples are duplicates is to be provided to the laboratory.

6. REFERENCES

Not applicable.

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Standard Operating Procedure No. 002
for
Chain-of-Custody Form

Prepared by

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225 Schilling Circle, Suite 400
Hunt Valley, Maryland 21031

Revision: 01
November 2018

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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. 002	
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**
01	November 2018	Systematic review and update	Dan Hinckley, Sheena Styger, Sanita Corum	Matthew Bowman

1. SCOPE AND APPLICATION

A chain-of-custody record (attached) is used as physical evidence of sample custody and as a permanent record for each sample collected. A chain-of-custody record documents the exchange and transportation of samples from the field to the laboratory. The purpose of this Standard Operating Procedure (SOP) is to delineate protocols for use of the chain-of-custody form. Three example forms are provided as Figures SOP002-1 (EA's standard electronic chain-of-custody form), SOP002-2 (EA's Toxicology Laboratory chain-of-custody form), and SOP002-3 (U.S. Environmental Protection Agency [EPA] Scribe chain-of-custody form). Other formats with similar levels of detail are acceptable.

Most EPA projects utilize sampling and chain-of-custody instructions as documented in EPA's Samplers Guide (2014), which includes the use of Scribe, an in-house software program used to establish computer records of all environmental data and includes generation of chain-of-custodies. Using Scribe requires training, and the software and guidance can be found at the following link: https://response.epa.gov/site/site_profile.aspx?site_id=ScribeGIS. Training on Scribe is necessary and can be obtained through the Scribe weblink.

All new U.S. Army Corps of Engineers projects require the use of Formerly Used Defense Sites chemistry database (FUDSchem), which can be found at the following link: http://fudschem.com/public/framework/bannerhtml.aspx?dsn=systm&idhtml=10642&themesuffix=default&banner=banner_fudschem.jpg. This software will generate chain-of-custody forms specific to the sampling session. As with Scribe, FUDSchem training is necessary.

It is essential that chain-of-custody forms be completed properly, and that sample relinquishment be signed and dated appropriately. Laboratories use chain-of-custodies as their statement of work and, if it is not correct, the samples will not be analyzed appropriately. Sample custody documentation assures that the particular samples have been in secure locations, and that none of them have been tampered with, thus assuring appropriate results.

2. MATERIALS

The following materials may be required: chain-of-custody form and indelible ink pen.

3. PROCEDURE

- Give the site name and project name/number.
- Enter the sample identification code.
- Indicate the sampling dates for all samples.
- List the sampling times (military format) for all samples.

- Enter the total number of containers per cooler.
- List the analyses/container volume.
- Obtain the signature of sample team leader.
- State the carrier service and airbill number, analytical laboratory, and custody seal numbers (if applicable).
- Sign, date, and time the "relinquished by" section. Be sure the carrier signs and enters dates and time of acceptance of the samples.
- Upon completion of the form, retain a copy or portable document format, and affix the laboratory copy to the inside of the sample cooler in a zip-seal bag to protect from moisture, to be sent to the designated laboratory.

4. MAINTENANCE

Not applicable.

5. PRECAUTIONS

None.

6. REFERENCES

U.S. Environmental Protection Agency (EPA). 2014. Sampler's Guide, Contract Laboratory Program Guidance for Field Samplers. EPA/540/R014/013, Directive 92400.2-147. October.

Figures

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Figure SOP002-1 EA Chain-of-Custody Form

Company Name:	Project Manager or Contact: Phone:	Parameters/Method Numbers for Analysis	Chain-of-Custody Record
Project No. Dept.: Task:	Project Name:		EA Laboratories 231 Schilling Circle Hunt Valley, MD 21031 Telephone: (410) 584-7000
Sample Storage Location:	P.O. No.:		**Report Deliverables:** **1 2 3 4 D E** **EDD: Yes/No** **DUE TO CLIENT: _____**
Page of	**Report No.:**		

Date	Time	Water	Soil	Sample Identification 19 Characters	**No. of Containers**	**EA Labs Accession Number**	Remarks
				XXXXXXXXXXXXXXXXXX			**LPM**:
				XXXXXXXXXXXXXXXXXX			
				XXXXXXXXXXXXXXXXXX			
				XXXXXXXXXXXXXXXXXX			
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Company Name:	Project Manager or Contact: Phone:	Parameters/Method Numbers for Analysis	Chain-of-Custody Record
Project No. Dept.: Task:	Project Name:		EA Laboratories 231 Schilling Circle Hunt Valley, MD 21031 Telephone: (410) 584-7000
Sample Storage Location:	P.O. No.:		**Report Deliverables:** **1 2 3 4 D E** **EDD: Yes/No** **DUE TO CLIENT: _____**
Page of	**Report No.:**		

Date	Time	Water	Soil	Sample Identification 19 Characters	**No. of Containers**	**EA Labs Accession Number**	Remarks
				XXXXXXXXXXXXXXXXXX			
				XXXXXXXXXXXXXXXXXX			
				XXXXXXXXXXXXXXXXXX			
				XXXXXXXXXXXXXXXXXX			
				XXXXXXXXXXXXXXXXXX			
				XXXXXXXXXXXXXXXXXX			
				XXXXXXXXXXXXXXXXXX			
				XXXXXXXXXXXXXXXXXX			
				XXXXXXXXXXXXXXXXXX			

Samples by: (Signature)	Date/Time	Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Date/Time
Relinquished by: (Signature)	Date/Time	Received by Laboratory: (Signature)	Date/Time	Airbill Number:	Sample Shipped by: (Circle) Fed Ex. Puro. UPS Hand Carried Other:

Cooler Temp. _____C pH: ___ Yes ___ No Comments: **Custody Seals Intact ___ Yes ___ No**

NOTE: Please indicate method number for analyses requested. This will help clarify any questions with laboratory techniques.

Figure SOP002-2 EA Toxicology Laboratory Chain-of-Custody Form

Client:	Project Manager: Phone: Project Contact: Phone:																														
Project Name: Project#:																															
Page 1 of 1																															
Sample Collected		Matrix		SAMPLE IDENTIFICATION	No. of Containers																											
Date	Time	Sediment	Water																												
Sampled by: (Signature)		Date/Time		Relinquished by: (Signature)																								Date/Time			
Relinquished by: (Signature)		Date/Time		Received by Laboratory: (Signature)																								Date/Time			

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Figure SOP002-3 EPA Scribe Chain-of-Custody Form

Page 1 of 1

USEPA
Lab Contact: John Smith
CarrierName: UPS
AirbillNo:
1Z2886820195095104

CHAIN OF CUSTODY RECORD
Site #: 47909
Contact Name: Michael Smith
Contact Phone: 800-332-0534

No: 5-112818-101859-0021
Cooler #: 13
Case #: 47909
Lab Phone: 800-660-1990

Lab #	Sample #	Location	Analyses	Matrix	Sample Date	Sample Time	Numb Cont	Container	Preservative	Lab QC
	HT18-01	HT18-01	MI 10 Metals + FE, NI 34PAHs, PCBs, TOC, Moisture	Sediment			1	8 oz amber	4 C	
	HT18-02	HT18-02	MI 10 Metals + FE, NI 34PAHs, PCBs, TOC, Moisture	Sediment			1	8 oz amber	4 C	
	HT18-03	HT18-03	MI 10 Metals + FE, NI 34PAHs, PCBs, TOC, Moisture	Sediment			1	8 oz amber	4 C	

Special Instructions:	**SAMPLES TRANSFERRED FROM CHAIN OF CUSTODY #**

Items/Reason	Relinquished by (Signature and Organization)	Date/Time	Received by (Signature and Organization)	Date/Time	Sample Condition Upon Receipt

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Standard Operating Procedure No. 009
for
Fieldwork during Times of High Risk for Wildfire

Prepared by

EA Engineering, Science, and Technology, Inc., PBC
225 Schilling Circle, Suite 400
Hunt Valley, Maryland 21031

Revision: 00
March 2022

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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. 009	
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	March 2022	New standard operating procedure	Catherine LeCours	Rob Marcase

1. BACKGROUND

1.1 PURPOSE AND SCOPE

This standard operating procedure (SOP) is intended to provide guidance for personnel conducting fieldwork when the risk for wildfires is high. It covers procedures prior, during, and following on-site activities to minimize hazards and maintain safety requirements.

The presence or imminent threat of wildfires present two distinct safety issues for fieldwork:

- Exposure to environmental or ambient smoke
- Harm to people or property (resulting in evacuation)

1.2 EXPOSURE TO ENVIRONMENTAL OR AMBIENT SMOKE

Smoke can irritate eyes and the respiratory system and worsen chronic heart and lung diseases. Older adults are more likely to be affected by smoke, possibly because they are more likely to have heart or lung diseases than younger people. If you have heart or lung disease, such as congestive heart failure, angina, chronic obstructive pulmonary disease, emphysema, or asthma, you are at higher risk of having health problems than healthy people (EPA 2019).

When smoke levels are high enough, even healthy individuals may experience some of the following symptoms:

- Coughing
- Scratchy throat
- Irritated sinuses
- Shortness of breath
- Chest pain
- Headaches
- Stinging eyes
- Runny nose
- Chest pain
- Rapid heartbeat
- Shortness of breath
- Fatigue

Smoke may worsen symptoms for those who have pre-existing respiratory conditions, such as respiratory allergies, asthma, and chronic obstructive pulmonary disease, in the following ways:

- Inability to breathe normally
- Cough with or without mucus
- Chest discomfort
- Wheezing and shortness of breath

1.3 HARM TO PEOPLE OR PROPERTY

Wildfires burn millions of acres in the United States each year, resulting in loss of life and property. Wildfires create their own atmospheric environment, do not adhere to roads or state boundaries, nor are they predictable. Detailed planning and proper execution of appropriate response actions are necessary to ensure the safe return of EA personnel from the fieldwork.

2. ROLES AND RESPONSIBILITIES

Clear lines of authority must be established to facilitate safe field practices during times of high risk for wildfires. The Project Manager shall designate the following roles in advance of each field event. Note that the Project Manager can also serve as the Site Logistics Coordinator, Office Coordinator, or neither.

2.1 PROJECT MANAGER

The ***Project Manager*** has the overall responsibility for executing a project as specified in the planning documents. The Project Manager is also responsible for making safe and well-informed decisions about the execution of fieldwork in the context of wildfire conditions. Prior to mobilization for fieldwork, a Project Manager will work with the Site Logistics Coordinator to ensure this SOP is followed and, if needed, postpone fieldwork if conditions warrant. The Project Manager, supported by the Office Coordinator, will also provide updates, as needed, regarding wildfire conditions to the client's point(s)-of-contact, the Director of Health and Safety, and EA's management.

2.2 SITE LOGISTICS COORDINATOR

The ***Site Logistics Coordinator*** is responsible for assessing pre-mobilization wildfire conditions (i.e., air quality, fires, fire conditions); coordination of on-site operations associated with wildfire safety; and, if needed, ensuring all on-site personnel have safely evacuated. **The Site Logistics Coordinator must be on-site during field activities.** In consultation with the Project Manager, the Site Logistics Coordinator will determine if mobilization or postponement for a field event shall occur. Once at the worksite, the Site Logistics Coordinator, supported by the Office Coordinator, will monitor worksite conditions (i.e., Air Quality Index, smoke, location and movement of wildfires, etc.) to determine if conditions remain safe for fieldwork or if modifications need to be made. The Site Logistics Coordinator must always have a line of communication with the Office Coordinator. If needed, the Site Logistics Coordinator has the authority to evacuate the field team. The Site Logistics Coordinator will notify the Project Manager of changing worksite conditions or evacuation.

2.3 OFFICE COORDINATOR

The ***Office Coordinator*** is responsible for continuously monitoring the parameters for safe field operations and must notify the Site Logistics Coordinator if conditions change. **The Office Coordinator must be off-site**, either at an EA office or home office with at least two sources for outside information (e.g., phone, internet, radio, television) and at least one reliable line of communication (e.g., cell phone, satellite phone, two-way radios) with the Site Logistics Coordinator during field activities. This off-site monitoring provides additional support to the field team that may be engrossed in work activities and unaware of changing fire conditions.

3. PROCEDURE

3.1 PRIOR TO MOBILIZATION AND FIELD ACTIVITIES

The Project Manager and Site Logistics Coordinator will determine on-site hazards that may be impacted by fires prior to fieldwork mobilization.

3.1.1 Daily Pre-Fieldwork Departure Form

Prior to mobilization and field activities, the Site Logistics Coordinator shall complete a Pre-Fieldwork Departure Form (Attachment A) each day for each project requiring fieldwork during times of high wildfire risk. The form first requires the Project Manager and Site Logistics Coordinator to evaluate the risk of fieldwork based on site-specific conditions. It also contains useful contact information in case of emergency, necessary equipment, and a guideline for an emergency procedure specific to the worksite.

3.1.2 Daily Fieldwork Health and Safety Evaluation

The Project Manager and Site Logistics Coordinator will use weather data, air monitoring data, environmental conditions, and general knowledge of the worksite to make an informed decision about potential risks to field team safety. Below are minimum data points and information that should be gathered and used when making daily Go/No-Go decisions:

- Air Quality Index (current and predicted)
- Wind direction at worksite (current and predicted)
- Active air monitoring data from the worksite (if available)
- Notable public health communications for air quality and safety
- Cellular service at the worksite

The Air Quality Index is an evaluation of multiple air quality parameters including ground-level ozone, particle pollution, carbon monoxide, sulfur dioxide, and nitrogen dioxide. In general, particle pollution and ozone serve as the best indicator of unhealthy ambient air quality during the fire season. Below is a table of the Air Quality Index basics for Ozone and Particle Pollution.

Air Quality Index Basics for Ozone and Particle Pollution			
Daily Air Quality Index Color	**Levels of Concern**	**Values of Index**	**Description of Air Quality**
Green	**Good**	**0–50**	**Air quality is satisfactory, and air pollution poses little or no risk.**
Yellow	**Moderate**	**51–100**	**Air quality is acceptable. However, there may be a risk for some people, particularly those who are unusually sensitive to air pollution.**
Orange	**Unhealthy for Sensitive Groups**	**101–150**	**Members of sensitive groups may experience health effects. The general public is less likely to be affected.**
Red	**Unhealthy**	**151–200**	**Some members of the general public may experience health effects; members of sensitive groups may experience more serious health effects.**
Purple	**Very Unhealthy**	**201–300**	**Health alert: The risk of health effects is increased for everyone.**
Maroon	**Hazardous**	**301 and higher**	**Health warning of emergency conditions: everyone is more likely to be affected.**

Fieldwork will be postponed when the Air Quality Index reaches 200. The Project Manager and Site Logistics Coordinator will seriously consider postponing fieldwork when the Air Quality Index is above 150. Employees that may be at increased risk are permitted to postpone fieldwork as needed.

In addition to the Air Quality Index, the status of active wildfires can be determined using the AirNow website, state and local news, and any available state-specific reporting sites. Some states also designate high risk zones for severe wildfires, which should be considered when evaluating the risk of fieldwork.

The Site Logistics Coordinator and Office Coordinator should use weather data and predictions to review wind direction. The Site Logistics Coordinator will postpone fieldwork if wildfires are within 5 miles of the worksite and wind direction is likely to spread toward the direction of the worksite or if wildfires are more than 5 miles away and wind and weather conditions could rapidly spread the fire near the worksite.

The following websites can also provide important information to help evaluate risk:

- https://www.airnow.gov/ – Data evaluation of current air quality and more detail on the Air Quality Index
- https://www2.purpleair.com/ – Additional air quality data from Purple Air
- https://gacc.nifc.org/explore/index.php – Fire information from the National Interagency Fire Center
- https://wildfirerisk.org/explore/2/06/ – A nation-wide map of relative wildfire risk from the U.S. Forest Service
- https://www.wrh.noaa.gove/fire2/cafw/ – Red flag warnings

3.1.3 Required Equipment

The Site Logistics Coordinator will ensure the following list of equipment is procured prior to mobilization and present for all fieldwork during high fire risk:

- Satellite telephone
- Hard copy area maps
- Anemometer (e.g., hand-held for windspeed and direction)
- Particulate respirators (e.g., N95)
- First aid kit with eye wash
- Emergency escape kit (water, flare gun, and road flares)
- Spare tire for each vehicle
- Jumper cables in each vehicle
- Fire extinguisher in each vehicle.

To help inform project management of the ongoing risk of wildfire spread during fieldwork, monitoring equipment should also be deployed to the worksite when local weather and Air Quality Index information is not available. Personal protective equipment may be donned as sudden changes in air quality occur or evacuation of the worksite becomes mandatory.

3.1.4 Worksite Best Practices Checklist

The field team shall ensure the following practices are implemented prior to and during field activities:

- Gas tanks in vehicles are more than half-full at the time of arrival on-site.
- Vehicles are not driven or parked in tall grasses.

- Fire extinguisher and other field equipment are kept in vehicles unless in use.
- Alternate routes to/from the worksite have been mapped and printed out.
- Cell phones are to be kept as close to fully charged as possible and team members have staff contact information pre-programmed into their phones in case of emergency.

The Site Logistics Coordinator may also choose to implement additional best practices as they see fit to increase safety and document such practices on the Pre-Fieldwork Departure Form.

3.1.5 Emergency Procedure Outline

This section of the Pre-Fieldwork Departure Form outlines general emergency evacuation procedures and provides fields for specific contacts and rendezvous points for the specific worksite. It is imperative that resources such as maps for evacuation and alternate evacuation routes and all sections of the Pre-Fieldwork Departure Form are printed and distributed to each field team member prior to fieldwork activities. The Site Logistics Coordinator will confirm each field team member has the necessary resources and those resources are also readily available on-site to ensure a safe evacuation if necessary.

The Site Logistics Coordinator and Project Manager will designate rendezvous points, evacuation routes, alternate evacuation routes, and evacuation locations. Alternate routes are necessary in case a fire or emergency response blocks one or more routes to and from the worksite.

3.2 ON-SITE PROCEDURES

The field team members, including the Site Logistics Coordinator, shall follow guidance from community, local, and state authorities. The factors affecting wildfire spread can vary greatly between worksites. If an evacuation order is issued, even if a wildfire is not in the immediate vicinity of the worksite, the order must be followed.

Once on-site, field team members will confirm the appropriateness of the best practices designated in the Pre-Fieldwork Departure Form. Most important, the field team members will assess cellular reception and the field team's ability to communicate between themselves and the off-site Office Coordinator. The field team members may identify new risks that were not stated in the Pre-Fieldwork Departure Forms or Health and Safety Plans. All field team members will follow the best practices designated in the Pre-Fieldwork Departure Form, as modified if appropriate.

3.2.1 Worksite Fires

Should a fire be observed on-site that is extinguishable, field team members should immediately use a fire extinguisher and secure the area. If the fire is unable to be extinguished, the field team,

directed by the Site Logistics Coordinator, will evacuate, contact local emergency responders (e.g., call 911), and report the incident to the Project Manager and Office Coordinator.

3.2.2 Active Wildfires

If there is an active fire nearby, the Site Logistics Coordinator will remain in contact with the Office Coordinator to ensure continuous monitoring of wind conditions and wildfire locations. If available, the Site Logistics Coordinator will deploy active monitoring equipment at the worksite, monitor the equipment at least twice per hour, and communicate important data with the Project Manager to inform decisions as conditions change.

If a red flag warning is issued at any point during fieldwork, all activities must stop, and the worksite conditions assessed. Any spark-producing equipment should be shut off and nearby combustible materials checked for small fires.

3.2.3 Situations Altering General Procedures

The air quality at a worksite may worsen as a nearby wildfire travels closer or if wind carries more pollutants toward the worksite. If Air Quality Index values exceed 200, the Site Logistics Coordinator will postpone fieldwork. If the Air Quality Index reaches or exceeds 150, the Project Manager and Site Logistics Coordinator will consider postponing or limiting strenuous work. Field members who are at increased risk will be permitted to postpone work.

In some cases, a wildfire may spread into an area closer to the worksite than anticipated for during planning. The Project Manager and the Site Logistics Coordinator will be prepared for any of the following scenarios and have the field team evacuated if necessary. The field team, led by the Site Logistics Coordinator, shall follow the emergency procedures outlined in the Pre-Fieldwork Departure Form in each scenario unless otherwise advised.

3.2.3.1 Scenario 1 – Wildfire Spreads within 5-Mile Radius of Site

If the Office Coordinator identifies or a field team member notices a fire rapidly encroaching on the worksite or within a 5-mile radius, the field team must gather their equipment and evacuate the worksite as quickly as possible. Hard copy maps with alternate evacuation routes may need to be consulted. The Site Logistics Coordinator will notify the Office Coordinator and Project Manager. The Project Manager will then notify the client's point(s)-of-contact of the evacuation and work postponement.

3.2.3.2 Scenario 2 – Wildfire Burning Outside 5-Mile Radius but within 10-Mile Radius Experiences a Change in Wind Direction Toward the Worksite

If a wildfire within a 10-mile radius of the worksite experiences a change in wind direction towards the worksite, a spread into the 5-mile radius becomes more likely. Even if the fire does not spread within 5 miles, poor air quality may impact the worksite. In this scenario, the Site Logistics Coordinator will increase frequency of Air Quality Index and fire condition monitoring

to every 15 minutes to determine if work should be postponed or evacuation is necessary. The Site Logistics Coordinator will notify the Project Manager of any significant changes in air quality or other conditions that may require procedure adjustments or potential evacuation of the worksite.

At no point during monitoring should any field team member's life be put in danger to investigate the fire. If the Site Logistics Coordinator is unable to determine the direction of the fire or smoke, the field team will immediately prepare for evacuation.

3.2.3.3 Scenario 3 – Fire Starts On-Site due to Spark or Embers from a Wildfire

If a fire breaks out on-site that was not caused by field activities and cannot be immediately extinguished, field team members will safely gather at a pre-designated meeting point and evacuate the worksite. If the fire on-site was started by an ember, it is likely that a larger wildfire is nearby, and alternate evacuation routes may be necessary. After safely evacuating the area, the Site Logistics Coordinator will notify local emergency responders of the situation. The Site Logistics Coordinator will then notify the Office Coordinator and Project Manager, who will in turn notify the client's point(s)-of-contact of the situation.

3.3 EVACUATION PROCEDURES

If evacuation from the worksite is necessary, field team members will meet at the arranged emergency rendezvous point designated in the Pre-Fieldwork Departure Form. Once at this location, the Site Logistics Coordinator will take a head count and ensure the full team is present prior to evacuation. While the team gathers and prepares to evacuate, the Site Logistics Coordinator will notify the local emergency responders, the Project Manager, and the Office Coordinator. The Project Manager will then notify the client's point(s)-of-contact of the evacuation.

The Site Logistics Coordinator will designate an evacuation location and document the location in the Pre-Fieldwork Departure Form. The team may be separated due to the use of multiple vehicles or alternate driving routes. Therefore, it is important that the address of the evacuation location is outlined in the Pre-Fieldwork Departure Form and distributed to every field team member prior to the start of field activities.

Once all team members arrive at the evacuation location, the dismissal of the team members is at the discretion of the Project Manager, Site Logistics Coordinator, and any emergency authorities that may need to investigate the incident.

4. REFERENCES

U.S. Environmental Protection Agency (EPA). 2019. Wildfire Smoke: A Guide for Public Health Officials.

Attachment A

Pre-Fieldwork Departure Form

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ATTACHMENT A – PRE-FIELDWORK DEPARTURE FORM

PRE-FIELDWORK DEPARTURE FORM			
Background Information			
Project Name (Project Number)			
Site Address or Work Location Description			
Date(s) of Proposed Fieldwork			
Fieldwork Health and Safety Evaluation Questions	**Yes**	**No**	**Comments**
Are there any wildfires present within 5 miles of the worksite?			
If yes, how far?			
What is the wind direction at the worksite?			
What is the wind direction at nearest wildfire?			
Is the spread of wildfire into the worksite and immediate area likely?			
What is the Air Quality Index at the worksite?			
Are there any notable public health communications for air quality and/or safety specific to the worksite?			
If yes, what is the source and what do they say?			
Is cellular service adequate for communication with both on-site and off-site contacts?			
If no, what is the alternative method of communication with **on-site** contacts?			
If no, what is the alternative method of communication with **off-site** contacts?			
Have alternate routes to/from the worksite been mapped out and printed?			
Has fieldwork at the worksite been deemed safe and approved by a responsible individual today?			

PRE-FIELDWORK DEPARTURE FORM	
Contacts	**Name and Phone Number, mobile preferred (XXX-XXX-XXXX)**
EA Project Manager	
EA Site Logistics Coordinator (has to be on-site)	
EA Office Coordinator (has to be off-site)	
Local Fire Department	
Local Fire Protection District (if applicable)	
Client's Point(s)-of-Contact	
Field Staff Members (identify all personnel to be on-site: EA, subcontractors, or otherwise)	

PRE-FIELDWORK DEPARTURE FORM			
Equipment Checklist	**Yes**	**No**	**Comment**
Satellite Telephone			
Hard Copy Area Maps			
Anemometer			
Particulate Respirator			
First Aid Kit with Eye Wash			
Emergency Escape Kit (containing water, flare gun, road flares)			
Spare Tire in Vehicle			
Jumper Cables			
Fire Extinguisher (kept in vehicle)			
Worksite Best Practices Checklist	**Yes**	**No**	**Comment**
Are the gas tanks in vehicles more than half-full at the time of arrival on-site?			
Are there places to drive or park vehicles that are not in tall grasses?			
Are the fire extinguishers and other field equipment kept in vehicles unless in use?			
Have alternate routes to/from the worksite been mapped out and printed?			
If deemed appropriate for use at the worksite, are the cell phones kept as close to fully charged as possible and contacts pre-programmed in staff phones in case of emergency?			
Project Manager Name (Printed)			
Project Manager Signature and Date			

PRE-FIELDWORK DEPARTURE FORM	
Emergency Procedure Outline	
If the emergency is a fire, be prepared to communicate the following information:	● What is the situation? ● Has the worksite been impacted or is it threatened? ● What are potential risks if the worksite is impacted (i.e., infrastructure, release of contaminants, loss of equipment, etc.)? ● What are sensitive areas to avoid or risks to first responders? ● Who needs this information? ● What is the communication strategy (i.e., external/internal)? ● How and when should updates be communicated?
In the case of an uncontrollable fire on the site, the Site Logistics Coordinator will begin evacuation procedures.	
The Site Logistics Coordinator will notify the entire field team and have them immediately gather at the designated rendezvous location prior to evacuation.	Rendezvous Point Name: Address:
The Site Logistics Coordinator will ensure that every member of the field team is present or otherwise accounted for prior to fully evacuating the worksite.	Total Number of Field Workers: Workers Present at Evacuation:
The Site Logistics Coordinator will notify the local emergency responders, Project Manager, and Office Coordinator. This notification will include details of any injured or missing persons if appropriate. The Project Manager will notify the client's point(s)-of-contact.	Local Emergency Responder: Project Manager: Office Coordinator:
Depending on the situation, an alternate evacuation route may be needed. The field teams will consult hard copy maps outlining such routes if needed.	
All team members and vehicles will reconvene at the evacuation location.	Evacuation Location Name: Address:
Once all team members arrive at the evacuation location, the dismissal of the team members is at the discretion of the Project Manager, Site Logistics Coordinator, and any emergency authorities that may need to investigate the incident	

Standard Operating Procedure No. 043
for Multi-Probe Water
Quality Monitoring Instruments

Prepared by

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Hunt Valley, Maryland 21031

Revision No. 2
June 2020

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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. 043	
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**
2	June 2020	Systematic review and update. Combined with previously separate SOPs for pH, temperature, specific conductivity, turbidity, dissolved oxygen, and redox potential.	Eddie Meadows Catherine Maxwell	Matthew Bowman

1. PURPOSE AND SCOPE

The purpose of this Standard Operating Procedure (SOP) is to delineate protocols for field operation of multi-probe water quality instruments. The instrument can monitor a variety of basic parameters including dissolved oxygen, percent saturation, temperature, pH, conductivity, specific conductivity, resistivity, salinity, total dissolved solids, turbidity, oxidation reduction potential (ORP), level, and depth.

The use of brand names in this SOP is not intended as endorsement or mandate that a given brand be used. Alternate equivalent brands of detectors, sensors, meters, etc. are acceptable. If alternate equipment is to be used, the vendor must provide applicable and comparable SOPs for the maintenance and calibration from the specific manufacturer of the instrument being used.

2. MATERIALS

The following materials may be required:

- Multi-probe instrument
- Probe/sonde with appropriate cables
- Appropriate standards/calibration fluids
- Accessories (batteries, charger, case, etc.)
- Decontamination materials or laboratory wipes
- Deionized water and distilled water (as needed for calibration and decontamination)
- Instrument logbook
- Manufacturer's Operations Manual.

3. CALIBRATION PROCEDURE

Calibration must be performed or verified daily at a minimum before using the instrument. Calibration may be performed in the laboratory or in the field. Detailed step-by-step calibration procedures for the equipment described below are provided in the most recent version of the manufacturer's Operations Manual. Documentation includes at a minimum: time, date, analyst, standard, primary standard/calibration fluid lot number, secondary standard/calibration fluid lot number, and expiration dates of standards/calibration fluids. An example calibration log is provided in Attachment A.

Fill the calibration cup with the appropriate standard as follows:

- Temperature: None required
- Specific Conductance: Conductivity standards
- pH: pH 7 buffer plus pH 4 and/or pH 10 buffer
- Dissolved Oxygen: Saturated air or saturated water
- ORP: Quinhydrone (Zobell's Solution) or other standard

- Turbidity: Nephelometric turbidity unit (NTU) standards
- Salinity: Calibration for specific conductance
- Depth/Level: Set zero in air.

3.1 CONDUCTIVITY CALIBRATION

Conductivity meters are calibrated at least once per day to at least one standard. The standard should be selected in accordance with the range expected to be measured (e.g., 1.0 microSiemans per centimeter [µS/cm]) standard should not be used to calibrate meters being used in saltwater). See manufacturer's recommendations in the Operations Manual for additional information on calibration standard selection. Calibration information is recorded in conjunction with the data collected for that sampling event.

3.2 PH CALIBRATION

The pH meters are calibrated at least once per day to a minimum of two standard buffers (pH 4 and 7, or pH 7 and 10) in accordance with the range expected to be measured. The calibration is verified using a fresh solution of pH 7 buffer post-calibration. The probe should be rinsed in distilled water between standards. Calibration information is recorded in conjunction with the data collected for that sampling event.

3.3 DISSOLVED OXYGEN CALIBRATION

Dissolved oxygen meters are saturated-air or saturated-water calibrated at least once per day. Each method requires the true barometric pressure to be input or collected from the instrument prior to calibration.

- ***Saturated Air Method***—Dip the calibration chamber (i.e., probe storage cup) into distilled or tap water at ambient temperature, pour out excess water, and then insert dissolved oxygen probe into the wet chamber. This ensures that the air inside the chamber is saturated with water vapor. CAUTION: Be sure that the membrane/probe has no droplets of water adhering to it since this would reduce the rate of oxygen diffusion through the membrane and would produce erroneous results. Do not fully thread the probe storage cup on the probe during equilibration.

- ***Saturated Water Method***—To make a 100 percent (%) air-saturated calibration standard, fill a container (e.g., a 1-liter or 1-gallon container with a closed top) three-quarters full with distilled water or clean (conductivity of less than 500 µS/cm) tap water. Let the water temperature reach equilibrium with the calibration environment. Then shake the container vigorously for approximately 30 seconds. This makes 100% air-saturated water. Place the air-saturated water into the probe storage cup and allow to equilibrate. Do not fully thread the probe storage cup on the probe during equilibration.

Calibration information is recorded in conjunction with the data collected for that sampling event.

3.4 OXIDATION REDUCTION POTENTIAL CALIBRATION

ORP meters are calibrated at least once per day to at least one standard. It is recommended that Zobell's Solution is used; however, another solution can be used as long as it meets the manufacturer's specifications for calibration. Note that the standard value for Zobell's Solution is dependent on temperature. Calibration information is recorded in conjunction with the data collected for that sampling event.

3.5 TURBIDITY CALIBRATION

The turbidity meters are calibrated at least once per day to a minimum of two standards (0 NTU and 100 or 200 NTUs recommended) in accordance with the range expected to be measured. Calibration information is recorded in conjunction with the data collected for that sampling event.

3.6 DEPTH/LEVEL CALIBRATION

The depth and level calibration is performed with the depth sensor module in the air and not immersed in any solution. The appropriate correction for height above the water surface is inputted into the meter. Calibration information is recorded in conjunction with the data collected for that sampling event.

3.7 ADDITIONAL CALIBRATIONS

Additional measurements may be taken with the multi-probe water quality instruments. For any of these measurements, the calibration procedures will be conducted in accordance with the manufacturer's specifications. Calibration information is recorded in conjunction with the data collected for that sampling event.

4. FIELD OPERATION

4.1 SETUP OF MULTI-PROBE WATER QUALITY INSTRUMENT

Post-calibration and prior to sampling, the multi-probe water quality instrument should be inspected, cleaned, and set up for data collection. If the cables have been unattached, they will be reconnected to the transmitter (if applicable) and the display. Once all cables are attached, the meter will be turned on and allowed to warm up for a few seconds in order to allow the display screen to load. The unit should be allowed to come to ambient air temperature if it has been stored in a hotter or colder environment prior to use.

4.2 SURFACE WATER

Prior to sampling, check the condition of the probes before each deployment. When sampling in surface water, the sensor must be in an amount of water sufficient for all probes to be submerged. Data values displayed on the display screen are recorded in a field logbook, a dedicated project field form (i.e., an EA Purging and Sampling Record, or on an EA-provided iPad on an approved GoFormz), and accepted into the instrument's data logger (if used). Post-data collection, the sensor will be retrieved and rinsed for use at the next sample location. If travel time between sample locations is significant, the display is to be turned off. When all sampling is completed, disconnect all equipment, clean probes and the instrument in accordance with the manufacturer's instructions, attach a solid protective cap, and return it to its proper storage location.

4.3 GROUNDWATER

Prior to sampling, check the condition of the probes before each deployment. When sampling groundwater, mount sampler on a flow-through cell. Start sampler pump and allow pump/hose system to be purged of air bubbles. Required parameters should be recorded every 3-5 minutes (unless otherwise specified in the sampling plan). Record the monitored values in the appropriate field logbook, on a dedicated project field form (i.e., an EA Purging and Sampling Record, or on an EA provided iPad on an approved GoFormz) to ensure against inadvertent data loss. If travel time between sample locations is significant, the display is to be turned off. When all sampling is completed, disconnect all equipment, clean probes and the instrument in accordance with the manufacturer's instruction, remove flow-through cell and attach solid protective cap, and return it to its proper storage location. If a flow-through cell cannot be used (e.g., groundwater sampling using a bailer), bailed water should be poured into a clean container for collecting readings over standard intervals of volume purged or time.

5. MAINTENANCE

All maintenance should be performed in accordance with the manufacturer's Operations Manual.

6. PRECAUTIONS

Check the condition of the probes frequently between sampling. Do not force pins into connections; note keying sequence. If field readings are outside the expected range, check for bubbles on, or damage to, the probes. If there are no bubbles or damage, recalibrate the sensor.

7. REFERENCES

Not applicable.

Attachment A

Equipment Calibration Log

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ATTACHMENT A

EQUIPMENT CALIBRATION LOG

Site Name:		**Client:**		
Job Number:		**Calibration Performed by:**		Page _____ of _____

Date and Time	Instrument Name	Instrument Make and Model	Instrument Serial Number	Standard Value	Calibrated Value	Percent Deviation	Bump Check (if applicable)	Standard/ Calibration Fluid Lot Number and Expiration Date	Comments or Adjustments Made

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Standard Operating Procedure No. 052
for
Bear Safety for Fieldwork Occurring in Bear Habitats

Prepared by

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Revision: 00
January 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. 052	
SOP Section	**Variance**

Project Manager (Name)

Project Manager (Signature) Date

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ATTACHMENT A: BEAR RISK AND HAZARD CONTROL PROPOSAL CONSIDERATIONS SUMMARY AND PRE-FIELDWORK DEPARTURE FORM
ATTACHMENT B: BEAR RECOGNITION AND REACTION FIELD GUIDE

DOCUMENT REVISION HISTORY

ORIGINAL (MASTER) DOCUMENT REVISION HISTORY				
Revision Number	**Revision Date**	**Revision Summary**	**Revised By**	**Reviewed By**
00	January 2023	New standard operating procedure	Mark Fisher Ashton Alban	Rob Marcase Frank Barranco

1. BACKGROUND

1.1 PURPOSE AND SCOPE

This standard operating procedure (SOP) is intended to provide Business Unit Directors (BUDs) and Project Managers (PMs) with the guidance necessary to prepare and equip field teams to protect themselves from bears when traveling through and working in areas that bears live.

Avoidance is key to protecting field team members from bears; however, where bears are unavoidable, field team preparation is necessary. Field team preparation will focus on equipment and training requirements that establish procedures to identify bears from a distance, maintain safe distances, deter bears, safely store food and garbage, and respond to attacking bears. BUDs and PMs shall assure field team members are prepared and equipped prior to being deployed to the field by identifying and mitigating risk of bear attacks as established in the risk matrix and Pre-Fieldwork Departure Form provided in Attachment A. Field team preparation and equipment must include the following:

- Wilderness Exploration Training:
  - Provided by a qualified wilderness exploration professional with experience instructing on wilderness safety measures, including bear safety in the region where fieldwork is being performed.
  - Includes time and instruction necessary for field team members to become proficient at using provided equipment.
  - Includes the time and instruction necessary for field team members to learn how to set up bear-resistant camps.
- Equipment/Services
  - Ground transportation capable of getting the team as close to the work site as possible. Ground transportation must be capable of providing shelter from bear attacks. Depending on the location of the work site, air transportation may be necessary.
  - Communication equipment capable of functioning in the region and able to request support or rescue 24/7.
  - Spotting scopes or binoculars.
  - Establish and staff a field-operations base to support field teams.
  - Bear-repelling noise makers.

- Capsaicin-based bear spray

- Professional guides with experience in the region where fieldwork is occurring.

2. ROLES AND RESPONSIBILITIES

Clear lines of authority must be established to facilitate safe field practices while working in areas that have bears. The PM shall designate the following roles in advance of each field event. Note that the PM can also serve as the Site Logistics Coordinator (SLC), Office Coordinator, or neither.

2.1 PROJECT MANAGER

The PM has the overall responsibility for executing a project as specified in the planning documents located in Attachment A. The PM is also responsible for making safe and well-informed decisions about the execution of fieldwork in areas where bears exist. Prior to mobilization for fieldwork, a PM with the SLC will utilize the risk categorization and mitigation resources in Attachment A to ensure this SOP is followed; field team members have been properly trained; and, if needed, professional bear and wildlife protection services are available for field teams. The PM will perform the following tasks to assure field teams are properly informed of bear hazards and know how to properly respond to bear sightings and encounters. In order to understand the potential area threat, the PM should do the following:

- Determine level of risk using the risk matrix (Attachment A) and completing the following actions:

  - Interview fish and game protection officers local to the work being performed to determine the type of bear and the level of bear activity.

  - Determine if field crews will be able to drive to and park at work locations and conveniently use vehicles for shelter.

  - Evaluate field crew bear and wildlife protection experience and arrange an appropriate amount of training for them before going into the field.

2.2 SITE LOGISTICS COORDINATOR

The SLC will ensure that field teams are properly staffed, and members are properly trained in bear and wildlife safety prior to mobilization. When necessary, the SLC will ensure that professional bear and wildlife protection services are available to guide field teams.

3. TRAINING

Field team members need to recognize attack behaviors and respond with the appropriate defense as shown in the Bear Recognition and Reaction Field Guide provided in Attachment B. All field team members will be trained in bear safety prior to going into the field. The level and type of training that field team members must receive is based on the risk categorization (determined using the risk matrix in Attachment A). The following training is required based on the associated fieldwork risk categorization:

- **High Risk:** One day hands-on bear safety training with bear spray deployment
  - *Frequency:* Yearly with a 2-hour SLC provided refresher within 1 day of fieldwork
- **Medium Risk:** Virtual bear safety training with hands on bear spray deployment training
  - *Frequency:* Yearly with a 2-hour SLC provided refresher within 1 day of fieldwork
- **Low Risk:** Virtual bear awareness training with hands on bear spray deployment
  - *Frequency:* Yearly with a 2-hour SLC provided refresher within 1 day of fieldwork
- **Limited Risk:** Virtual bear awareness training
  - *Frequency:* Yearly with a 2-hour SLC provided refresher within 1 day of fieldwork

The following is a generalized model for field team training, staffing, and preparation that, at a minimum, must be included in training and covered by the SLC provided refresher:

1. Training will teach the team members:
   a. Identification of bears and how to best visualize them from a distance
   b. How to make appropriate sounds and noises to drive bears away
   c. Identification of physical signs indicating that bears may be in the immediate vicinity
   d. Identification of curious bears' behavior and how best to avoid them
   e. Identification of defensive and attacking bears' behavior and how best to walk away or defend in the case of attack
   f. Safe and proper deployment of bear spray

Bear safety training (virtual and hands-on) will be provided by professional wilderness guides with bear and wildlife protection service experience respective to the region where fieldwork is conducted.

4. STAFFING

Field teams will be staffed to maximize awareness of bears in the area and escape dangerous situations. The following staffing models are minimally acceptable; however, locations with increased likelihood of encountering bears, especially sow bears with cubs, should be considered by the PM as a high-risk situation that might require additional personnel.

Field teams will consist of a minimum of two team members. One member will always be observing the area for bears. In the case where both members of the team are simultaneously engaged in work activities, a third member is required on the team. The third member will be the full-time bear look-out.

Teams required to hike and work in known high risk bear areas will be guided by a professional bear safety officer who will stand guard over working team members for the duration of time in the area. If the bear safety officer chooses to carry a firearm, they will be trained, certified, and permitted by local authorities to use the firearm in self-defense from bears.

5. PROCEDURE

5.1 PRIOR TO MOBILIZATION AND FIELD ACTIVITIES

The PM and SLC will assess the potential for field teams to encounter bears while performing fieldwork by using, at a minimum, the risk categorization matrix located in Attachment A.

5.1.1 Daily Pre-Fieldwork Departure Form

If a risk to bear encounters exists, the SLC shall complete a Pre-Fieldwork Departure Form (Attachment A) each day prior to mobilization and field activities. The form first requires the PM and SLC to evaluate the risk of fieldwork based on site-specific conditions using the risk categorization matrix located in Attachment A. It also contains useful contact information in case of emergency, necessary equipment, and a guideline for an emergency procedure specific to the worksite.

5.1.2 Daily Fieldwork Health and Safety Evaluation

The PM and SLC will use general knowledge of the area to make an informed decision about potential risks to field team safety. Below are decision points for field team staffing and bear and wildlife guard services:

- Notable recent local communications about bear encounters causing injury or death
- Hiking distances away from vehicles and safe shelter
- Regional map indication of bear habitats
- Known activity of bears where sampling is to occur
- Cellular or satellite service at the worksite
- Ability to have one worker observe the area while the other works

The PM and SLC will use the collected information to determine the risk based on the matrix in Attachment A.

In order to determine the frequency of encounters, the PM and SLC will:

- Determine the history of attacks in the area
- Determine the number of reported sighting of bears in the area

To determine the severity of encounter, the PM and SLC will consider the following:

- Fieldwork site location features that attribute to or prevent risk of bear attacks
- Barriers or perimeters that maintain distance between bear and workers

The following websites can also provide important information to help evaluate risk:

- https://keepbearswild.org/bear-tracker/ – Keep Bears Wild, Bear Tracker
- https://www.fws.gov/ – U.S. Fish and Wildlife Service
- Local news outlets

5.1.3 Required Equipment and Services

Once risk is determined using the matrix located in Attachment A, the PM and SLC will ensure the team training, preparation, and support service requirements provided in Table 1 below are fulfilled prior to site work.

Table 1. Field Team Requirement Checklist

	Training	Team Composition	Equipment	Professional Guard Service
Limited Risk	General bear awareness training	Minimum 2-person team as long as 1 can do the work and the other watch for bears. Otherwise, a 3-person team is required and 1 of the 3 must be on full-time bear watch.	Communication equipment (i.e., satellite and/or cell phone with service) Hardtop vehicles that provide shelter	Not required
Low	Virtual bear awareness training Hands-on bear spray deployment training with proven competency	Minimum 2-person team if 1 can do the work and the other watch for bears. Otherwise, a 3-person team is required and 1 of the 3 must be on full-time bear watch.	Communication equipment (i.e., satellite and/or cell phone with service) Binoculars Bear spray per person Hardtop vehicles that provide shelter	Not required
Medium	Hands-on bear awareness training Hands-on bear spray deployment training with proven competency	Minimum 3-person team with 1 person always watching for bears.	Communication equipment (i.e., satellite and/or cell phone with service) Binoculars Bear spray per person Hardtop vehicles that provide shelter	Not required
High	Every team member must receive and show competency in hands-on bear training that includes avoidance methods, bear spray deployment, safe camp setup, and communication equipment usage	Minimum 3-person team including 1 professional guide	Satellite phone Binoculars Bear spray per team member Battery and/or electric powered fencing	Required

In limited, low, medium, and high risk, all team members that will be on-site are required to complete training. In all risk situations, the field team is required to ensure they will have the following equipment:

- Bear spray
- Binoculars
- Satellite or cellular phone

In limited and low-risk situations, teams must include at least two people, where one always remains on the lookout. Medium-risk situations require at least three people with one always observing the surroundings.

Professional guard services are required for any situation that is deemed "high risk."

Additional equipment, at minimum, should be procured prior to mobilization and present for all fieldwork occurring under the precautions of the SOP:

- A vehicle that can safely traverse the terrain and carry field team personnel as close to sampling sites as possible
- First aid kit with eye wash
- Emergency escape kit (water, flare gun, and road flares)
- Spare tire for each vehicle
- Jumper cables in each vehicle
- Fire extinguisher in each vehicle

5.1.4 Worksite Best Practices Checklist

The field team shall ensure the following practices are implemented prior to and during field activities:

- Required equipment remains on personnel in the field while on-site.
- Gas tanks in vehicles are more than half-full at the time of arrival on-site.
- Fire extinguisher and other field equipment are kept in vehicles unless in use.
- Alternate routes to/from the worksite have been mapped and printed out.
- Cell phones are to be kept as close to fully charged as possible and team members have staff contact information pre-programmed into their phones in case of emergency.

The SLC may also choose to implement additional best practices as they see fit to increase safety and document such practices on the Pre-Fieldwork Departure Form (Attachment A).

5.1.5 Emergency Procedure Outline

This section of the Pre-Fieldwork Departure Form (Attachment A) should be filled out to include the established general emergency procedures and specific contacts for the worksite. It is imperative that resources such as maps, first aid, and all sections of the Pre-Fieldwork Departure Form (Attachment A) are printed and distributed to each field team member prior to fieldwork activities. The SLC will confirm each field team member has the necessary training and resources readily available on-site to ensure a safe bear encounter if necessary.

5.2 ON-SITE PROCEDURES

Field team members will implement what they learned from their bear and wildlife training during fieldwork and in the case they encounter a bear. All members should be aware of their surroundings and the designated person to observe surroundings must always be on the look-out for bear. Every team member should always maintain their supplies on their bodies while on-site.

When a professional bear safety officer is determined to be necessary, they are responsible for bear avoidance and defense coordination.

6. REFERENCES

Not applicable.

Attachment A

Bear Risk and Hazard Control Proposal Considerations Summary and Pre-Fieldwork Departure Form

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ATTACHMENT A
BEAR RISK AND HAZARD CONTROL PROPOSAL CONSIDERATIONS SUMMARY

The Project Managers (PMs) and Site Logistics Coordinators (SLCs) must evaluate the safety risks on projects where bears may be encountered by the field team. After assessing risk, PMs must propose risk control methods in the project-associated safety plans and client proposals. This attachment defines high, medium, low, and limited risks situations when working in areas where bears exist. The attachment provides the associated mitigation procedures that must be included in client proposals and safety plans, and implemented in the field.

Risk Situation Definitions

High

- Bears are known to be in areas that field teams have to traverse and work in.
  - The presence of bears must have been recently seen or verified to be present by fish and game officials.
- Communication to home base is intermittent or nonexistent.
- There is no shelter that will withstand a bear attack near the field team.
  - When pickup trucks and sports utility vehicles with hardtop passenger cabins cannot be used to travel to work locations and the field teams must hike or use all-terrain vehicles or utility-terrain vehicles to get people and equipment to the work location.
- It is not possible to travel to, perform work, and return to home base is 1 work day and overnight camping is required.

Medium

- Bears have been seen in the area or their presence has been verified by fish and game officials.
- Communication with home base is not interrupted.

- Vehicles used to travel to the work area can provide shelter from a bear attack.
- The team will travel to the jobsite to perform the work and return to home base in the same workday (no overnight camping).

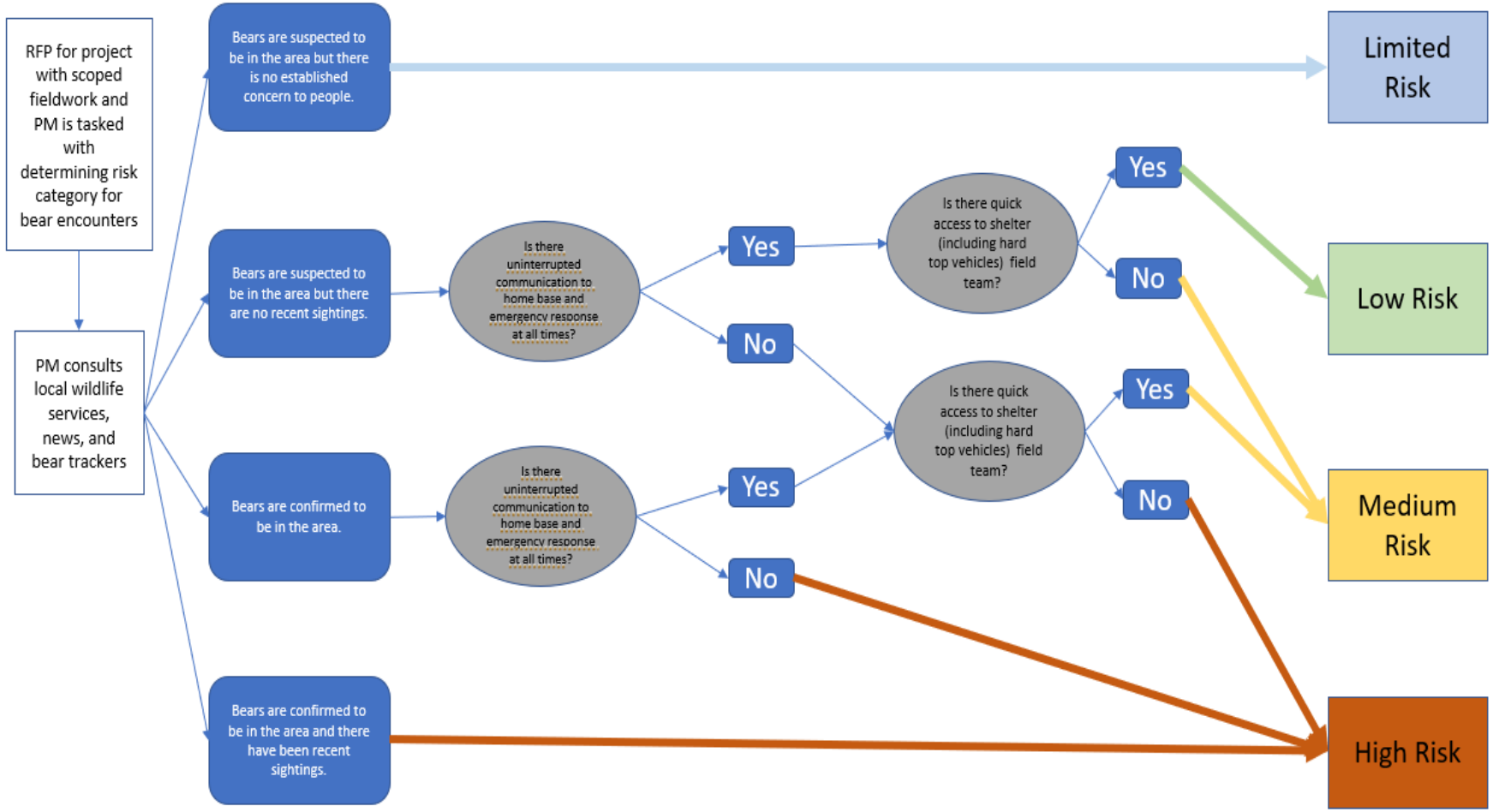
Low

- The presence of bears is suspected due to what is known about the area where the work is to be performed.
- Suspect areas may provide food or shelter preferred by bears during some seasons of the year but bears have not been seen recently.
- Communication with home base is not interrupted.
- Vehicles used to travel to the work can be used for shelter from a bear attack.
- Teams can travel to perform work and return to home base is one day. No overnight camping.

Limited

- Areas are conducive to black bear habitats; however, the best advice from fish and game officials is that bears are not threatening in the area.
- Communication with home base is not interrupted.
- Vehicles used to travel to the worksite can be used for shelter from bear attack
- Teams can travel to perform work and return to home base in 1 day. No overnight camping.

Risk Situation Determination Graphic



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PRE-FIELDWORK DEPARTURE FORM			
Background Information			
Project Name (Project Number)			
Site Address or Work Location Description			
Date(s) of Proposed Fieldwork			
Fieldwork Health and Safety Evaluation Questions	**Yes**	**No**	**Comments**
Are bears suspected to be in area where fieldwork is conducted?			
If yes, how far?			
Is there uninterrupted communication to home base and emergency response?			
If no, what is the alternative method of communication with **on-site** contacts?			
Are there any notable public health communications for air quality and/or safety specific to the worksite?			
If yes, what is the source and what do they say?			
Is there quick access to shelter (including hardtop vehicles) field team?			
If no, what is the alternative method of shelter that is established **on-site**?			
Is there planned overnight camping?			
Has fieldwork at the worksite been deemed safe and approved by a responsible individual today?			
Contacts	**Name and Phone Number, mobile preferred (XXX-XXX-XXXX)**		
EA Project Manager			
EA Site Logistics Coordinator (has to be on-site)			
EA Office Coordinator (has to be off-site)			

PRE-FIELDWORK DEPARTURE FORM	
Local Rescue Department	
Local Wildlife Services Department	
Client's Point(s)-of-Contact	
Field Staff Members (identify all personnel to be on-site: EA, subcontractors, or otherwise)	

PRE-FIELDWORK DEPARTURE FORM			
Equipment Checklist	**Yes**	**No**	**Comment**
Satellite Telephone			
Hard Copy Area Maps			
Binoculars			
Electric Fence			
Trained Bear Guard			
Bear Spray			
First Aid Kit with Eye Wash			
Emergency Escape Kit (containing water, flare gun, road flares)			
Spare Tire in Vehicle			
Jumper Cables			
Fire Extinguisher (kept in vehicle)			
Worksite Best Practices Checklist	**Yes**	**No**	**Comment**
Do all field team members understand their job while on-site including who is the established bear watch guard?			
Does each member have bear spray on their person throughout the work event?			
Are the fire extinguishers and other field equipment kept in vehicles unless in use?			
Have alternate routes to/from the worksite been mapped out and printed?			
If deemed appropriate for use at the worksite, are the cell phones kept as close to fully charged as possible and contacts pre-programmed in staff phones in case of emergency?			
Project Manager Name (Printed)			
Project Manager Signature and Date			

PRE-FIELDWORK DEPARTURE FORM	
Emergency Procedure Outline	
If the emergency is a bear attack, be prepared to communicate the following information:	● What is the situation? ● Who at the worksite has been impacted or is threatened? ● What is the condition of attacked person? ● What is the exact location of the bear or attack? ● Who needs this information? ● What is the communication strategy (i.e., external/internal)? ● How and when should updates be communicated?
In the case of a bear sighting on the site, the Site Logistics Coordinator will begin evacuation procedures.	
The Site Logistics Coordinator will notify the entire field team and have them immediately gather in the designated shelter.	Shelter:
The Site Logistics Coordinator will ensure that every member of the field team is present or otherwise accounted for prior to fully evacuating the worksite.	Total Number of Field Workers: Workers Present at Evacuation:
The Site Logistics Coordinator will notify the local emergency responders, Project Manager, and Office Coordinator. This notification will include details of any injured or missing persons if appropriate. The Project Manager will notify the client's point(s)-of-contact.	Local Emergency Responder: Project Manager: Office Coordinator:
Once all team members arrive at the office location, the dismissal of the team members is at the discretion of the Project Manager, Site Logistics Coordinator, and any emergency authorities that may need to investigate the incident	

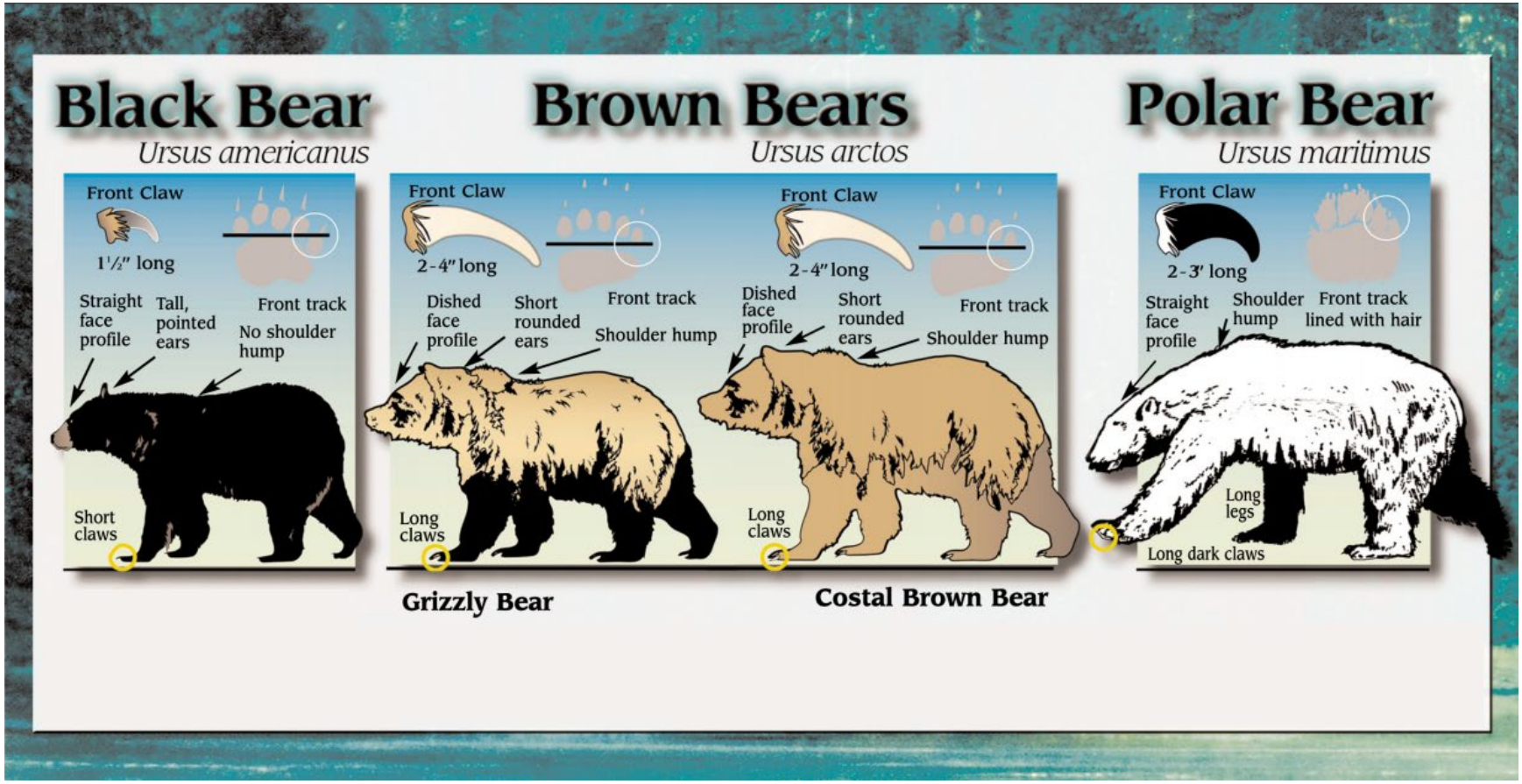
Attachment B

Bear Recognition and Reaction Field Guide

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Bear Recognition

(Be Bear Aware. 2022. *Bear Comparison Chart*. Photograph. Be Bear Aware. https://bebearaware.org/files/2021/02/Bear_Comparison_Chart.png)



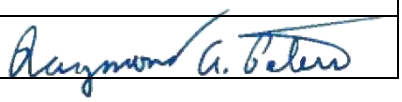
Bear Reaction:

- ***Brown and Grizzly Bears***—If you are attacked by a brown and/or grizzly bear, **PLAY DEAD** remaining still until the bear leaves the area. While playing dead, lay flat on your stomach with your hands clasped behind your neck and keep your legs spread to make it more difficult for the bear to flip you over. Remain still until the bear leaves the area. In the case where the bear attack continues for an extensive time, fight back using whatever you have, hitting the bear in the face.

- ***Black Bears***—In the case of a black bear attack, **DO NOT PLAY DEAD**. Escape to a shelter such as a hard top vehicle or building. If you are not able to escape, fight back using any available objects hitting the face and muzzle.

ENVP-2002
Rev. 0

Sample Handling and Shipping

Applicability: Companywide	Effective Date: 06/19/19	Approver/ Title:	Ray Peters, CIH, CSP ESH&Q Director
For the most recent revision, refer to the Document Management System.		Signature:	

History of Revisions

Revision	Issue Date	Action	Description
0	06/19/19	New document.	Integration of North Wind procedures.

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DEFINITIONS

Chain of custody. A form used to provide instructions to the laboratory and document sample custody from collection to analysis.

Sample. Any physical evidence collected from an environmental measuring or monitoring activity. Evidence is anything offered at the time of a legal proceeding as a means of ascertaining the truth. In investigations involving hazardous wastes, physical and documentary evidence is collected to determine if the site poses a potential threat to human health or the environment and if the site complies with regulations.

ACRONYMS

COC	chain of custody
DOT	Department of Transportation
ENVF	environmental form
ENVP	environmental procedure
EPA	Environmental Protection Agency
ESH&Q	environmental, safety, health, and quality
PCB	polychlorinated biphenyl
QAP	quality assurance procedure
RCRA	Resource Conservation and Recovery Act
SDS	safety data sheet

1. PURPOSE

This environmental procedure (ENVP) establishes methods for proper handling, packaging, custody, and shipping of samples to ensure sample validity, personal and public safety, and compliance with applicable regulations.

2. SCOPE

This ENVP is applicable to projects of North Wind Group and its wholly owned subsidiaries (referred herein either individually or collectively as North Wind), except where client- or contract-specific procedures are required. Where referenced, this ENVP applies to all North Wind and subcontractor personnel performing work described herein.

3. RESPONSIBILITIES/PREREQUISITES

3.1 Responsibilities

All personnel shall work in compliance with North Wind and project-specific environmental, safety, health, and quality (ESH&Q) procedures and work control documents.

Performer	Responsibilities
Project Manager	• Ensures that project-specific and contract-specific requirements are established in project quality assurance project plans, sampling and analysis plans, or similar work control documents. • Provides proper equipment, personnel, and training so that this ENVP can be implemented safely and efficiently. • Evaluates potential issues to ensure compliance with Department of Transportation (DOT) shipping regulations and sample quality control requirements, such as those described in ENVP-2004, "Collection of Quality Control Samples," and ENVP-2016, "Data Quality Management." • Arranges for analytical services in accordance with contract and North Wind quality and purchasing requirements.
Sampler	• Ensures that sample handling, packaging, and shipping tasks are completed as identified in this ENVP and documented in accordance with ENVP-2003, "Field Documentation." • Identifies and follows appropriate shipping classification (based on DOT regulations). • Verifies sample condition and receipt at the laboratory. • Archives shipping records, including chain-of-custody (COC) forms, in the project file and North Wind records.

3.2 Prerequisites

None.

4. INSTRUCTIONS

Potentially applicable regulations regarding sample management include these:

- 49 CFR 173 et seq.: Hazardous Materials Regulations – General Requirements for Shipments and Packaging. This regulation provides:
  - Definitions of hazardous materials for transportation purposes
  - Requirements to be observed in preparing hazardous materials for shipment by air, highway, rail, or water, or any combination thereof.

- 40 CFR 261(d): Lab sample exclusion. The Environmental Protection Agency (EPA) excludes small samples of wastes from the requirements of Parts 262 through 268, 270, 124, and the notification requirements under Resource Conservation and Recovery Act (RCRA) §3010, provided that the samples are collected and shipped for the sole purpose of determining hazardous waste characteristics or composition. Storage, transportation, and testing of the sample are excluded from RCRA regulation even when the lab testing is complete, provided that the sample is returned to the generator, and as long as the specific provisions in §261.4(d) are met. When shipping the sample to or from the laboratory, the sample collector or lab personnel must comply with certain labeling requirements, as well as any applicable U.S. Postal Service or DOT shipping requirements [§261.4(d)(2)]. The lab sample exclusion is intended to apply to small samples. Although the regulations do not specify a size limit, EPA has stated that typically no more than one gallon is needed to completely characterize a sample for purposes of compliance with RCRA or other federal, state, or local regulations (46 FR 47426, 47427; September 25, 1991).

- 40 CFR 261 (e–f): Treatability study exemption. Treatability studies are used to determine information such as whether a treatment process is efficient, or what types of wastes remain after the treatment is complete. Section 261.4(e) conditionally excludes treatability study samples from the requirements of Parts 261 through 263 and the notification requirements of §3010, and persons who generate or collect samples for the sole purpose of conducting treatability studies provided that the conditions in §§261.4(e)(1) through (3) are met. These requirements include packaging, labeling, and recordkeeping. Both the treatability samples and the laboratories conducting such treatability studies are excluded from the requirements in Parts 261 through 266, 268, and 270, and the notification requirements of RCRA §3010 as long as the provisions in §§261.4(f)(1) through (11) are met. On February 18, 1994, EPA modified the treatability study exclusions by increasing the time and quantity limits for contaminated media and debris (59 FR 8362).

- Radiological control requirements: Determine facility-specific rules pursuant to the site-specific radiological control manual.

4.1 Handling

4.1.1 Sample containers typically are obtained from the laboratory or from an environmental supply company. Many projects require that containers be certified clean by the supplier.

4.1.2 There may be circumstances when alternative containers will be used (Ziploc bags, plastic buckets, etc.) for which laboratory certification is not available. Such containers should be purchased as food grade, or decontaminated prior to use, with applicable documentation as to the status of the containers.

4.1.3 Prior to filling, inspect containers to ensure that they are not damaged and have not been contaminated.

4.1.4 After filling, wipe the outside of the containers with a paper towel to remove gross contamination, if necessary.

4.1.5 For zero-headspace samples, invert the container and check for bubbles.

4.1.6 Label each container with a unique sample number that corresponds to the field documentation. Typically, the intended analytical methods, sample date and time, sample location, and sampler's name are also included on the label.

4.1.7 Unless otherwise specified in the test method, place sample containers in a cooler on ice as soon as the sample container has been filled and capped (e.g., do not leave bottles sitting out while others are being filled).

4.2 Preservation

4.2.1 Ensure that preservatives are available and meet analytical method specifications. Typically laboratories will provide sample containers that have been pre-preserved with small quantities of acid or other preservatives.

NOTE: *Acids, preservatives, reagents, etc., shall be used, handled, stored, and inventoried in compliance with North Wind's HSP-1102, "Hazard Communication." Safety data sheets (SDSs) shall be available for such products, and personnel shall review the SDS and implement applicable hazard controls before using a hazardous chemical.*

4.2.2 Be aware that some samples will react with the preservative. For non-volatile samples, the cap may be loosened to release pressure after the preservative has had time to react.

4.2.3 Avoid breathing any fumes emanating from acidified samples. Hold samples away from body and downwind.

NOTE: *High levels of contamination can affect pH preservation values; if uncertain, check with electronic pH pen and adjust as necessary.*

4.2.4 Temperature preservation is addressed in Section 4.3.

4.3 Packaging

4.3.1 Inventory and inspect sample bottles (e.g., tighten caps, check labels, cross-check with field documentation).

4.3.2 Package containers in durable plastic coolers, typically provided by the laboratory.

4.3.3 Pack bottles to prevent breakage (pack in bubble wrap, foam, vermiculite, etc.).

4.3.4 Control possible leakage (e.g., place containers in Ziploc bags, line cooler with garbage bag, or place absorbent pads or vermiculite in the bottom).

4.3.5 Pack adequate ice in and around samples to meet temperature requirements (e.g., < 6°C). Verify temperature as needed. Wet ice provides better cooling, but should be double bagged to prevent leakage.

NOTE: *Some air carriers do not allow shipments containing wet ice. Review air carrier requirements prior to shipping to ensure that proper packaging requirements are met.*

4.3.6 Secure cooler lids (strapping tape, poly banding, etc.); make sure cooler handles are free.

4.3.7 See Appendix B, Checklist for Shipment of Environmental Samples.

4.4 Custody

4.4.1 The sampler must maintain and document the custody of the samples from the time of sample collection to receipt at the laboratory in accordance with ENVP-2003, “Field Documentation.”

4.4.2 At all times, samples must be in the sampler’s possession or in the sampler’s view, secured in a designated area such as a locked sample refrigerator, or sealed with tamper-indicating devices (custody seals).

4.4.3 A completed COC form must be included with each sample shipment. ENVF-2003.01, “Chain of Custody Record,” can be used in accordance with ENVP-2003, “Field Documentation,” or approved COC forms can be obtained from the analytical laboratory or may be customized based on project needs. Appendix A provides an example of ENVF-2003.01.

4.4.4 If the samples are transferred from the sampler to another person, then both parties will sign, date, and note the time that the transfer occurred in the "Relinquished by" and "Received by" part of the COC form.

4.4.5 If the samples are shipped by commercial carrier (e.g., FedEx), then the sampler will sign, date, and note the time that the samples were packaged for shipping on the "Relinquished by" part of the form.

4.4.6 Place the COC form in a Ziploc bag and tape it to the underside (inside) of the cooler lid.

4.4.7 Seal cooler lid with signed and dated custody seals. Place one seal over a hinge and a second seal over the front of the lid. Wrap clear tape over the seals to prevent accidental damage during shipment.

NOTE 1: *Commercial carriers do not sign the COC form. When the samples arrive at the laboratory, laboratory personnel will fill in the "Received by" part of the form.*

NOTE 2: *If a change or correction needs to be made, void the entry by drawing a single line through the error. Do not erase or obscure the entry. Write the correct information next to the error or use a new sample entry line. Initial and date the correction.*

NOTE 3: *If laboratory personnel find a discrepancy, direct them to make the correction on their copy of the COC form and provide a scanned copy via email, or provide an explanatory email to be included in the laboratory report.*

4.5 Compliance Awareness

4.5.1 Typically, samples of environmental media with small volumes of some preservatives can be shipped as normal packages (e.g., via FedEx). However, containers with flammable, corrosive, or other hazards may have other legal requirements for shipping. If unsure, obtain specific instructions from the shipping company or verify compliance with a company subject matter expert to ensure that DOT regulations are followed.

4.5.2 Note that polychlorinated biphenyl (PCB) sample containers require special labeling when the material exceeds or may exceed a concentration of 50 parts per million PCBs.

5. BEST MANAGEMENT PRACTICES

The following practices are recommended, as applicable to individual projects:

- For events with multiple coolers, fill out one COC form for each shipping day and place copies inside each shipping container.
- For projects with multiple shipments, add a unique identifying number to each COC form.

- For projects with numerous shipments, write the shipper (e.g., FedEx) label number(s) on the COC form.
- Make a copy, electronically scan, or take a photo of each COC form prior to shipment.
- For large projects, request pre-printed vinyl labels from the laboratory or pre-print using commercially available labels and template software (such as Avery).
- If container labels are not waterproof, place clear tape over the labels to minimize potential water damage.
- Work with the laboratory to ensure that hold-times are understood; often chemical preservation can be used to extend hold times and minimize potential shipping problems.
- "Wet-ice" tends to reach temperature requirements better than "blue-ice." Double-bag ice packs to minimize potential leakage.
- Work with the laboratory to ensure that personnel are available to receive, process, and start sample analyses as planned (especially for short hold times, weekends, and holidays).
- Monitor national weather forecasts and plan ahead for possible delays with shipper (e.g., FedEx).

6. RECORDS

Maintain the following records in accordance with QAP-171, "Records Management":

- Chain-of-custody form(s) (i.e., ENVF-2003.01) for the shipped samples
- Airbill or other package tracking information provided by the courier.

7. REFERENCES

ENVF-2003.01, "Chain-of-Custody Record"

ENVP-2004, "Collection of Quality Control Samples"

ENVP-2003, "Field Documentation"

ENVP-2016, "Data Quality Management"

HSP-1102, "Hazard Communication"

QAP-171, "Records Management"

8. APPENDIXES

Appendix A – Example of ENVF-2003.01, "Chain-of-Custody Record"

Appendix B – Checklist for Shipment of Environmental Samples

Appendix A
Example of ENVF-2003.01, "Chain-of-Custody Record"

NORTHWIND

Applicability: ESH&Q
Owner: ESH&Q Director

For the most recent revision, refer to the Document Management System.

CHAIN-OF-CUSTODY RECORD
For use with ENVP-2003

ENVF-2003.01
Revision: 0
Effective Date: 06/19/19
Page 1 of 1

Chain-of-custody forms from approved vendors (i.e., analytical laboratories) may be substituted for this form.

Company Name:			Sampler:				Analyses Requested					Page ____ of ____	
Address:			Phone:		Fax:							Date:	
City:			Email:									COC #:	
State:	Zip:		Project Manager:										
Project Name:			Phone:		Fax:							Carrier/Airbill #:	
Project Location:			Email:									Type, Volume, and No. of Containers	Remarks/Special Instructions:
Sample Number	Sample Location	Date	Time	Depth	Sample Preservative	Sample Matrix							
							☐	☐	☐	☐	☐		
							☐	☐	☐	☐	☐		
							☐	☐	☐	☐	☐		
							☐	☐	☐	☐	☐		
							☐	☐	☐	☐	☐		
							☐	☐	☐	☐	☐		
							☐	☐	☐	☐	☐		
							☐	☐	☐	☐	☐		
							☐	☐	☐	☐	☐		

Possible Hazard Identification
☐ Non-Hazardous ☐ Skin Irritant ☐ Rad ☐ Flammable ☐ Poison ☐ Unknown

Sample Disposal
☐ Return to Client ☐ Disposal by Lab

Other Comments

Relinquished by: (Signature/Company)	Date	Time	Received by: (Signature/Company)	Date	Time	**Ship to:**
Relinquished by: (Signature/Company)	Date	Time	Received by: (Signature/Company)	Date	Time	
Relinquished by: (Signature/Company)	Date	Time	Received by: (Signature/Company)	Date	Time	

EXAMPLE

NOTE: This completed form is a record and shall be completed entirely and maintained in accordance with project/program records management requirements.

Appendix B
Checklist for Shipment of Environmental Samples

The following basic packaging instructions are not inclusive for all projects, and require coordination with project- and facility-specific work plans and controls.

If a package other than a cooler is used, packaging instructions shall be provided and will differ from those that follow.

Other issues, such as elevated radioactivity, require compliance with facility work controls. The following are to be used only as general guidance.

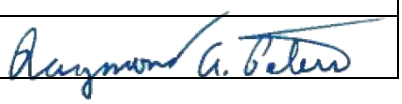
Step	Action	Completed?
1	Place a layer of absorbent cushioning material in either the bottom of the shipping container or in the bottom of the liner bag for packaging containing liquid constituents.	
2	Line the shipping packaging with a large plastic bag.	
3	For samples containing liquid constituents:	
4	**IF** cooler has drain plug, **THEN** seal the interior and exterior of the plug with duct tape or equivalent.	
5	Place the sample container in a plastic bag.	
6	Squeeze as much air as possible from the bag before sealing, and seal the bag.	
7	Position the container so that the label or tab (if used) can be read through the plastic bag.	
8	Ensure that the container is upright and surrounded with an absorbent cushioning material to prevent tipping over, breaking, or spilling. If necessary, use partitions and protective sleeves.	
9	**IF** packaging volatile organic compound vials (for liquids), **THEN** perform the following sub-steps; **OTHERWISE, GO TO** Step 13.	
10	Wrap each vial individually in one of the following: • Paper cloth • Bubble wrap with cushioning between each bottle • Foam vial holders • Secure the cloth with a rubber band, or seal with bubble wrap.	
11	**IF** wrapped in cloth, **THEN** place all vials in a sealable bag.	
12	Fill in around the sample containers with additional absorbent cushioning material.	
13	Pull the ends of the liner bag together and twist.	

Step	Action	Completed?
14	Tape the top down.	
15	For samples requiring temperature preservation, place ice packs or bagged ice in packaging to maintain sample temperature at levels identified by sample analytical method. **NOTE:** *As applicable, provide a temperature control blank packed with the sample containers*.	
16	For samples collected from radiologically posted areas, determine and comply with facility release requirements.	
17	**COC Forms and Seals** Sample Custodian: Print and sign the COC form fields for "Relinquished by," and enter date and time that the COC form is ready to be placed inside the packaging.	
18	Place the original COC form in a large transparent sealable bag. Retain a copy of the COC for the project file.	
19	Close the packaging.	
20	Make a few wraps around the packaging, using fiberglass or strapping tape to ensure that the lid will remain closed, unless other means of securing are available.	
21	Remove any existing packaging labels that are not applicable for the current shipment or are frayed or torn. **NOTE:** *If packaging is mislabeled, a U.S. DOT fine can be imposed upon the shipper or contractor.*	
22	Identify name of receiving laboratory on the lid (top) of the packaging.	
23	**IF** sample custodian is not personally delivering the material package to the receiving laboratory, **THEN** perform the following substeps:	
24	Using dark indelible ink, initial and date or sign and date each chain-of-custody seal to be used.	
25	Before transferring custody, place at least two custody seals across the opening of the lid of the packaging, one each on two different sides. Attach seals in such a way that it is necessary to break the seal to open the packaging.	
26	If the samples are sealed, and left unattended, and the seal is broken prior to shipping, notify the sample coordinator or Analytical Services Contracting Lead so that corrective action can be taken.	
27	Place another piece of transparent tape over custody seals after the custody seals are in place for shipment.	

Step	Action	Completed?
28	**Shipping Package Markings** Sample Custodian: **IF** the package is a DOT non-hazardous package shipment and contains liquid samples, **THEN** place "This End Up" arrow markings and "Fragile" labels on all four sides of the shipping package, if possible. There should be no labels or markings on the bottom of the shipping package.	
29	**Non-hazardous Material Sample Shipments** Sample Custodian: Ensure that all samples are shipped as soon as possible after collection to ensure that all holding times are met.	
30	**Transport and Shipping** Deliver non-hazardous sample shipping package directly to an appropriate shipping location carrier, and indicate this to the sample coordinator on the shipping form. **NOTE:** *Except when delivered directly to the laboratory by the sample custodian, all other short-holding-time samples will be shipped "priority one/overnight."*	
31	**IF** necessary, request, and **THEN** verify that the carrier delivers on Saturday, Sunday, and holidays. **NOTE:** *The hard-sided coolers are suitable non-hazardous material shipping packages by commercial air cargo transporter, rail, or truck.*	
32	**DOT Hazardous Material Sample Transport and Shipments** Sample Custodian: **IF** transporting hazardous samples to a laboratory, **THEN** ensure the sample(s) COC is reviewed by the laboratory sample custodian and that the custodian signs COC receipt acknowledgment prior to transferring sample custody.	

ENVP-2003
Rev. 0

Field Documentation

Applicability: Companywide	Effective Date: 06/19/19	Approver/ Title:	Ray Peters, CIH, CSP ESH&Q Director
For the most recent revision, refer to the Document Management System.		Signature:	

History of Revisions

Revision	Issue Date	Action	Description
0	06/19/19	New document.	Integration of North Wind procedures.

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DEFINITIONS

Field logbook. A bound notebook with consecutively numbered pages that cannot be easily removed. It is used to document observations, measurements and activities conducted in the field for environmental investigation, cleanup, or monitoring projects.

Field form. Unbound (loose-leaf) pre-designed form that is filled out in the field. It can be helpful when collecting a large number of samples or performing repetitive measurements. Uncontrolled forms (i.e., forms that are not approved in a specific procedure) are allowed as long as they are referenced in the field logbook in accordance with this procedure.

ACRONYMS

COC	chain of custody
ENVF	environmental form
ENVP	environmental procedure
GPS	Global Positioning System
QAP	quality assurance procedure
QAPjP	quality assurance project plan
SAP	sampling and analysis plan

1. PURPOSE

This environmental procedure (ENVP) establishes North Wind's requirements for field documentation associated with environmental field work and sampling efforts. Field documentation is an important source of historical data for long-term review of data and work activities. Logbooks and other documentation, such as forms, are used to reconstruct project events for reporting. They are an official project record and can be audited by clients and legal authorities.

2. SCOPE

This ENVP applies to North Wind Group and its wholly owned subsidiaries (referred to herein either individually or collectively as North Wind) performing environmental field work and sampling efforts. All employees and subcontractors performing work on North Wind–controlled job sites that use, maintain, or enter information into field logbooks, forms, etc., will follow this ENVP, except where client- or contract-specific or procedures are required. Where referenced, this ENVP applies to all North Wind and subcontractor personnel performing work described herein.

3. RESPONSIBILITIES/PREREQUISITES

3.1 Responsibilities

Performer	Responsibilities
Project Manager	• Determines when field logbooks are required on a project-by-project basis. A graded approach will be used to determine the rigor and detail needed based on contract specification, project-specific quality requirements, and regulatory conditions. • Purchases logbook(s) and issues them to specific personnel for specific projects or work activities. • Ensures that logbooks are properly completed, managed, and secured.
Field Personnel	• Typically, the person who is assigned to lead the field activity is also responsible for completing the logbook. However, this procedure is not position specific; any and all field team members may make logbook entries at the direction of the field team leader.

3.2 Prerequisites

None

4. INSTRUCTIONS

4.1 Field Logbooks

4.1.1 Obtain logbooks that are of the appropriate type and format for the project conditions (e.g., Rite-in-the-Rain™ environmental pattern).

4.1.2 Use logbooks that have bound pages and pre-printed page numbers; do not remove pages under any circumstances.

4.1.3 Enter information into the logbook at the same time that the work is performed. Do not take "unofficial notes" and copy into the logbook later.

4.1.4 If additional information needs to be added "after the fact," then make a note such as "Late Entry made on DATE/TIME:" to make it clear when the entry was made.

4.1.5 Review entries daily to make sure they are clear, complete, and accurate; sign and date the bottom of each page.

4.1.6 Make corrections by drawing a single line through the incorrect entry and initialing and dating the line. Do not erase, scribble out, or cover up entries so that they cannot be read.

4.1.7 If field forms (see Section 4.2) are used, an entry should be made in the logbook that describes the form(s) and how many/which ones were filled out on that day.

4.1.8 Make concise, complete, and easy-to-read entries, preferably in all capital letters; use objective and factual language free of personal feelings or inappropriate words. Table 1 provides guidance for contents.

4.1.9 The following practices are recommended, as applicable to individual projects:

- Check entries daily for legibility, completeness, and accuracy; the reviewer should sign and date the bottom of each page.
- Organize the information using indents, bullets, or headings.
- Do not try to "save money," "save pages," or "squeeze everything in."
- Cross through, sign, and date unused pages or unused space.
- Use a pen with waterproof ink (Fisher and Rite-in-the-Rain pens are good options).
- Protect logbooks against damage and loss. Scan and archive logbooks often.
- Do not write in the margins or areas that are difficult to copy/scan.
- If pre-printed labels, receipts, etc., are put in the logbook, sign over them at the border so that they cannot be removed without detection.

- For projects with multiple logbooks, keep an index or sign-out sheet.
- For logbooks with multiple sections, include a table of contents and section tabs.
- Do not duplicate information recorded in other logbooks or forms (e.g., calibration logs, field forms); instead, summarize the information and reference the other records.
- Provide training regarding the importance and proper use of logbooks with examples.

Table 1. Guidance for logbook contents.

Cover or first page	Logbook name and sequential number. Project/facility name, location. Project identification number or contract number. Names of the project manager, field team leader, and/or site supervisor. Corporate address and contact information for field team leader or site supervisor.
Top of each page	Date. Sequential page number. Project name and number (project number, contract number, or charge number).
Bottom of each page	Signature of person who recorded the information. Signature and date of person who reviewed.
Contents	Time of individual work activities and events. Name(s) of person making the entries. Personnel present at the work site, including arrival/departure of visitors. Weather conditions. Safety briefings, hazards, and mitigation. Arrival/departure of major site equipment. Equipment calibration data. Start and completion of individual work activities. Observed field conditions and site information. Cite any information recorded on field forms, including the form number. Procedures being implemented. Project-specific information identified in the SAP, QAPjP, or other project plans. Field measurement data. Safety monitoring data. Deviations from project plans or procedures. New, changing, or unexpected conditions. Problems encountered.

If sampling is conducted	Calibration standards, including manufacturer, lot #, expiration dates, and instrument readings. Well total depth, depth to water, pump depth, and drawdown measurements. Purge parameter measurements and times. Measurement/sample date and time. Measurement/sample identification number. Measurement/sample location and depth (description, sketches, or GPS information). Include sampling locations, using the methods and resolution described in the SAP or QAPjP (e.g., narrative description, GPS, or land survey). Include location, description, and log of sampling point photographs. Sample containers (number and type) and preservation. Physical description of matrix. Procedures and equipment used for decontamination, collection, and handling. Identify sample collection method and sample handling procedures such as filtration and executed preservation techniques, including the distinction between composite and grab samples. Identify the type, matrix, and characterization method for any investigation-derived waste generated. Shipment information (e.g., FedEx tracking numbers, COC numbers). Sample team member names. Conditions that may adversely impact quality of samples (rain, exhaust, wind, smoke, dust, temperature, etc.).

4.2 Field Forms

Project-specific forms may be developed and used for the documentation of field data. Forms may be used in conjunction with, and referenced in, field logbooks, or may be used in place of field logbooks, with the approval of the project manager (with guidance as needed from Quality Assurance personnel). Forms shall be controlled though the North Wind Document Management System in accordance with QAP-3061, "Management of Controlled Documents."

4.3 Custody

4.3.1 The sampler must maintain and document the custody of the samples from the time of sample collection to receipt at the laboratory.

4.3.2 At all times, samples must be in the sampler's possession or in the sampler's view, secured in a designated area such as a locked sample refrigerator, or sealed with tamper-indicating devices (custody seals).

4.3.3 A completed chain-of-custody (COC) form must be included with each sample shipment. ENVF-2003.01, "Chain-of-Custody Record," can be used, or approved COC forms can be obtained from the analytical laboratory or may be customized based on project needs. Appendix A provides an example of ENVF-2003.01.

4.3.4 If the samples are transferred from the sampler to another person, then both parties will sign, date, and note the time of transfer in the "Relinquished by" and "Received by" fields of the COC form.

4.3.5 If the samples are shipped by commercial carrier (e.g., FedEx), then the sampler will sign, date, and note the time that the samples were packaged for shipping in

the "Relinquished by" field of the form.

4.3.6 Place the COC form in a Ziploc bag and tape it to the underside (inside) of the cooler lid.

4.3.7 Seal cooler lid with signed and dated custody seals. Place one seal over a hinge and a second seal over the front of the lid. Wrap clear tape over the seals to prevent accidental damage during shipment.

NOTE 1: *Commercial carriers do not sign the COC form. When the samples arrive at the laboratory, laboratory personnel will fill in the "Received by" field of the form.*

NOTE 2: *If a change or correction is required, void the entry by drawing a single line through the error. Do not erase or obscure the entry. Write the correct information next to the error or use a new sample entry line. Initial and date the correction.*

NOTE 3: *If laboratory personnel find a discrepancy, direct them to make the correction on their copy of the COC form and provide a scanned copy via email, or provide an explanatory email to be included in the laboratory report.*

5. RECORDS

The project manager or designee shall archive the logbook, COC, and any associated field forms in accordance with QAP-171, "Records Management."

6. REFERENCES

ENVF-2003.01, "Chain-of-Custody Record"

QAP-171, "Records Management"

QAP-3061, "Management of Controlled Documents"

7. APPENDIXES

Appendix A, Example of ENVF-2003.01, "Chain-of-Custody Record"

Appendix A
Example of ENVF-2003.01, "Chain-of-Custody Record"

NORTHWIND

Applicability: ESH&Q
Owner: ESH&Q Director

For the most recent revision, refer to the Document Management System.

CHAIN-OF-CUSTODY RECORD
For use with ENVP-2003

ENVF-2003.01
Revision: 0
Effective Date: 06/19/19
Page 1 of 1

Chain-of-custody forms from approved vendors (i.e., analytical laboratories) may be substituted for this form.

Company Name:			Sampler:				Analyses Requested					Page ____ of ____	
Address:			Phone:		Fax:							Date:	
City:			Email:									COC #:	
State:	Zip:		Project Manager:										
Project Name:			Phone:		Fax:							Carrier/Airbill #:	
Project Location:			Email:									Type, Volume, and No. of Containers	Remarks/Special Instructions:
Sample Number	Sample Location	Date	Time	Depth	Sample Preservative	Sample Matrix							
							☐	☐	☐	☐	☐		
							☐	☐	☐	☐	☐		
							☐	☐	☐	☐	☐		
							☐	☐	☐	☐	☐		
							☐	☐	☐	☐	☐		
							☐	☐	☐	☐	☐		
							☐	☐	☐	☐	☐		
							☐	☐	☐	☐	☐		
							☐	☐	☐	☐	☐		

Possible Hazard Identification
☐ Non-Hazardous ☐ Skin Irritant ☐ Rad ☐ Flammable ☐ Poison ☐ Unknown

Sample Disposal
☐ Return to Client ☐ Disposal by Lab

Other Comments

Relinquished by: (Signature/Company)	Date	Time	Received by: (Signature/Company)	Date	Time	**Ship to:**
Relinquished by: (Signature/Company)	Date	Time	Received by: (Signature/Company)	Date	Time	
Relinquished by: (Signature/Company)	Date	Time	Received by: (Signature/Company)	Date	Time	

EXAMPLE

NOTE: This completed form is a record and shall be completed entirely and maintained in accordance with project/program records management requirements.

NORTHWIND
A CIRI COMPANY

Applicability: ESH&Q
Owner: ESH&Q Director

For the most recent revision, refer to the Document Management System.

CHAIN-OF-CUSTODY RECORD

For use with ENVP-2003

ENVF-2003.01
Revision: 0
Effective Date: 06/19/19

Chain-of-custody forms from approved vendors (i.e., analytical laboratories) may be substituted for this form.

Company Name:			Sampler:				Analyses Requested					Page _____ of _____	
Address:			Phone:		Fax:							Date:	
City:			Email:									COC #:	
State:	Zip:		Project Manager:										
Project Name:			Phone:		Fax:							Carrier/Airbill #:	
Project Location:			Email:									Type, Volume, and No. of Containers	Remarks/Special Instructions:
Sample Number	Sample Location	Date	Time	Depth	Sample Preservative	Sample Matrix							
							☐	☐	☐	☐	☐		
							☐	☐	☐	☐	☐		
							☐	☐	☐	☐	☐		
							☐	☐	☐	☐	☐		
							☐	☐	☐	☐	☐		
							☐	☐	☐	☐	☐		
							☐	☐	☐	☐	☐		
							☐	☐	☐	☐	☐		
							☐	☐	☐	☐	☐		

Possible Hazard Identification

☐ Non-Hazardous ☐ Skin Irritant ☐ Rad ☐ Flammable ☐ Poison ☐ Unknown

Sample Disposal

☐ Return to Client ☐ Disposal by Lab

Other Comments

Relinquished by: (Signature/Company)	Date	Time	Received by: (Signature/Company)	Date	Time	**Ship to:**
Relinquished by: (Signature/Company)	Date	Time	Received by: (Signature/Company)	Date	Time	
Relinquished by: (Signature/Company)	Date	Time	Received by: (Signature/Company)	Date	Time	

NOTE: This completed form is a record and shall be completed entirely and maintained in accordance with project/program records management requirements.

ENVP-2004
Rev. 0

Collection of Quality Control Samples

Applicability: Companywide	Effective Date: 06/19/19	Approver/ Title: Ray Peters, CIH, CSP ESH&Q Director
For the most recent revision, refer to the Document Management System.		Signature:

History of Revisions

Revision	Issue Date	Action	Description
0	06/19/19	New document.	Integration of North Wind procedures.

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ACRONYMS

CLP	Contract Laboratory Program
COC	chain of custody
ENVP	environmental procedure
EPA	U.S. Environmental Protection Agency
PM	project manager
PVC	polyvinyl chloride
QA	quality assurance
QAP	quality assurance procedure
QC	quality control
SAP	sampling and analysis plan
SDS	safety data sheet
VOC	volatile organic compound

1. PURPOSE

This environmental procedure (ENVP) provides requirements for establishing quality control (QC) for sampling activities. Strict adherence to all of the processes outlined in this ENVP form the basis for an acceptable sampling Quality Assurance (QA) program.

2. SCOPE

This ENVP is applicable to all projects of North Wind Group and its wholly owned subsidiaries (referred herein either individually or collectively as North Wind), except where client- or contract-specific procedures are required. Where referenced, this ENVP applies to all North Wind and subcontractor personnel performing work described herein.

3. RESPONSIBILITIES

The project manager (PM) and sampling technician have the following responsibilities to ensure that QA/QC requirements are met.

Performer	Responsibilities
Project manager	• Establishes detailed procedures in a project-specific SAP. • Maintains chain-of-custody (COC) documents. • Ensures that tasks identified in this ENVP are carried out by qualified personnel. • Identifies QA/QC problems/issues from field notes and analytical data. • Provides corrective action information to the field sampling team during resolution of QA/QC issues.
Sampling technician	• Adheres to QA/QC procedures identified in the project-specific SAP. • Prepares QC samples as discussed in this ENVP and the SAP. • Prepares COC forms and sampling field documentation in accordance with ENVP-2003, “Field Documentation.”

4. COLLECTION OF QUALITY CONTROL SAMPLES

This section identifies standard QA/QC procedures that are expected to be included in applicable project-specific SAPs.

4.1 Experience Requirements

There is no substitute for field experience. Therefore, all sampling technicians shall have the equivalent of 6 months of field experience before they are permitted to select sampling sites on their own initiative. This field experience shall be gained by on-the-job training using the "buddy" system. Each new sampling technician shall accompany an experienced employee on as many different types of field studies as possible. During this training period, the new employee will be permitted to perform all facets of field investigations, including sampling, under the direction and supervision of senior sampling technicians.

4.2 Traceability Requirements

All sample collection activities shall be traceable through field documentation (see ENVP-2003, "Field Documentation") to the person collecting the sample and to the specific piece of sampling equipment (where appropriate) used to collect that sample. All maintenance and calibration records for sampling equipment shall be maintained in accordance with QAP-3121, "Control of Measuring and Test Equipment."

4.3 Chain of Custody

A chain-of-custody (COC) record is used as physical evidence of sample custody. The sampling technician will complete a COC in accordance with ENVP-2003, "Field Documentation," to accompany each sample shipment from the field to the laboratory. The COC specifies time, date, sample location, unique sample number, requested analyses, sampling technician name, required turnaround time, time and date of transaction between field and laboratory staff, and name of receiving party at the laboratory. Upon receipt of the samples, laboratory personnel confirm that the contents of the shipment are accurately described by the COC. Upon verification, the laboratory representative signs and dates the COC, indicating receipt of the samples. Copies of the COCs shall be included in all reports containing laboratory test data.

4.4 Sampling Equipment Construction Material

Sampling equipment construction materials can affect sample analytical results. Materials used must not contaminate the sample being collected and must be easily decontaminated in accordance with ENVP-2014, "Equipment Decontamination," so that samples are not cross-contaminated.

4.5 Sample Preservation

Samples for some analyses must be preserved in order to maintain their integrity. Chemical preservatives are typically provided by the analytical laboratory. All samples requiring preservation shall be preserved immediately upon collection in the field. Samples that will NOT be preserved in the field are:

- Those collected within a hazardous waste site that are known or thought to be highly contaminated with toxic materials which may be highly reactive. Barrel, drum, closed container, spillage, or other source samples from hazardous waste sites are not to be preserved with any chemical. These samples may be preserved by placing the sample container on ice, if necessary per sampling method protocol.
- Those that have extremely low or high pH or samples that may generate potentially dangerous gases when preserved.
- Those for metals analyses, which are shipped by air, shall not be preserved with nitric acid in excess of 0.15 weight percent of the solution.

All samples preserved with chemicals shall be clearly identified by indication on the sample tag that the sample is preserved. If samples normally requiring preservation were not preserved, field documentation shall clearly specify the reason.

NOTE: *Acids, preservatives, reagents, etc., shall be used, handled, stored, and inventoried in compliance with North Wind's HSP-1102, "Hazard Communication." Safety data sheets (SDSs) shall be available for such products, and personnel shall review the SDS and implement applicable hazard controls before using each hazardous chemical.*

4.6 Special Precautions for Trace Contamination Sampling

Some contaminants can be detected in the parts-per-billion and/or parts-per-trillion range. Extreme care must be taken to prevent cross-contamination of these samples. The following precautions shall be taken when trace contaminants are of concern:

- A clean pair of new, non-powdered, disposable gloves (nitrile, latex, etc.) will be worn each time a different location is sampled and the gloves shall be donned immediately prior to sampling. The gloves shall not come into contact with the media being sampled.
- Sample containers for source samples or samples suspected of containing high concentrations of contaminants shall be placed in separate plastic bags immediately after collecting, tagging, etc.
- If possible, ambient samples and source samples shall be collected by different field teams. If different field teams cannot be used, all ambient samples shall be collected first and placed in separate ice chests or shipping containers. Samples of waste or highly contaminated samples shall never be placed in the same ice chest as environmental samples. Ice chests or shipping containers for source samples or

samples suspected to contain high concentrations of contaminants shall be lined with new, clean, plastic bags.

- If possible, one member of the field sampling team shall take all the notes and fill out tags, etc., while the other members collect the samples.
- When sampling surface waters, the water sample shall always be collected before the sediment sample is collected.
- Sample collection activities shall proceed progressively from the least suspected contaminated area to the most suspected contaminated area.
- Sampling technicians shall use equipment constructed of Teflon®, stainless steel, or glass that has been properly pre-cleaned for collection of samples for trace metals or organic compounds analyses. Teflon® or glass is preferred for collecting samples where trace metals are of concern. Clean, disposable equipment shall be used where practical.

4.7 Sample Handling and Mixing

After collection, all sample handling shall be minimized. The sampling technician shall use extreme care to ensure that samples are not contaminated. If samples are placed in an ice chest, sampling technicians shall ensure that melted ice cannot cause the sample containers to become submerged, since this may result in sample cross-contamination. Plastic bags, such as Ziploc® or similar plastic bags sealed with tape, shall be used when small sample containers (e.g., volatile organic compounds [VOC] vials or bacterial samples) are placed in ice chests to prevent cross-contamination.

Once a sample has been collected, it may have to be transferred into separate containers for different analyses. The best way to transfer liquid samples is to continually stir the sample contents with a clean pipette or pre-cleaned Teflon® rod and allow the contents to be alternately siphoned into respective sample containers using Teflon® or polyvinyl chloride (PVC; Tygon® type) tubing (and a siphon bulb to start the flow). Teflon® must be used when analyses for organic compounds or trace metals are to be conducted. Any device used for stirring, or tubing used for siphoning, must be cleaned in the same manner as other equipment. However, samples collected for VOC, oil and grease, bacteria, sulfides, and phenols analyses may not be transferred using this procedure. For these analyses the sample containers shall be filled directly from the sampling equipment rather than collected into a single collection vessel and proportioned to fill the sample containers.

It is extremely important that waste (when appropriate), soil, and sediment samples be mixed thoroughly to ensure that the sample is as representative as possible of the sample media. The most common method of mixing is referred to as quartering. The quartering procedure shall be performed as follows:

4.7.1 The material in the sample pan shall be divided into quarters, and each quarter shall be mixed individually.

4.7.2 Two quarters shall then be mixed to form halves.

4.7.3 The two halves shall be mixed to form a homogeneous matrix.

This procedure shall be repeated several times until the sample is adequately mixed. If round bowls are used for sample mixing, adequate mixing is achieved by stirring the material in a circular fashion, reversing direction, and occasionally turning the material over.

4.8 Special Handling of Samples for Volatile Organic Compounds Analysis

Water samples to be analyzed for VOCs shall be stored in 40-mL septum vials with screw cap and Teflon®-silicone disk in the cap to prevent contamination of the sample by the cap. The disks shall be placed in the caps (Teflon® side to be in contact with the sample) in the laboratory prior to the beginning of the sampling program.

The vials shall be completely filled to prevent volatilization, and extreme caution shall be exercised when filling a vial to avoid any turbulence, which could also produce volatilization. The sample shall be carefully poured down the side of the vial to minimize turbulence. As a rule, it is best to gently pour the last few drops into the vial so that surface tension holds the water in a convex meniscus. The cap is then applied and some overflow is lost, but the air space in the bottle is eliminated. After capping, turn the bottle over and tap it to check for bubbles. If any bubbles are present, repeat the procedure with another clean 40-mL vial. Since the VOC vials are pre-preserved, caution shall be exercised when the vials are used as the collection device for surface water samples in order to prevent the loss of the preservative. When collecting water samples for VOCs, three 40-mL vials containing preservative shall be filled with sample.

Soil samples for VOC analyses shall be collected and handled as appropriate for the sample container being filled. VOC samples shall not be mixed and shall be collected as soon as possible after the sample has been removed from its point of origin. The VOC samples shall be preserved as required by the analytical method as soon as they are placed in the sample container.

4.9 Estimating Variability

4.9.1 Spatial Variability

The following spatial duplicate sampling procedures shall be used during the collection of samples as a measure of variability within the area represented by the sample. When appropriate, spatial duplicate grab and/or composite samples shall be collected during major investigations and studies. A “major study” would include all investigations where more than 20 samples were collected or those studies where the study objectives dictate that additional QC samples be

collected. No more than 10% of all samples shall be collected as spatial duplicates. These samples shall be collected at the same time, using the same procedures, the same type of equipment, and in the same types of containers as the original samples, but collected from a different location within the area represented by the original. They shall also be preserved in the same manner and submitted for the same analyses as the required samples. The collection of spatial duplicate composite samples requires that the sample aliquots be arrayed in a manner different from the original sample and spaced within the same area of representativeness. Data from spatial duplicates will be examined to determine if the samples represent the areas intended in the project work plan.

4.9.2 Temporal Variability

When required, temporal variability at a given sampling location will be measured by collecting temporal duplicate samples. These samples will be collected from the same sampling location, using the same techniques and the same type of equipment, but at a time different from the original sample. The time selected for the temporal duplicate sample will be within the same span of time for which the original sample is designed to be representative in the project work plan. Data from temporal duplicates will be examined by the PM to determine if samples represent the time span intended in the project work plan.

4.9.3 Sample Handling Variability

The effectiveness of sample handling techniques will be measured by collecting split and blank samples.

Split Samples

Split samples will be collected by initially collecting twice as much material as is normally collected for a sample. After mixing, the material will be apportioned into two sets of containers. Both sets of containers will be submitted for analyses with unique identification codes. Data from split samples will be examined to determine sample-handling variability. On large studies (more than 20 samples), no more than 10% of all samples will be collected as split samples.

Blank Samples

The following blank samples will be prepared by the laboratory and obtained by the PM prior to traveling to a sample site.

- Water sample VOC trip blank – A water sample VOC trip blank is required for every study where water samples are collected for VOC analysis. Two sealed, preserved (or unpreserved if appropriate) 40-mL VOC vials will be transported to the field. For routine studies these samples will be prepared by lab personnel. Sampling technicians shall request that these samples be provided at least 1 week in advance of scheduled field investigations and

inspections and never (except in emergency situations) less than 2 days in advance of scheduled field investigations and inspections. These samples shall not be picked up earlier than the morning of departure for the scheduled inspection/investigation. These field blanks will be handled and treated in the same manner as the water samples collected for VOCs analysis on that particular study.

- Soil sample VOC trip blank – A soil sample VOC trip blank is required for every study where soil samples are collected for VOC analysis. This trip blank may consist of a purified water blank in two 40-mL vials, as above, or may be pure solid material provided by the laboratory (i.e., lab sand).
- Air sample field blank – For environmental air samples, a field blank of the filter medium should be sent to the lab to account for potential contamination from the filters.

These samples will be clearly identified on sample tags and COC Records as trip blanks.

The following blanks may be prepared in the field according to the SAP for the project:

- Inorganic sample preservative blanks – Metals and general inorganic sample containers filled with analyte-free water will be transported to the field and preserved and submitted for the same analyses as the other inorganic samples collected. These samples will be clearly identified as preservative blanks on sample tags and the COC Record(s).
- Equipment field blanks (rinsates) – When field cleaning equipment is required during a sampling investigation, a piece of the field-cleaned equipment will be selected for collection of a rinse blank. After the piece of equipment has been field cleaned and prior to its being used for sample operations, it will be rinsed with organic/analyte-free water. The rinse water will be collected and submitted for analyses of all constituents for which normal samples collected with that piece of equipment are being analyzed.
- Organic/analyte-free water system blanks – When using a portable organic-free water-generating system in the field, a sample of the raw source water and water generated will be collected at least once during each week of operations. The collected water sample will be submitted for analyses of all constituents for which normal samples are being analyzed.
- Material blanks – When construction materials are being used on a site in such a way as to have a potential impact on constituent concentrations in the sample, a sample of the materials will be submitted for analyses. An example of a situation in which construction blanks might be required is monitoring well construction. In this situation all materials used in well construction could be submitted for analyses (grout, sand, tap water, etc.).

Analytical results from these blank samples are indicators of the quality of the sampling process. The PM shall provide corrective measures to the field sampling crew if any of the blank results indicate unacceptable sample quality.

5. SPECIAL QUALITY CONTROL PROCEDURES

This section identifies QC procedures that may be included in applicable SAPs under which specialized analysis or independent laboratory checks are required.

5.1 Special Quality Control Procedures for Extractable Organic Compounds, Pesticides, or Herbicides Analyses (Matrix Duplicate)

Duplicate water samples may be submitted, as required by the project SAP, to the laboratory for extractable organic compounds, pesticides, and/or herbicides analyses from at least one sampling location per project and laboratory used. These samples shall be collected from a location expected to be relatively free from contamination, since the samples will be used for laboratory QC purposes. The duplicate samples shall be clearly identified as "Duplicate Sample for Matrix Spike" on the sample tag, COC Record, in the field documentation, and on the Contract Laboratory Program (CLP) Traffic Report Form (if appropriate). This procedure shall be followed for all projects where water samples are collected for the indicated analyses.

5.2 Special Quality Control Procedures for EPA Contract Laboratories

On a case-by-case basis, split samples may be required (or duplicate samples if appropriate) for analyses by both the contract laboratory and an independent laboratory. The contract laboratory involved shall not be notified that samples were split, i.e., there shall be no indication on COC Records or CLP Traffic Report Forms submitted to the contract laboratories that these samples were split with the independent laboratory.

6. RECORDS

The PM or designee shall maintain the following records in accordance with QAP-171, "Records Management":

- Completed COC forms (i.e., ENVF-2003.01, "Chain-of-Custody Record")
- Calibration records (per QAP-3121, "QAP-3121, "Control of Measuring and Test Equipment")
- CLP Traffic Reports
- Field documentation, including sample collection forms and logbooks (per ENVP-2003, "Field Documentation").

7. REFERENCES

ENVF-2003.01, “Chain-of-Custody Record”

ENVP-2003, “Field Documentation”

ENVP-2014, “Equipment Decontamination”

HSP-1102, “Hazard Communication”

QAP-171, “Records Management”

QAP-3121, “Control of Measuring and Test Equipment”

ENVP-2006
Rev. 1

Groundwater Sampling

Applicability: Companywide	Effective Date: 11/28/2023	Approver/ Title: Ray Peters, CIH, CSP ES&H Director
For the most recent revision, refer to the Document Management System.		Signature: Ray Peters (Nov 28, 2023 14:17 EST)

History of Revisions

Revision	Issue Date	Action	Description
0	06/20/2019	New document.	Integration of North Wind procedures.
1	11/28/2023	Revised document.	Added groundwater purge and sampling form, updated low flow procedure, removed passive diffusion procedure, and added no-purge procedures.

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DEFINITIONS

High-yield formation. A formation that provides groundwater to a well in sufficient quantity that the well is not pumped dry at flowrates used during purging and sampling operations.

HydraSleeve™. A no-purge (passive) grab sampling device that is used to collect groundwater samples directly from the screened interval of a well.

Low-flow sampling approach. An approach for purging a well and sampling groundwater that utilizes groundwater extraction rates that are so low that mobilization of colloids and larger particles in the vicinity of the well is minimized.

Low-yield formation. A formation that provides groundwater to a well in such low quantity that the well is pumped dry at flowrates used during purging and sampling operations.

Purge water. Water extracted from a well during purging.

Purging. Removal of water from a well prior to sample collection so that the sample consists of water recently drawn from the formation.

ACRONYMS

ENVF	environmental form
ENVP	environmental procedure
EPA	Environmental Protection Agency
HASP	Health and Safety Plan
HSP	health and safety procedure
ID	identification
NTU	nephelometric turbidity units
ORP	oxidation reduction potential
PID	photoionization detector
PM	Project Manager
UFP-QAPP	Uniform Federal Policy Quality Assurance Project Plan
VOC	volatile organic compound

1. PURPOSE

The purpose of this procedure is to set guidelines for the collection of groundwater samples and to specify a process to reduce potential bias caused by the sampling equipment.

2. SCOPE

This procedure is applicable to all North Wind projects that specifically reference this procedure in the approved project-specific work control document (i.e., Uniform Federal Policy Quality Assurance Project Plan [UFP-QAPP], Sampling and Analysis Plan, Field Sampling Plan, or Work Plan).

This is a standard (i.e., typically applicable) operating procedure, which may be varied or changed as required, dependent upon site conditions or project-specific requirements.

3. RESPONSIBILITIES/PREREQUISITES

3.1 Responsibilities

Performer	Responsibilities
Project Manager (PM)	• Ensure that sampling personnel have been trained to this and related procedures and that the training has been documented. • Ensure that sampling personnel have access to necessary equipment/materials. • Ensure that sampling personnel follow approved protocol and procedures.
Sampling Personnel	• Ensure that appropriate preparation and planning are completed prior to field activities. • Ensure that all materials and equipment are available, calibrated as needed, and in proper working order. • Communicate with the PM on a routine basis for status, any additional needs, or issues. • Ensure that all field activities are clearly and accurately documented in logbooks or approved field forms.

3.2 Prerequisites

Generating defensible groundwater data involves multiple procedures (calibration, decontamination, etc.) and technical knowledge. Personnel must be trained to the associated North Wind procedures, be familiar with technical guidance documents (see Section 7, References), and understand manufacturer's operating instructions.

Sampling activities should be coordinated ahead of time with field personnel, the project chemist, project data manager, PM, and the analytical laborator(ies). A preparatory meeting is recommended. Appendix A provides an example preparation checklist.

Assemble the following documentation:

- Health and Safety Plan (HASP) with job hazard analysis (or activity hazard analysis) per Health and Safety Procedure (HSP)-1101, "Project Hazard Analysis."
- UFP-QAPP and associated field procedures and forms:
  - Logbook and/or approved forms, preferably on waterproof paper.
  - Standard forms include Environmental Form (ENVF)-2006.01, "*Groundwater Level Measurements*" and ENVF-2006.02, "*Groundwater Purging and Sample Collection*".
- Manufacturer's operating manuals for pumps, controllers, measuring and test equipment, and sampling equipment.

NOTE: Bound hardcopies are preferred for quick reference in the field.

Obtain and inspect the following equipment and supplies prior to use for proper function, cleanliness, and calibration (as needed):

- Electronic water level indicator graded to 0.01 foot (ft) ($1/100^{th}$).
- Oil-water interface probe, if appropriate for free product measurements.
- Multi-parameter water quality instrument and calibration supplies.
- Pump, controllers, and samplers, as needed for the selected sampling method.
- Appropriate sample bottles and preservatives (as described in UFP-QAPP).
- Photoionization detector (PID) (if required by the project HASP).

NOTE: *Peristaltic pumps require special techniques to collect organic samples (reverse pumping, foot valves, Z-crimp, vacuum caps, etc.). Verify proper pump selection in the UFP-QAPP. Refer to the EPA (2023) document or local regulatory guidance for details on proper use. Document the actual techniques used in the project logbook/field forms.*

4. PROCEDURE

4.1 Preparatory Activities

1. Inspect the well pad and riser. Note cracks, missing locks, damage, evidence of tampering, or other conditions that could impact sample quality. Lay plastic sheeting around the well as needed to keep equipment clean.

2. Verify the well identification (ID)/location. Document how the well ID was determined (brass survey marker, engraving, stencil, map, or global positioning system). Start filling out ENVF-2006.01 and/or ENVF-2006.02.

3. Wear clean, waterproof gloves (e.g., latex or nitrile) to protect personnel and to prevent skin oils, dust particles, or other contaminants from contaminating samples. Change gloves between wells or discrete sampling zones.

4. Note wind direction; stand up wind to avoid breathing contaminants emanating from the well. Groundwater wells with volatile contaminants may require air monitoring. Refer to the project-specific HASP for any air monitoring requirements.

NOTE: *Leather work gloves can be worn over waterproof gloves at the discretion of field personnel and will be worn when required by applicable work control documents. Leather work gloves shall not be worn while filling or handling sample containers.*

4.2 Depth to Water and Depth to Product Measurements

Accurate water level and/or product measurements are critical to determine groundwater flow direction and other aquifer and plume characteristics. For newly developed wells, water levels should be allowed to stabilize for a minimum of 24 hours. In low-yield situations, recovery of water levels to equilibrium may take longer.

1. When applicable, start at those wells that are least contaminated and proceed to those wells that are most contaminated. Decontaminate equipment between each well.

2. Remove the well cap. If required by the project-specific HASP, conduct air monitoring with a calibrated PID. Wells that have air-tight seals/caps, should be allowed to equilibrate for a minimum of 15 minutes after opening the sealing caps and prior to measurement.

3. Lower the water level indicator into the well slowly until the water surface is reached, as indicated by a tone or meter deflection.

4. Document the well ID, date, time, sampler's name, and measuring reference point (top of casing V-notch or top of casing N-side) on ENVF-2006.01.

5. Record the depth to the water surface from the reference measuring point. Repeat the measurement two to three times to ensure accuracy. Record the measurement to the nearest 0.01-ft (1/100th).

6. If necessary for the project, lower the probe to the bottom of the borehole and measure the total depth. Wells that are more than 300 ft deep or have "silty" bottoms require additional weight to feel the bottom. Use zip ties to connect decontaminated stainless-steel weights, as needed.

NOTE: *If conducting low-flow or no purge sampling, do not measure the total depth of the well to avoid stirring up silt. Take the total depth readings after sampling, if necessary.*

If free product (i.e., organic liquid) is suspected, then the top and bottom of the layer need to be measured with a specialized oil-interface meter (Solinst, Heron, Geotech, etc.). Operate the interface meter in accordance with the manufacturer's instructions.

Measurements should be taken at least twice. If results do not agree to within 0.01 ft, a third measurement should be taken, and the readings averaged. Inconsistent readings may mean that levels are not stable, or the equipment is malfunctioning.

Water levels should be measured at a given site within a 24-hour period. However, additional time may be required for large sites. Refer to local permits or project-specific documents for schedule requirements.

4.3 Purging and Sampling

Purging is the process of removing stagnant water from a well, immediately prior to sampling, causing its replacement by fresh groundwater from the adjacent formation. Sampling is the process of obtaining, containerizing, and preserving (when required) groundwater after the purging process is complete.

4.3.1 High Volume Method

1. Install the pump to the target depth, typically the intake needs to be in the center of the saturated interval of the screen. If the water level is above the top of screen, simply divide the screen length by 2 and add it to the depth of the top of screen. If the water level is below the top of screen, then use the effective screen length (only the portion that is under water).

2. With submersible pumps, measure the depth using a wireline counter or by lowering the pump together with a water level probe. For peristaltic pumps, weight the end of the tubing or attach to a water level probe with a rubber band, zip tie, etc.

3. If sampling a low-yield formation, remove the standing water in the well one time (pump the well dry); collect the purge water in a bucket and record the volume.

4. If sampling a high-yield formation, then there are two options: (a) purge the calculated volume of water in the well three times (refer to Appendix B to find the volume of water that needs to be purged) or (b) purge continually until water quality parameters have stabilized (refer to Appendix C for stabilization criteria).

NOTE: *Check client and/or local regulatory requirements for required purge volume and/or stabilization criteria as they may differ from the standards provided in this document.*

5. Record the purge rate, volume purged, depth to water, indicator parameter values, and clock time at approximately 5-minute intervals on ENVF-2006.02, "Groundwater Purging and Sample Collection." Adjust time

intervals, as needed, to ensure that the volume of water in the flow cell and tubing is completely displaced between readings. Document total volume purged and well-volume equivalent (if required) prior to sampling.

6. Monitor the water level and collect samples as soon as a sufficient volume of water has recharged.

7. Disconnect or bypass the discharge tubing from the flow-through cell. Begin filling sample containers by allowing the pump discharge to flow gently down the inside of the container with as little agitation or aeration as possible.

8. Secure the pump and tubing and replace and lock the well cap.

4.3.2 Low-Flow Method

Low-Flow purging and sampling is a method that extracts groundwater at a low flowrate, approximately equal to the rate that formation water infiltrates into the monitoring well. This method minimizes the volume of purge water and often gives the best (i.e., most representative) sample results.

If a well cannot be purged without continuously increasing drawdown, even at very low pumping rates (e.g., 50 to 100 milliliters per minute [mL/min]), the well should not be sampled using this sampling method.

1. Connect the pump to an in-line flow-through cell coupled with a calibrated multiparameter instrument.

2. Lower the pump (or intake tubing if using peristaltic pump) to the target depth, typically the intake needs to be in the center of the saturated interval of the screen. If the water level is above the top of screen, simply divide the screen length by 2 and add it to the depth of the top of screen. If the water level is below the top of screen, then use the effective screen length (only the portion that is under water).

3. Lower the pump/tubing slowly to minimize mixing water in the well and stirring up sediment. If possible, install ahead of time to allow time for the sediment to settle. For wells that will be sampled repeatedly, it is recommended that pumps be installed permanently.

4. Measure the pump depth using a wireline counter or by lowering the pump together with a water level probe. With peristaltic pumps, weight the end of the tubing or attach to a water level probe with a rubber band, zip tie, etc.

NOTE: *Screen depths are typically recorded in reference to ground surface (below ground surface); if so, the depth must be corrected for the casing stickup (or stickdown for vaulted wells).*

5. Start the pump at a low initial pumping rate (e.g., 100 to 200 mL/min). Measure the depth to water to determine the amount of drawdown caused by pumping.

6. Adjust the pumping rate, as needed, until a relatively small amount of drawdown is observed (< 0.033 ft) and turbidity readings have been minimized (ideally below 10 nephelometric turbidity units [NTU]).

7. Record the purge rate, volume purged, depth to water, indicator parameter values, and clock time at approximately 5-minute intervals on ENVF-2006.02, "Groundwater Purging and Sample Collection." Adjust time intervals, as needed, to ensure that the volume of water in the flow cell and tubing is completely displaced between readings.

   Purging is considered complete when three consecutive readings of the water quality indicator parameters agree within approximately 10%, however specific criteria vary by project. Appendix C provides parameter specific stabilization criteria.

8. Begin sampling immediately after operational and indicator parameters stabilize. Do not move the pump intake, change the pump rate, or turn off the pump prior to sampling.

NOTE: *The pumping rate should ideally remain at the established purging rate to avoid potentially altering the composition of the sample. However, if it is necessary to change the pumping rate, then repeat the stabilization process.*

9. Disconnect or bypass the discharge tubing from the flow-through cell.

10. Fill sample containers by allowing the pump discharge to flow gently down the inside of the container with as little agitation or aeration as possible. The order of filling is important, refer to the project UFP-QAPP for proper order.

11. Secure the pump and tubing and lock the well cap.

4.3.3 No Purge Methods

The three standard "no purge" methods are HydraSleeves™[1], Snap Samplers™[2], and Bailers; all three collect "grab" samples. Passive diffusion samplers, which rely on contaminants permeating a membrane, are not typically used, and are not addressed in this procedure.

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[1] HydraSleeeves™ are no-purge grab sampling devices consisting of a closed-bottom, flat polyethylene sleeve with a reed valve at the top. They are deployed in a collapsed state to the desired depth and fill themselves through the reed valve when pulled upward through the sampling interval.

[2] Snap Samplers™ are no-purge grab sampling devices consisting of 40-, 124-, and 350-mL sample bottles with "snap" sealing caps that are open at both ends. The bottles are lowered into the well to fill and then a manual trigger line releases the spring-loaded caps to capture the samples.

4.3.3.1 HydraSleeve™

1. Deploy HydraSleeves by attaching the reusable weight to the bottom of the sampler or attaching the sleeve to a weighted line (remember to decontaminate all downhole parts between wells). Tie off the tether to a fixed location (in case it is inadvertently dropped).

2. Lower the HydraSleeve into the well so that the top of the sampler is at the bottom of the well screen. (Consult the well completion log or UFP-QAPP for screen depth.) Do not pull up on the tether at any time when installing the HydraSleeve.

   The top of the HydraSleeve must be within the saturated screen, and the length of saturated screen above the HydraSleeve must be at least as long as the HydraSleeve (preferably ≥6 inches longer). In short-screen wells, or wells with a short water column, it may be necessary to use the top-weight to compress the top of the sleeve.

3. Allow a minimum of 1 hour for HydraSleeves to equilibrate. In periodic sampling programs, the sampler for the current sampling event can be recovered and a new sampler (for the next sampling event) deployed immediately thereafter, so the new sampler remains in the well until the next sampling event.

4. To retrieve the sampler, pull the line quickly to open the reed valve. Use a “fish on” upward pull to move it quickly upward 3 to 5 ft (1 foot per second or faster). Alternatively, cycle the HydraSleeve up and down to sample a shorter interval.

   The HydraSleeve will fill in a matter of seconds. When the sleeve is full, the reed valve closes by itself. Carefully pull the full sampler out of the well.

5. Immediately fill sample containers by puncturing the sleeve with the pointed discharge tube and draining the water into the containers. Avoid contact between the sampler and sample container. Minimize contact between water and the atmosphere.

6. Lock the well cap.

4.3.3.2 Snap Sampler

1. Load the sample bottles into the sampler and set the triggers (refer to manufacturer’s instructions). Tie off the tether to a fixed location (in case it is inadvertently dropped).

2. Install the sampler to the target depth; typically, the sample bottles need to be in the center of the saturated interval of the screen. If the water level is above the top of screen, simply divide the screen length by 2 and add it to the depth of the top of screen. If the water level is below the top of screen, then use the effective screen length (only the portion that is under water).

3. Allow a minimum of 1 week for the Snap Sampler to equilibrate. In periodic (i.e., quarterly, semi-annual, or annual) sampling programs, the sampler for the current sampling event can be recovered and a new sampler (for the next sampling event) deployed immediately thereafter, so the new sampler remains in the well until the next sampling event.

4. To retrieve the sampler, pull the trigger line quickly to snap the bottle caps closed and then carefully pull the sampler out of the well. For the manual trigger, the cable end should be pulled with sufficient force to move the cable up the tubing. Depending on the length of the cable, closure of the samplers usually can be felt through the trigger line when the samplers trip. (There is also a pneumatic trigger option; consult the manufacturer's instructions for use.)

5. Lock the well cap.

4.3.3.3 Bailers

1. If sampling a low-yield formation, remove the standing water in the well one time (bail the well dry); collect the purge water in a container and document the volume.

2. If sampling a high-yield formation, then there are two options: (a) purge the calculated volume of water in the well three times (refer to Appendix B to find the volume of water that needs to be purged) or purge continually until water quality parameters have stabilized (refer to Appendix C for stabilization criteria).

3. Record the volume purged, depth to water, water quality parameters (if measured), and clock time on ENVF-2006.02, "Groundwater Purging and Sample Collection Form."

4. Monitor the water level and collect samples as soon as a sufficient volume of water has recharged. Ideally, the bailer inlet should be positioned near the center of the saturated screened interval. (Consult the well completion diagrams or UFP-QAPP for the screen interval depth.)

5. Perform any operations necessary to fill the bailer. (Most bailers fill automatically; however, some have a manually operated valve.)

6. Slowly retrieve the bailer from the well. To the extent practical, avoid contact with the casing to minimize dislodging rust or foreign objects that could contaminate the samples.

7. Transfer water from the bailer into sample containers. Avoid contact between the bailer and sample container. Minimize contact between water and the atmosphere.

8. Lock the well cap.

4.3.4 Sample Handling

Refer to the UFP-QAPP for sample containers, preservation requirements, filtration requirements, and the necessary quality control samples.

1. Label each sample as it is collected. The order that sample containers are filled is important; refer to the UFP-QAPP for the required order.

2. Immediately place sample containers on ice in a cooler (for samples that require temperature preservation). Keep samples out of sunlight. Keep samples from freezing when outside temperatures are low.

3. Maintain sample temperature as specified in UFP-QAPP. Ship/deliver samples to the laboratory as soon as practical; organics, nutrients and others with short hold times should be shipped the same day they are collected.

4. Verify sample information is complete and accurate on bottle labels, custody form, and in the field documentation.

4.3.5 Investigation Derived Waste

Purging, sampling, and field cleaning of equipment generate investigation derived waste. All liquids should be containerized in the appropriate United Nations-rated screw-top or bung-top waste container, labeled, characterized, and disposed of according to site-specific policies and federal regulations.

Reference the project-specific UFP-QAPP, Work Plan, Waste Management Plan, or Environmental Procedure (ENVP)-2017, “Waste Management for Environmental Investigations” for guidance.

5. QUALITY ASSURANCE/QUALITY CONTROL

Typically, a survey mark (“V”-notch) exists on the top of the inner riser pipe to ensure a common reference point for groundwater level measurements. If a permanent survey mark is not available,

then measurements should always be taken from the due north side of the riser pipe. If there is not a riser pipe, then the measurement point should be due north on the grout apron or outer protective casing. The measurement reference point must be documented along with the water level measurements.

Samples requiring pH adjustment may need to have their pH checked to ensure that the proper pH has been obtained. This will require that a test sample be collected to determine the amount of preservative that needs to be added to the sample containers prior to sampling. Discuss with the project chemist.

Certain situations may produce rapidly changing groundwater levels that necessitate taking measurements as close in time as possible. Large changes in water levels among wells may be indicative of such a condition. Rapid changes may occur due to atmospheric pressure changes, tidal influences, changes in river stage, flow in nearby ditches, pumping of nearby wells, or stormwater runoff. Cascading water, particularly in open-hole or rock wells, may interfere with water level measurements.

Oil or other product floating on the water column can insulate the contacts of the probe and give false readings. If a separate phase is present, then an oil/water indicator probe is required for measurement of product thickness and water level.

When placing the pump downhole in the center of the well screen, note the units of measurement for the screen top and screen bottom. Often, well construction measurements will reference ground surface and will have to be corrected to account for the riser pipe stickup (or stick-down with surface completions).

Equipment must be decontaminated prior to initial use in the field and before each subsequent use at a different sampling location (don't forget clips, weights, tubing, or any other items that go downhole). In general, sampling activities should start at the least contaminated location and move inwards towards the most contaminated location.

Using the incorrect type of pump can ruin sample quality (e.g. organic samples should not be collected through peristaltic pump-head tubing). Refer to the project UFP-QAPP and technical guidance documents referenced below for detailed discussion.

6. RECORDS

- Logbook or daily field activity form
- ENVF-2006.01, "Groundwater Level Measurements"
- ENVF-2006.02, "Groundwater Purging and Sample Collection"

7. REFERENCES

Personnel using this procedure should be familiar with the technical guidance documents and must be trained to all the associated North Wind procedures:

ENVF-2006.01, “Groundwater Level Measurements”

ENVF-2006.02, “Groundwater Purging and Sample Collection Form”

ENVP-2002, “Sample Handling and Shipping”

ENVP-2003, “Field Documentation”

ENVP-2004, “Collection of Quality Control Samples”

ENVP-2011, “Field Measurements”

ENVP-2014, “Equipment Decontamination”

ENVP-2017, “Waste Management for Environmental Investigations”

QAP-171, “Records Management”

QAP-3121, “Control of Measuring and Test Equipment”

ASTM, 2021, *Standard Practice for Low-Flow Purging and Sampling Used for Groundwater Monitoring*, D6771 – 21, November 1, 2021.

USEPA, 2023, Region 4 U.S. Environmental Protection Agency Laboratory Services & Applied Science Division Athens, Georgia, Operating Procedure, Groundwater Sampling, United States Environmental Protection Agency, April 22, 2023.

USEPA, 1996, Groundwater Issue Low-flow (minimal Drawdown) Groundwater Sampling Procedures, United States Environmental Protection Agency, April 1996.

USEPA, 1992, RCRA Ground-Water Monitoring: Draft Technical Guidance, United States Environmental Protection Agency, November 1992.

Appendix A
Preparation Checklist

	SAMPLING EQUIPMENT	Notes
	Multiparameter meter with flow cell * pH/ORP probe MUST be replaced if it was not stored dry for more than 2 weeks (probes have to be stored in in pH 4 buffer to preserve life).	*Verify Factory calibration documents are less than 12 months old *Verify that the units are fully charged and calibrated before each workday
	Turbidimeter w/ manual	*Verify that the units are fully charged and calibrated before each workday
	Downhole sample tubing (polyethylene, Teflon lined, HDPE, LDPE, etc.)	*Verify required sample tubing for contaminants of concern
	Peristaltic or centrifugal pumps, tubing and power supply	
	Submersible pumps (electric or pneumatic), controllers, power supplies, hoses	
	HydraSleeves (with weights and clips if needed)	
	Snap Samplers (with appropriate sample bottles, if needed)	
	Electronic water level meters (100 ft, 300 ft., 500 ft. as needed)	
	Electronic oil/ water interface meter (where free product possible)	
	Wind and temperature meter (Kestrel or similar)	
	Portable generator, batteries, charger, etc. with GFI protected extension cord	
	Pre-Sampling Quantity Check:	

Filters:	Solid waste containers:	Nitrile Gloves:
Bladders:	Liquid waste containers:	Liquinox/Alconox:
Bailers:	Nitrogen Gas:	DI Water:
Tubing:	Batteries/Generator:	Alcohol:

	Check calibration standards amounts and expiration dates for these various standards:	*Conduct receipt inspection for new standards *File certificates of analyses and SDSs for all chemicals

Ph 4:	Conductivity:	
pH 7:	ORP:	
pH 14:	Turbidity:	

	Complete bottle sets, preferably provided by the laboratory. Containers assembled into “kits” one per well.	*Complete receipt inspection for containers, container labels, FedEx labels, custody labels, and custody forms.
	SAMPLING SUPPLIES	
	Functional ice machine, ice freezer, bagged ice	
	Coolers for sample collection (prior to shipping)	
	Ziploc 1-gallon freezer bags	
	Plastic sheeting	
	Silicon tubing (if needed for peristaltic pump)	
	Purge bucket (non-UN rated)	
	Calibrated beaker	
	Downhole safety cable with reel and line counter	
	PAPERWORK	
	Waterproof black pens and markers	
	Logbook and/or up-to-date field forms, and CoC forms (*print new versions*)	
	Maps of sites and well locations	
	Contact information for sites, access or right of entry documents	

	Safety documents, emergency contacts, and blank tailgate form	
	Applicable sections of UFP-QAPP or SAP/FSP	
	FedEx shipping labels, preferably pre-filled labels provided by the lab	
	BLADDER PUMP EQUIPMENT	
	Nitrogen K-Bottles, filled, upright in truck-rack or properly secured	
	Swagelok fittings for tubing to high pressure pump	
	Extra QED Bladders, high-pressure bladder, grab plates and O-rings	
	Quick release for pump airline	
	500 ft. stainless steel cable and hydraulic reel (*as needed for deep wells*)	
	Air pressure control boxes, pressure regulators, pressure hoses and fittings	
	SAFETY EQUIPMENT	
	First aid kit	
	Multiple size nitrile gloves	
	Mechanic Gloves/ work gloves	
	Dark and clear safety glasses	
	Face shield and aprons	
	Reflective vests	
	Sunscreen	
	Whip Checks *(if using pressurized air lines)*	
	DECON EQUIPMENT	
	UN Rated buckets w/ screw on lids for solid and liquid	*Verify UN ratings on ULINE website
	UN Rated containers for decon liquid waste *ULINE*	*Verify UN ratings on ULINE website
	Decontamination Brushes	
	Spray bottles with detergent, tap water, DI water, alcohol, etc.	*Verify bottles labeled per HAZCOM
	Blue shop towels	
	MISCELLANEOUS	
	Drinking water, Gatorade	
	Car Charger for radios/phones	
	Bolt Cutters	
	Extra combo pad locks for possible replacement	
	Portable air pump for tires	
	Portable jump starter	
	Toolbox (screwdrivers, hammer, wrenches, etc.)	
	Ratchet Straps	
	Extra batteries: 9-volt, AA, C, D	

Appendix B
Calculation of Volume of Standing Water in a Well

The amount of water standing in the water column (water inside the well riser and screen) is determined by the diameter of the well, total depth of the well, and the water level in the well. Subtract the water level from the total depth to get the length of the water column. Calculate the volume of standing water in a well as follows:

$V = 0.041\ d^2h$

Where:

h = length of water column in feet

d = diameter of well in inches

V = one well volume in gallons

Common volumes per feet are provided below:

Well Diameter (inch)	1 Well Volume (gallons/feet)	3 Well Volumes (gallons/feet)
0.5	0.01	0.03
0.75	0.02	0.07
1	0.04	0.12
2	0.16	0.49
3	0.37	1.1
4	0.65	2.0
5	1.0	3.1
6	1.5	4.4

Document required “well-volumes” and equivalent purge volume in logbook or field forms. When purging is complete, document the total volume of water purged.

Appendix C
Groundwater Stabilization Criteria

Dissolved oxygen (DO), oxidation-reduction potential (ORP), specific conductance, and pH are indicator parameters measured to determine when the discharge effluent is considered to represent a flow-weighted average of the formation water (*i.e.,* "stabilized") and sampling can begin. Indicator parameters should be measured using a calibrated multi-parameter instrument coupled with an in-line flow-through cell.

The optimum pumping rate must be established, and the pumping water level must be stable prior to determining the stabilization of other parameters.

Stabilization is achieved when three consecutive readings are within the recommended ranges for all the parameters being measured, and it appears that the readings will continue to remain within those ranges during subsequent readings (i.e., readings are leveling off).

Four industry standard stabilization criteria are listed below. However, specific criteria vary by state, regulatory agency, and client contract Verify and document the appropriate criteria for each project before use.

Parameter	ASTM D6771-2021	EPA Region 4-2023	Puls and Barcelona-1996	RCRA-1992
Flow Rate		<1 L/min	<0.5 L/min	
Pumping Water Level (Dynamic Depth to Water)	<0.1 ft	<0.33 ft	<0.33 ft	
DO	±0.2 mg/L or 10%*	±0.2 mg/L or 10%*	10%	10%
Specific Conductance	3%	5%	3%	10%
ORP	±10 mV or 10%*	±20 mV**	±10 mV	
Turbidity	10% or ±1 NTU*	10% or < 10 NTU	10%	10%
pH	±0.2	±0.1	±0.1	±0.5
Temperature	3%			10%

* Whichever is greater
** Optional for use as an indicator
ASTM = American Society for Testing and Materials
EPA = U.S. Environmental Protection Agency
RCRA = Resource Conservation and Recovery Act

Note: Temperature and pH typically stabilize quickly, turbidity typically stabilizes the most slowly, and other parameters are somewhere in between. Stabilization times can be minimized by (a) maximizing the time between installing the pump and beginning purging, and (b) minimizing the amount of disturbance of water in the well due to installing/removing/moving equipment in the well.

Temperature and ORP should be recorded but are not used as stabilization indicators at most sites. Temperature changes (e.g., heating up) can indicate problems with the pump or tubing.

NORTHWIND
A CIRI COMPANY

Applicability: ES&H
Owner: ES&H Director

For the most recent revision, refer to the Document Management System.

GROUNDWATER LEVEL MEASUREMENTS

For use with ENVP-2006

ENVF-2006.01
Revision: 1
Effective Date: 11/28/2023

Site/Unit Name: _____ Project: _____

Meter Model/SN: Location:

Well I.D.	Date	Time	Reference Point	Depth to Water (ft)	Depth to Product (ft)	Depth to Bottom (ft)

Observations:

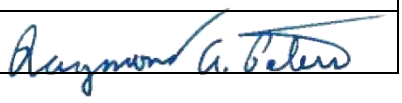
Weather:

Personnel Names:

NOTE: This completed form is a record and shall be completed entirely and maintained in accordance with project/program records management requirements.

ENVP-2011
Rev. 0

Field Measurements

Applicability: Companywide	Effective Date: 06/21/19	Approver/ Title: Ray Peters, CIH, CSP ESH&Q Director
For the most recent revision, refer to the Document Management System.		Signature: 

History of Revisions

Revision	Issue Date	Action	Description
0	06/21/19	New document.	Integration of North Wind procedures.

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ACRONYMS AND ABBREVIATIONS

ENVP	environmental procedure
eV	electron volt
GIS	geographic information system
GPS	Global Positioning System
IH	industrial hygiene
NAD27	North American Datum 1927
NAD83	North American Datum 1983
NGS	National Geodetic Survey
NOAA	National Oceanic and Atmospheric Administration
PDOP	point dilution of precision
PID	photoionization detector
ppb	parts per billion
ppm	parts per million
QAP	quality assurance procedure
SAP	sampling and analysis plan
UTC	Coordinated Universal Time
VOC	volatile organic compound

1. PURPOSE

The purpose of this environmental procedure (ENVP) is to set guidelines for determining location for samples taken in the field. This procedure may be varied or changed as required, dependent on site conditions, and equipment limitations. This ENVP also sets guidelines for the calibration of photoionization detectors (PIDs) before, during, and after use, and provides basic instructions for performance of field screening.

2. SCOPE

This ENVP applies to environmental field work and sampling efforts performed by North Wind Group and its wholly owned subsidiaries (herein either individually or collectively referred to as North Wind). All employees and subcontractors performing work on North Wind–controlled job sites that take field measurements as described herein will follow this ENVP, except where client- or contract-specific procedures are required. Where referenced, this ENVP applies to all North Wind and subcontractor personnel performing work described herein.

NOTE 1: *A PID is a scientific instrument that requires training on its principles and methods as well as hands-on practice under supervision prior to actual sampling and data interpretation. First-time user of PIDs must obtain project-specific training on the use of the instrument. This ENVP serves as a reference for field screening and a reminder that calibration must be performed every workday prior to use of PIDs in accordance with QAP-3121, "Control of Measuring and Test Equipment."*

NOTE 2: *QAP-3121 also applies to location equipment, such as mapping grade Global Positioning System (GPS) units.*

3. RESPONSIBILITIES/PREREQUISITES

3.1 Responsibilities

Performer	Responsibilities
Project Manager	• Meets each customer's expectations and serves as a primary point of contact with the customer. • Ensures that geologist/sampling technician(s) and industrial hygiene (IH) technician(s) have access to necessary equipment to complete measurements. • Ensures that geologist/sampling technician(s) and IH technician(s) follow protocol and procedures for completing measurement task(s). • Determines sampling location accuracy level based on project needs or government agency standards.

Performer	Responsibilities
Geologist/Sampling Technician(s)	• Ensures that appropriate preparation and planning are completed prior to measurement activities to reduce delays in startup or progress of task. • Ensures that all materials and equipment are available for the measurement task(s). • Communicates on a routine basis with the project manager on the status of task(s), any additional needs to complete task(s), and on any issues related to properly completing task(s). • Follows all procedures, plans, and protocols to adequately complete field location measurement task(s). • Ensures that all documentation of location measurement activities is complete and legible. • Develops a site sketch in accordance with QAP-3121, "Control of Measuring and Test Equipment," and ENVP-2003, "Field Documentation," with approximate locations and with appropriate sample IDs.
IH Technician(s)	• Responsible for on-site monitoring and field screening using a PID. • Ensures that appropriate preparation and planning are completed prior to measurement activities to reduce delays in startup or progress of task. • Ensures that all materials and equipment are available for the measurement task(s). • Conducts instrument calibration and records calibration data in accordance with QAP-3121, "Control of Measuring and Test Equipment," and ENVP-2003, "Field Documentation." • Performs field screening through headspace analysis of field samples as needed and records information with appropriate sample IDs in accordance with ENVP-2003.

3.2 Prerequisites

None

4. PROCEDURES

4.1 Location Equipment

4.1.1 Introduction

Field measurements of topographic features and physical dimensions are frequently required during field investigations. The purpose of the investigation will determine the scope and method of these measurements.

All sampling locations used during field investigations should be depicted on an accurate drawing, topographic or other standard map, or be referenced in such a manner that the location(s) can be firmly established. Types of required documentation, and the level of rigor associated with location documentation, are communicated in project contractual documents and described in project-specific SAPs. Prior to measurements being taken, the geologist/sampling technician(s) typically develop a site sketch in accordance with QAP-3121, "Control of Measuring and Test Equipment," and ENVP-2003, "Field Documentation," with approximate locations and with appropriate sample IDs.

Each field measurement made should be traceable to the person(s) making the measurement and to the field equipment used to make that measurement. Equipment calibration shall be performed in accordance with QAP-3121, "Control of Measuring and Test Equipment." Equipment maintenance, calibration, and operations records shall be kept in field records per ENVP-2003, "Field Documentation," so that the procedures are traceable. Time records shall be kept in local time using the hour format, with the time recorded to the nearest 5 minutes or less.

New or inexperienced employees shall perform each of the physical field measurements described in this section under the supervision of a senior technical staff member at least once before being permitted to make these measurements on their own.

Surveying is described as the art and science of determining the area and configuration of portions of the Earth's surface, and representing them on maps. Generally, surveying can be divided into two categories or classes: horizontal control surveying and vertical control surveying. Horizontal control surveying pertains to the measurement of the relative difference in the horizontal location of two or more control points. Vertical control surveying involves the measurement of the relative difference in vertical location, or elevation, of two or more control points. The following sections discuss the standard procedures, techniques, and methods used to survey, or locate sample points or site features horizontally. Basic surveying and field geology textbooks should be consulted for more detailed information on this topic (Breed and Hosmer 1940, 1945; Compton 1962). This ENVP addresses only horizontal location surveys. Vertical control

will be specific to each project and will be addressed in project-specific work control documents when needed.

4.1.2 Horizontal Location Surveys

Several field methods, from traditional or classical methods to GPS techniques, may be used to horizontally locate sample points or various site features during site investigations. Traditional traverse methods utilize horizontal angle or direction (azimuth/bearing) measurements and calculate horizontal distances from a starting point to a second point and from the second to the third, and so forth to the last point. The last point in a traverse is usually a return to the starting point, thus making a closed loop. During a traverse for site control, sample points or site features may be located by employing various techniques at the traverse control points, including:

- By angle (azimuth or bearing) and distance measurements from a control point
- By angular intersection from two control points
- By perpendicular offset from a line between two control points
- By angle from one control point and distance from another control point.

The majority of projects will use GPS methods to derive sample locations. GPS methods utilize radio frequency measurements with multichannel receivers of the signals from the global network of satellites that the U.S. Department of Defense has established. Measurements of the horizontal sample locations or site features by GPS technology is based on the same principles used in traditional surveying methods. However, with space-based GPS, hand-held receivers and dataloggers measure the distances to three or more non-coincident points or satellites of known positions and triangulate the position of the sample location, site feature, or point on earth.

Regardless of the method(s) used, horizontal location surveys should be based on established control points. A network of horizontally (and vertically) located control points has been established and is continually maintained by the National Oceanic and Atmospheric Administration (NOAA) through its National Geodetic Survey (NGS). The old horizontal datum, called the North American Datum of 1927 (NAD27), is currently being replaced with the newer datum of 1983 (NAD83). The NAD27 system of horizontal control points established geographic latitude and longitude positions and provided the basis for the State Plane coordinate grid systems used by many states.

When measuring horizontal angles, compensation should be made for the angle between true north and magnetic north. This angle is called the magnetic declination. Field surveying methods should be referenced to true north. Sources of existing information on horizontal control stations or coordinate grid data and

their "exact" locations may be obtained from local, state, or federal departments or agencies. However, the best place to obtain horizontal control point data is from the website www.ngs.noaa.gov. Typically, the engineering or public works departments of counties, cities, or towns have data on file that is near the particular site being investigated.

Before conducting a field survey, the project must first determine the required accuracy or any special requests identified by the client or applicable government standards. If locations need to be collected and stamped by a professional land surveyor, then collection will need to be subcontracted to a licensed professional or North Wind will need to hire a registered professional land surveyor. Different states have different standards for data collection. Project managers must determine what requirements are applicable to each project.

4.1.3 Location Information Collecting Equipment

North Wind has several pieces of equipment for collecting location information. Each has a different accuracy and should be matched up with the project requirements. This procedure does not discuss survey-grade GPS units since they require special training. A survey-grade GPS has a horizontal accuracy of 2.5 cm.

Among the mapping-grade GPS units available to North Wind are the following:

- A backpack-style Trimble Pro XRS, which is equipped with a datalogger and makes collecting many points easier because of the full alphanumeric button set. Accuracy is sub-meter after differential correction (<1 m).
- A Trimble XT, which provides 2-ft accuracy after differential correction.
- Several older GPS units called Trimble Geo Explorer III's. The majority of projects use this style of GPS unit. Accuracy is 1 m after differential correction.
- Although recommended as a last resort, there are several recreational-grade GPS units throughout the company. Accuracy is 8–10 m and the data can't be differentially corrected. Recreational grade is mostly for hikers and campers and is sold in typical shopping centers. Because data can't be corrected, accuracy can't be validated and calibration can't be certified, so keep this in mind when collecting field data.

Additional equipment is available commercially for rent or purchase based on project needs and internal equipment availability.

Sometimes there won't be any satellite availability to use a GPS unit. If that happens, survey tape and compass can be used to generate swing ties from known permanent locations (building corners, fence corners, other surveyed wells, etc.) to the sample collection point. At least three swing ties will be needed to tie the sample location onto a map.

4.1.4 Quality Control Procedures

All professional staff and field technicians must be trained by qualified staff in surveying equipment and procedures before performing surveys.

Each piece of field equipment shall be numbered, and documentation shall be kept regarding all maintenance and calibrations per ENVP-2003, "Field Documentation." GPS receivers will be evaluated, maintained, and calibrated as follows:

- Be evaluated before use as specified in user manuals
- Be serviced and calibrated by the manufacturer if damaged or suspected to be in error
- Be cleaned and maintained during field use and before being returned to storage as specified in user manuals.

Equipment calibration shall be performed in accordance with QAP-3121, "Control of Measuring and Test Equipment."

4.1.5 Procedures for Differential GPS

Differential GPS involves the use of two or more multichannel receivers. One or more are used as the rover receiver(s) and one is used as the base station. The base station and the rover(s) should be within 200 to 300 miles of each other in order to increase the accuracy of the measurements (accuracy increases as separation between base and rover decreases) and have a clear view of the sky. The base is set up on a control point of known horizontal location (usually expressed in terms of latitude, longitude, and elevation).

Trilaterated coordinate positions from the satellites are recorded at the base, which will be compared to the actual horizontal control point coordinates for the development of a correction factor to be applied to other roving GPS units. Since the base station receiver and the rover receiver(s) synchronize with the satellite's clocks, data must be recorded or logged by both receivers at the exact same time in order for the correction factor to be applicable. Often, base station data will be obtained via modem, disk, or internet after the field data collection by the rovers. It is therefore extremely important to coordinate the logistics and planning for using GPS techniques before leaving for the field.

The procedure for using GPS to locate horizontal positions of site features is quite simple. The GPS receiver/datalogger is turned on and a predefined point, line, or area feature to be mapped is selected from a data dictionary within the datalogger. Once the feature is logged, the receiver/datalogger user closes the feature, moves to the next feature for logging and so forth until all site features are logged. The data files are then downloaded, differentially corrected, if necessary, and exported to geographic information system (GIS) applications for

mapping and display of the features logged. Navigation to predefined points (called waypoints) is accomplished by selecting the waypoint from within the datalogger, and proceeding in the direction displayed by the datalogger until arriving at the waypoint desired.

However, depending on which GPS receiver/datalogger is used (Pathfinder Pro XRS, Geo XT, Geoexplorer III, etc.), different types of GPS processing measurements can be made: code pseudorange or carrier phase. With these different processing measurements comes different accuracy. When code pseudorange is employed, the autonomous position measurements (without differential correction) will be within about 10 m using the receivers/dataloggers listed above. When code pseudorange is used with differential GPS (this is either real time or post-processed), the position measurements will be less than 1 m for the Pathfinder Pro XRS, Geo XT, or Geoexplorer III. When carrier phase is employed, the receivers/dataloggers can obtain sub-meter accuracy for points to be logged only (not waypoint navigation), and it is necessary to occupy each point feature a minimum of 5 minutes. So, although the basic procedures are simple and easy, some thought must be put into the planning of the data collection effort in order to define the features to be logged, capitalize on the accuracy, and to meet the objectives of the project.

All professional staff and field technicians must be trained in the use of the GPS equipment by qualified staff before using this equipment. Specific procedures on the operation and setup of the GPS equipment are described in detail in the operations manuals for each of the instruments. All instruments will be used in accordance with the instructions in these manuals. A copy of each of the manuals will be maintained by designated personnel.

The following templates list the methods and procedures to be considered and performed if differential GPS procedures will be used to datalog GPS positions or horizontally locate sampling points or other site features.

Template 1. Planning To Capture GPS Data.

- Training in the use of GPS equipment is critical to the success of a field project.
- The objectives and accuracy requirements shall be established and factors that might limit the use of the GPS equipment shall be assessed.
- Check the availability of the GPS equipment and test it prior to going in the field in order to ensure that it works properly and meets the requirements of the field project.
- Decide what features (points, lines, or areas) and their attributes at a site will be captured with GPS equipment and create a Data Dictionary on the PC with Pathfinder Office software. Transfer the Data Dictionary to datalogger.

- Check the availability of horizontal control point data at or near the site for GPS equipment precision and accuracy check. If none exists, remember to log at least four points that surround the site and that can be seen in aerial photographs or topographic maps for checking and GIS geo-referencing.
- Check the availability of base station coverage if the project is not dependent on collecting real-time data.

Template 2. Differential Correction.

- If a real-time GPS unit was used for data capture, the data file(s) must be checked to see if all positions were differential corrected through the real-time broadcast signal. If any portion of a data file was not corrected with the real-time broadcast signal, a base station file must be obtained in order for all positions in the file to be differentially corrected.
- In Pathfinder Office software on the PC, select File, then Open. Select the data file(s) to look at, then select "OK." After a brief scan of the features, one by one, identify the features and file name(s) that need a base station file for differential correction, then close the file(s).
- Obtain base station file(s) from a base station as close to the site as possible and that match the month, date, and coordinated universal time (UTC) hour of the data file(s) exactly and place in the *Base* subdirectory of the *Project* directory in Pathfinder Office software on the PC (C:\Pfdata\(Project)\Base). These can be obtained through modem, internet, email, or disk via regular mail. The data files and the base station files use a similar file naming convention and will identify the month, date, and UTC hour that the base station file was collected. The following is the base station file naming convention:

  CITY YEAR MONTH DATE HOUR (UTC) A 9 02 15 14

- The following websites are good starting points for base station files and cover the United States:

  http://www.ngs.noaa.gov/CORS/cors-data.html

  http://www.fs.fed.us/database/gps/clickmap/cbsmap.htm

- Once base station files are obtained that match the month, date, and UTC hour, in the data files as indicated above (and also in the same year), in Pathfinder Office software on the PC, select "Utilities" and then "Differential Correction."
- Select the rover file(s) (more than one may be selected) to be differentially corrected. If the base station files were placed in the *Base* subdirectory as mentioned above, select "Local Search" and the base station files that match the data files will be highlighted. Select "OK."

- The differentially corrected files will be placed in the *Project* directory with a "*.cor" extension and the processing should be set to *Smart Code* and *Carrier Phase Processing*. After all of the above procedures are followed, select "OK" to start the differential correction process.
- To view the corrected files, select "File" and then "Open" and the corrected files should be highlighted. Select "OK" to view, then scan through the features to make sure all positions were differentially corrected.

4.1.6 Accuracy

Accuracy in a GPS is dependent upon atmospheric distortion, the number of connected satellites, how the satellites are arranged in space, the amount of time spent collecting the specific point, the type of receiver and antenna, and the experience of the person collecting the features.

Atmospheric distortion can be corrected after the data are collected when project members return to the office. The distortion can be corrected by using a base station within range (<300 miles) that has been surveyed in by a professional land surveyor. Each data file on the receiver is time stamped and the time stamp value is compared to the base information file at the same time to attain a correction value. The process is semi-automated in the Pathfinder Office software. Atmospheric distortion is approximately 90% of the error associated with GPS. (This is why we do not recommend using recreational-grade GPS units, which don't have a way to correct for the atmospheric distortion.)

Another contributor to poor accuracy is the number of satellites and how they are arranged in space. A minimum of three satellites are needed to pick up horizontal values and four satellites to pick up elevation. The more satellites, the better. If the satellites are poorly arranged (like in a line), the accuracy goes down since it doesn't triangulate as well. The best arrangement is satellites spread throughout the sky. All GPSs have a screen that shows what satellites they are tracking and where they are located in space. Point dilution of precision (PDOP) is a numeric assessment of these errors. For most surveys, a PDOP of less than 6 is needed. The PDOP value is displayed on all GPS units.

The Pathfinder Office software uses an averaging algorithm when locating positions. The longer the time collecting over a point, the better the accuracy of that point. Time can range anywhere from 1 minute a point to 5 minutes. Some of the super-high-accuracy GPS units require 60 minutes a point.

The type of receiver and antenna play a role in the quality of data collected. Typically the more expensive units have better antennas and receivers.

Items to check in the field include:

- Making sure the antenna is over the location of collection

- Confirming that the antenna is level
- Making sure technicians have a good field of view to the sky. Areas of high vegetation or in a canyon will narrow the number of satellites the GPS receiver can see. In some cases an offset may be necessary in order to get good GPS signals.

4.2 Photoionization Detectors

4.2.1 Preparatory Information/Activities

A photoionization detector (PID) measures organic vapors. It indicates if volatile organic compounds (VOCs) are present, but it does not identify type. It incorporates a sampling pump and data download capabilities for monitoring, site survey, and leak detection. It is typically intrinsically safe and easy to use.

PIDs will be used in accordance with this ENVP and the manufacturer's documentation.

A PID can measure double-bonded organic vapors in a variety of ranges. The IH technician, with assistance from the Health & Safety Manager as needed, must determine the upper and lower range limits needed for the PID to be used based on the potential contaminants of concern, typically described in the SAP. Typical PIDs measure VOCs and other gases in concentrations from the parts-per-million (ppm) to parts-per-billion (ppb) level. Contaminants with very low occupational exposure limits typically require ppb sensitivity on the lower end of the range.

The PID technique uses a lamp with known photon energies. The output from the lamp is used to photoionize gaseous molecules with ionization potentials lower than the photon energy emitted. PID lamps are available with ionization energies ranging from 8.4 electron volt (eV) to 11.8 eV. The most typical applications are 10.6 eV and 11.7 eV lamps. The 10.6-eV lamp is most commonly used, detects the largest number of compounds, and is most durable. However, a number of compounds are detected only with the 11.7-eV lamp (carbon tetrachloride, chloroform, ethanol, formaldehyde, trichloroethane, etc.). Also be aware that a number of organic compounds (e.g., semivolatiles) cannot be detected by PIDs. If unsure regarding lamp energy requirements, reference the manufacturer's literature to verify that the target analyte is detectable and to select the proper lamp. Manufacturer's literature will also help the IH technician become familiar with other limitations of the instrument, including the use of correction factors to obtain the concentration of the gas being measured (when different than the calibration gas used).

The IH technician shall ensure that the PID chosen is appropriate for use in the intended field environment per the IH Sampling and Monitoring Equipment section of HSP-1138, "Industrial Hygiene Program."

The IH technician will need to ensure that the PID is fully charged and verify that the following items are available on site: spare lamps, calibration gas, logbook/sample forms, indelible pens, 110-V power supply (generator or 12-V inverter) for charging, Ziploc® bags, infrared thermometer, and other items based on the SAP.

4.2.2 PID Operating Procedures

Turn the PID on and pay attention to the unit as it goes through its operational self-check. The manufacturer's documentation describes the normal sounds and display parameters for the unit's self-check activities, as well as sounds or display parameters which may indicate failure or improper operation of the unit.

Once the PID is turned on and in normal operating mode, follow on-screen instructions to perform calibration and field screening activities. Calibration and calibration data recording shall be performed in accordance with manufacturer's documentation, QAP-3121, "Control of Measuring and Test Equipment," and ENVP-2003, "Field Documentation." ENVP-2003 also applies to PID field screening activities.

For PIDs with data-logging capability (preferred), follow manufacturer's documentation to ensure this function is enabled.

4.2.3 Calibration

Calibration must be performed every work day prior to use of the PID. Additionally, calibration is required after the PID lamp has been replaced. The IH technician performing calibrations must document the calibration data as required by the project-specific SAP and health and safety plan.

There are typically two calibration modes for a PID: "Fresh Air" and "Standard Reference Gas." The fresh air mode is used to set the zero point of the instrument in the absence of VOCs (and to calibrate oxygen sensors on PIDs which are part of multi-gas detection units). After the PID zero point has been set, the Standard Reference Gas mode is used to set the PID sensor to the known concentration of a given VOC. Typically, a known concentration of isobutylene is used for PID sensor calibration, and correction factors are used to determine concentrations of other contaminants detected. This set point will be used as a point of reference in field screening. The IH technician shall ensure that gases used for calibration are not expired and have a documented certificate of analysis.

Follow instructions in the manufacturer's documentation and on the PID display screen until calibration is complete.

4.2.4 Field Screening Procedures

The IH technician is responsible for field screening of VOCs. Use of the PID in field screening is determined by requirements established in project-specific SAPs and health and safety plans. Field screening typically requires headspace analysis of soil samples containing various VOCs. Follow the SAP to perform headspace analysis. Typical analysis steps are outlined below:

- Don clean latex or nitrile gloves before collecting each individual sample (refer to ENVP-2008, "Soil Sampling," for additional precautions and requirements).
- Fill a Ziploc® bag with approximately 8 oz of soil suspected of containing the VOC.

  NOTE: *This function can also be performed using a SAP-approved sample collection container with a septum lid for insertion of PID sample probe.*

- Shake the bag for 15 seconds immediately after filling the bag. Warm the contents, if needed, to approximately 40–60ºF (4–20ºC), with 60ºF (20ºC) being the optimum temperature. Check temperature of the soil using an infrared thermometer, as needed. If the soil was frozen when filling the bag, shake the bag again after the soil has reached the desired temperature range.
- Let the sample bag sit for 10 minutes to 1 hour, to allow accumulation of headspace vapor.
- Shake the bag again for 15 seconds immediately before taking the headspace measurement of VOC concentration.
- Open one corner of the bag to allow just enough room for inserting the sample probe and seal the opening around the probe. Follow PID manufacturer's documentation and on-screen instructions to take headspace measurements. Record the highest reading (usually registered within the first 5 seconds of probe insertion) in the field documentation and include sample ID.

References to action levels and occupational exposure limits for the contaminants of concern shall be readily available during field screenings. If PID readings indicate that an action level or occupational exposure limit has been exceeded, sampling activities **shall be paused** (e.g., stop, isolate, and notify) and notifications shall be made (i.e., PM, Health and Safety Manager) to determine if work can continue and if additional precautions need to be documented, briefed, and implemented.

5. RECORDS

All data must be documented on field data forms or sheets, or within site logbooks per ENVP-2003, "Field Documentation."

All instrumentation must be operated in accordance with operating instructions as supplied by the manufacturer, unless otherwise specified in the work plan. Equipment checkout and calibration activities must occur prior to field activities, and they must be documented per ENVP-2003, "Field Documentation," and QAP-3121, "Control of Measuring and Test Equipment."

All information generated during the measurement tasks is to be recorded in the project file and North Wind records per QAP-171, "Records Management." At a minimum, the project file and records shall contain:

- Project authorization form and supporting documentation (contract release, statement of work, schedule, SAP, etc.)
- Correspondence specific to locations or standards set by project
- Quality Assurance documentation (calibration data and certificates, certificates of analysis, etc.) where applicable
- Project deliverables and supporting notes, calculations, field documentation, site sketches, datalogs, etc.

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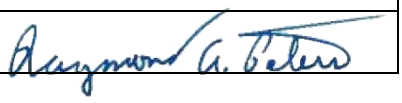
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ENVP-2014
Rev. 0

Equipment Decontamination

Applicability: Companywide	Effective Date: 06/21/19	Approver/ Title:	Ray Peters, CIH, CSP ESH&Q Director
For the most recent revision, refer to the Document Management System.		Signature:	

History of Revisions

Revision	Issue Date	Action	Description
0	06/21/19	New document.	Integration of North Wind procedures.

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ACRONYMS

CFR	Code of Federal Regulations
DOT	Department of Transportation
ENVP	environmental procedure
HDPE	high-density polyethylene
OSHA	Occupational Safety and Health Administration
SDS	safety data sheet

1. PURPOSE

This environmental procedure (ENVP) establishes methods for controlling cross-contamination of samples by proper decontamination of sampling equipment.

2. SCOPE

This procedure is applicable to all employees of North Wind Group and its wholly owned subsidiaries (referred to herein either individually or collectively as North Wind) who are tasked to collect environmental samples, except where client- or contract-specific or procedures are required. Where referenced, this ENVP applies to all North Wind and subcontractor personnel performing work described herein.

3. RESPONSIBILITIES/PREREQUISITES

3.1 Responsibilities

Performer	Responsibilities
Project Manager/ Task Lead	• Ensure data quality through adequate planning and preparatory activities for equipment decontamination as prescribed in this ENVP and other work control documents associated with the activities.
Sampling Technician	• Follow this procedure to ensure that sampling equipment has been adequately decontaminated. • Document the decontamination event in sampling log book, field forms, or other project specific documentation per ENVP-2003, "Field Documentation," to help demonstrate sample quality.

3.2 Prerequisites

None

4. HEALTH AND SAFETY

4.1 Verify that a job hazard analysis (JHA; i.e., HSF-1101.02 or approved equivalent) has been completed for this activity as required by North Wind health and safety procedure HSP-1101, "Project Hazard Analysis."

4.2 Verify that safety data sheets (SDSs) are available for hazardous chemicals and that containers are properly labeled per HSP-1102, "Hazard Communication."

4.3 Don personal protective equipment per HSP-1103, "Personal Protective Equipment," and implement any work controls identified in the JHA (at minimum, nitrile gloves and safety glasses).

4.4 Personnel shall be trained and qualified to perform the activities described in this ENVP. Training and qualification shall be documented and approved by the project manager/ task lead.

4.5 Consider the following decontamination hazards during the project hazard analysis process:

- **Exposure hazard**: Exposure of skin, eyes, and mouth due to splashing contaminants and rinsate. Vapors from contaminants or decontamination solutions may cause an inhalation hazard, especially when steam cleaning.
- **Explosion/fire hazard**: Potential ignition of propane gas with steam cleaners. Vapors from site contaminants or decontamination solutions may be flammable.
- **Impact hazard**: Pressurized water, steam, or air brushes could generate flying debris.
- **Incompatibility hazard**: The decontamination solution may react with contaminants to produce heat, explosion, or toxic products.
- **Chemical degradation**. Cleaning agents may degrade protective clothing; some solvents can permeate gloves or other personal protective equipment.
- **Equipment contamination**. Preventing unnecessary equipment contamination is the most significant aspect of decontamination. Reduce the incidence of contamination by bringing only required equipment into the contamination zone, following as low as reasonably achievable (ALARA) work practices, and sleeving tools and field instrumentation such as photoionization detectors and Geiger-Mueller counters.
- **Waste generation**. Wastes generated from decontamination activities require proper handling, storage, and disposal per ENVP-2017, “Waste Management for Environmental Investigations.”

5. DECONTAMINATION PROCEDURE

NOTE: *Use one-time-use (disposable) sampling equipment when practical to avoid the need for equipment decontamination.*

5.1 Select an appropriate decontamination method considering the type of equipment, type of contamination, data quality objectives, weather, and other site-specific conditions. Appendix A describes commonly used methods.

NOTE: *The project manager/task lead shall approve selections in steps 5.2 through 5.4.*

5.2 Select an appropriate decontamination solution to remove potential contaminants and interfering compounds. Appendix B lists possible decontamination solutions.

5.3 Set up a decontamination station and select appropriate equipment/tools to collect and properly dispose of contaminated media and used decontamination solutions. Appendix C lists commonly used decontamination equipment.

5.4 Implement any hazard controls that were identified in the hazard analysis; don skin- and eye-protective equipment at a minimum.

5.5 Disassemble sampling equipment, as necessary.

5.6 Remove gross contamination by brushing, scraping, wiping, and high- or low-pressure water spray, etc.

5.7 Wash equipment using the selected decontamination solution; remove all visible soil, oils, grease, etc.

5.8 Rinse equipment with tap water.

5.9 Rinse equipment with distilled, deionized, or purified water.

5.10 Additional rinses using specialized rinse agents may be performed if required to meet project objectives. See Appendix B.

5.11 Once dried, wrap sampling equipment with aluminum foil, plastic, or other protective material.

NOTES:

- Use caution to avoid damaging sensitive or electronic equipment during the decontamination process.
- If air drying is impractical due to environmental conditions, use Kimwipes® or equivalent disposable wipes. Alternatively, isopropyl alcohol may be used as a final rinse instead of water if it will not interfere with the intended analyses.
- Decontamination activities typically generate waste as defined by federal regulations (40 CFR 261, “Identification and Listing of Hazardous Waste”). All waste generation activities require some degree of regulatory analysis and hazardous waste determination. Follow ENVP-2017, “Waste Management for Environmental Investigations,” and request direction from the task lead or a subject matter expert if you are unsure of this process.
- Investigation-derived wastes generated as part of environmental remediation activities are often considered to be hazardous waste regardless of contaminant concentration.
- Ensure that wastes which have the potential to meet the definition of hazardous waste are properly containerized, labeled, stored, shipped, and disposed of.
- Ignitable, corrosive, or reactive wastes may require special handling precautions and waste containers.

6. QUALITY ASSURANCE/QUALITY CONTROL

- If deviations from this procedure are necessary, then document the changes in project-specific documents and/or field records per ENVP-2003, “Field Documentation.”
- Based on project requirements defined in applicable project plans, verify decontamination by collecting equipment rinsate blanks, equipment wipes, exterior radiological surveys, or other

confirmation samples, in accordance with ENVP-2004, "Collection of Quality Control Samples."

7. RECORDS

The sampling technician(s) will document each event in project sampling documentation (e.g., sample log book or field forms per ENVP-2003, "Field Documentation"). The project manager/task lead will maintain these records in accordance with QAP-171, "Records Management."

8. REFERENCES

40 CFR 261, "Identification and Listing of Hazardous Waste"

ENVP-2003, "Field Documentation"

ENVP-2004, "Collection of Quality Control Samples"

ENVP-2017, "Waste Management for Environmental Investigations"

HSF-1101.02, "Job Hazard Analysis"

HSP-1101, "Project Hazard Analysis"

HSP-1102, "Hazard Communication"

HSP-1103, "Personal Protective Equipment"

QAP-171, "Records Management"

9. APPENDIXES

Appendix A – Methods for Decontamination of Sampling Equipment

Appendix B – Decontamination Solutions and Rinse Agents

Appendix C – Decontamination Equipment

Appendix A
Methods for Decontamination of Sampling Equipment

In some cases, large pieces of equipment (such as drilling equipment) may be moved to a large secondary containment berm or in-the-ground plastic-lined pad. There they can be cleaned by steam or pressurized water. Drilling equipment that has low potential to cross contaminate samples is not typically cleaned to the same degree as sample containers and other sample collection equipment.

Decontamination methods and considerations are as follows:

- Equipment that is small enough to handle (split spoons, sleeves, shovels, bailers, flow cells, etc.) may be washed by hand in a tub or basin using cloth wipes, brushes, and gloved hands.
- Small equipment (spoons, trowels, flow cells, etc.) may be washed by hand over a bucket or absorbent rags using a hand sprayer with decon solution and a second hand sprayer with deionized or distilled water.
- Low-pressure sprayers (e.g., garden sprayers or concrete sprayers) work well for many applications. Use one for decontamination solution and a second one for tap water rinse.
- High-pressure washers or steam cleaners work well for many applications. These methods typically produce very little wash water and are very effective at removing contaminants, especially if the water is heated.
- In some instances, due to sensitive, non-waterproof equipment or due to the unlikelihood of equipment being contaminated, it is not necessary to conduct an extensive decontamination procedure. For example, air sampling pumps hooked on a fence, placed on a drum, or wrapped in plastic bags are not likely to become heavily contaminated. A damp cloth should be used to wipe off contaminants that may have adhered to equipment through airborne deposits or from surfaces upon which the equipment was set.

Appendix B
Decontamination Solutions and Rinse Agents

- Tap water with a phosphate-free detergent (Liquinox®, Alconox®, or similar) is the most commonly used solution for decontamination of sampling equipment.
- The use of an untreated or non-potable water supply is NOT an acceptable substitute for tap water.
- Distilled or deionized water, commonly available from grocery stores, is an acceptable rinse agent for most environmental sampling activities.
- Prior to using food-grade distilled/deionized water, verify that project-specific sampling plans do not require special rinse agents (high-purity liquid chromatography water, laboratory-certified deionized water, etc.). High-purity water is available from most chemical suppliers.
- Dilute acids (10% or less of nitric acid, acetic acid, or boric acid) may be used as a rinse agent in cases where basic (caustic) compounds or metal contamination is a concern. Acid rinses should not be used on metallic sampling equipment.

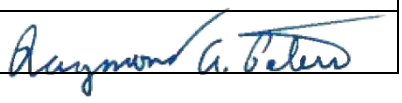
  NOTE: *Acids, bases, solvents, and other hazardous decontamination chemicals shall be used, handled, stored, and inventoried in compliance with North Wind's HSP-1102, "Hazard Communication." Safety data sheets (SDSs) shall be available for such products, and personnel shall review the SDSs and implement applicable hazard controls before using hazardous chemicals.*
- Dilute bases (10% or less sodium bicarbonate) may be used as a rinse agent in cases where cross contamination from acidic compounds, phenols, thiols, and some nitro and sulfonic compounds is a concern.
- Organic solvents such as isopropyl alcohol or methanol may be used as rinse agents in cases where organic contamination is a concern. Similarly, hexane may be applicable for polychlorinated biphenyl contamination.
- Commercial degreasing products (CitraSolv®, Simple Green®, etc.) are not recommended for cleaning sample equipment.

Appendix C
Decontamination Equipment

- Assorted brushes (long handle, short handle, nylon bristle, steel bristle, etc.)
- Kimwipes® (if air drying is not an option)
- Hand pump sprayer
- Pressure washer
- High-density polyethylene (HDPE) squeeze bottles for acids (with secondary container labels per HSP-1102, "Hazard Communication")
- HDPE spray bottles (with secondary container labels per HSP-1102, "Hazard Communication")
- Spill containment berms, liners, sumps, trays, etc. (see UltraTech International or Uline products)
- Plastic sheeting
- Plastic kiddie pools
- Plastic buckets
- Stainless-steel or HDPE funnels
- Steam cleaner
- Ziploc® bags
- Aluminum foil
- Trash bags
- Department of Transportation (DOT)-approved closed-top polyethylene drums for waste water/decon solution; various sizes
- DOT-approved open-top polyethylene or steel drums for waste debris, soil, mud; various sizes
- DOT-approved Super Sacks® or similar for waste debris, soil; various sizes
- Waste container labels
- Decontamination solution with applicable SDS

ENVP-2014
Rev. 0

Equipment Decontamination

Applicability: Companywide	Effective Date: 06/21/19	Approver/ Title:	Ray Peters, CIH, CSP ESH&Q Director
For the most recent revision, refer to the Document Management System.		Signature:	

History of Revisions

Revision	Issue Date	Action	Description
0	06/21/19	New document.	Integration of North Wind procedures.

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ACRONYMS

CFR	Code of Federal Regulations
DOT	Department of Transportation
ENVP	environmental procedure
HDPE	high-density polyethylene
OSHA	Occupational Safety and Health Administration
SDS	safety data sheet

1. PURPOSE

This environmental procedure (ENVP) establishes methods for controlling cross-contamination of samples by proper decontamination of sampling equipment.

2. SCOPE

This procedure is applicable to all employees of North Wind Group and its wholly owned subsidiaries (referred to herein either individually or collectively as North Wind) who are tasked to collect environmental samples, except where client- or contract-specific or procedures are required. Where referenced, this ENVP applies to all North Wind and subcontractor personnel performing work described herein.

3. RESPONSIBILITIES/PREREQUISITES

3.1 Responsibilities

Performer	Responsibilities
Project Manager/ Task Lead	• Ensure data quality through adequate planning and preparatory activities for equipment decontamination as prescribed in this ENVP and other work control documents associated with the activities.
Sampling Technician	• Follow this procedure to ensure that sampling equipment has been adequately decontaminated. • Document the decontamination event in sampling log book, field forms, or other project specific documentation per ENVP-2003, "Field Documentation," to help demonstrate sample quality.

3.2 Prerequisites

None

4. HEALTH AND SAFETY

4.1 Verify that a job hazard analysis (JHA; i.e., HSF-1101.02 or approved equivalent) has been completed for this activity as required by North Wind health and safety procedure HSP-1101, "Project Hazard Analysis."

4.2 Verify that safety data sheets (SDSs) are available for hazardous chemicals and that containers are properly labeled per HSP-1102, "Hazard Communication."

4.3 Don personal protective equipment per HSP-1103, "Personal Protective Equipment," and implement any work controls identified in the JHA (at minimum, nitrile gloves and safety glasses).

4.4 Personnel shall be trained and qualified to perform the activities described in this ENVP. Training and qualification shall be documented and approved by the project manager/ task lead.

4.5 Consider the following decontamination hazards during the project hazard analysis process:

- **Exposure hazard**: Exposure of skin, eyes, and mouth due to splashing contaminants and rinsate. Vapors from contaminants or decontamination solutions may cause an inhalation hazard, especially when steam cleaning.
- **Explosion/fire hazard**: Potential ignition of propane gas with steam cleaners. Vapors from site contaminants or decontamination solutions may be flammable.
- **Impact hazard**: Pressurized water, steam, or air brushes could generate flying debris.
- **Incompatibility hazard**: The decontamination solution may react with contaminants to produce heat, explosion, or toxic products.
- **Chemical degradation**. Cleaning agents may degrade protective clothing; some solvents can permeate gloves or other personal protective equipment.
- **Equipment contamination**. Preventing unnecessary equipment contamination is the most significant aspect of decontamination. Reduce the incidence of contamination by bringing only required equipment into the contamination zone, following as low as reasonably achievable (ALARA) work practices, and sleeving tools and field instrumentation such as photoionization detectors and Geiger-Mueller counters.
- **Waste generation**. Wastes generated from decontamination activities require proper handling, storage, and disposal per ENVP-2017, “Waste Management for Environmental Investigations.”

5. DECONTAMINATION PROCEDURE

NOTE: *Use one-time-use (disposable) sampling equipment when practical to avoid the need for equipment decontamination.*

5.1 Select an appropriate decontamination method considering the type of equipment, type of contamination, data quality objectives, weather, and other site-specific conditions. Appendix A describes commonly used methods.

NOTE: *The project manager/task lead shall approve selections in steps 5.2 through 5.4.*

5.2 Select an appropriate decontamination solution to remove potential contaminants and interfering compounds. Appendix B lists possible decontamination solutions.

5.3 Set up a decontamination station and select appropriate equipment/tools to collect and properly dispose of contaminated media and used decontamination solutions. Appendix C lists commonly used decontamination equipment.

5.4 Implement any hazard controls that were identified in the hazard analysis; don skin- and eye-protective equipment at a minimum.

5.5 Disassemble sampling equipment, as necessary.

5.6 Remove gross contamination by brushing, scraping, wiping, and high- or low-pressure water spray, etc.

5.7 Wash equipment using the selected decontamination solution; remove all visible soil, oils, grease, etc.

5.8 Rinse equipment with tap water.

5.9 Rinse equipment with distilled, deionized, or purified water.

5.10 Additional rinses using specialized rinse agents may be performed if required to meet project objectives. See Appendix B.

5.11 Once dried, wrap sampling equipment with aluminum foil, plastic, or other protective material.

NOTES:

- Use caution to avoid damaging sensitive or electronic equipment during the decontamination process.
- If air drying is impractical due to environmental conditions, use Kimwipes® or equivalent disposable wipes. Alternatively, isopropyl alcohol may be used as a final rinse instead of water if it will not interfere with the intended analyses.
- Decontamination activities typically generate waste as defined by federal regulations (40 CFR 261, “Identification and Listing of Hazardous Waste”). All waste generation activities require some degree of regulatory analysis and hazardous waste determination. Follow ENVP-2017, “Waste Management for Environmental Investigations,” and request direction from the task lead or a subject matter expert if you are unsure of this process.
- Investigation-derived wastes generated as part of environmental remediation activities are often considered to be hazardous waste regardless of contaminant concentration.
- Ensure that wastes which have the potential to meet the definition of hazardous waste are properly containerized, labeled, stored, shipped, and disposed of.
- Ignitable, corrosive, or reactive wastes may require special handling precautions and waste containers.

6. QUALITY ASSURANCE/QUALITY CONTROL

- If deviations from this procedure are necessary, then document the changes in project-specific documents and/or field records per ENVP-2003, “Field Documentation.”
- Based on project requirements defined in applicable project plans, verify decontamination by collecting equipment rinsate blanks, equipment wipes, exterior radiological surveys, or other

confirmation samples, in accordance with ENVP-2004, "Collection of Quality Control Samples."

7. RECORDS

The sampling technician(s) will document each event in project sampling documentation (e.g., sample log book or field forms per ENVP-2003, "Field Documentation"). The project manager/task lead will maintain these records in accordance with QAP-171, "Records Management."

8. REFERENCES

40 CFR 261, "Identification and Listing of Hazardous Waste"

ENVP-2003, "Field Documentation"

ENVP-2004, "Collection of Quality Control Samples"

ENVP-2017, "Waste Management for Environmental Investigations"

HSF-1101.02, "Job Hazard Analysis"

HSP-1101, "Project Hazard Analysis"

HSP-1102, "Hazard Communication"

HSP-1103, "Personal Protective Equipment"

QAP-171, "Records Management"

9. APPENDIXES

Appendix A – Methods for Decontamination of Sampling Equipment

Appendix B – Decontamination Solutions and Rinse Agents

Appendix C – Decontamination Equipment

Appendix A
Methods for Decontamination of Sampling Equipment

In some cases, large pieces of equipment (such as drilling equipment) may be moved to a large secondary containment berm or in-the-ground plastic-lined pad. There they can be cleaned by steam or pressurized water. Drilling equipment that has low potential to cross contaminate samples is not typically cleaned to the same degree as sample containers and other sample collection equipment.

Decontamination methods and considerations are as follows:

- Equipment that is small enough to handle (split spoons, sleeves, shovels, bailers, flow cells, etc.) may be washed by hand in a tub or basin using cloth wipes, brushes, and gloved hands.
- Small equipment (spoons, trowels, flow cells, etc.) may be washed by hand over a bucket or absorbent rags using a hand sprayer with decon solution and a second hand sprayer with deionized or distilled water.
- Low-pressure sprayers (e.g., garden sprayers or concrete sprayers) work well for many applications. Use one for decontamination solution and a second one for tap water rinse.
- High-pressure washers or steam cleaners work well for many applications. These methods typically produce very little wash water and are very effective at removing contaminants, especially if the water is heated.
- In some instances, due to sensitive, non-waterproof equipment or due to the unlikelihood of equipment being contaminated, it is not necessary to conduct an extensive decontamination procedure. For example, air sampling pumps hooked on a fence, placed on a drum, or wrapped in plastic bags are not likely to become heavily contaminated. A damp cloth should be used to wipe off contaminants that may have adhered to equipment through airborne deposits or from surfaces upon which the equipment was set.

Appendix B
Decontamination Solutions and Rinse Agents

- Tap water with a phosphate-free detergent (Liquinox®, Alconox®, or similar) is the most commonly used solution for decontamination of sampling equipment.
- The use of an untreated or non-potable water supply is NOT an acceptable substitute for tap water.
- Distilled or deionized water, commonly available from grocery stores, is an acceptable rinse agent for most environmental sampling activities.
- Prior to using food-grade distilled/deionized water, verify that project-specific sampling plans do not require special rinse agents (high-purity liquid chromatography water, laboratory-certified deionized water, etc.). High-purity water is available from most chemical suppliers.
- Dilute acids (10% or less of nitric acid, acetic acid, or boric acid) may be used as a rinse agent in cases where basic (caustic) compounds or metal contamination is a concern. Acid rinses should not be used on metallic sampling equipment.

  NOTE: *Acids, bases, solvents, and other hazardous decontamination chemicals shall be used, handled, stored, and inventoried in compliance with North Wind's HSP-1102, "Hazard Communication." Safety data sheets (SDSs) shall be available for such products, and personnel shall review the SDSs and implement applicable hazard controls before using hazardous chemicals.*
- Dilute bases (10% or less sodium bicarbonate) may be used as a rinse agent in cases where cross contamination from acidic compounds, phenols, thiols, and some nitro and sulfonic compounds is a concern.
- Organic solvents such as isopropyl alcohol or methanol may be used as rinse agents in cases where organic contamination is a concern. Similarly, hexane may be applicable for polychlorinated biphenyl contamination.
- Commercial degreasing products (CitraSolv®, Simple Green®, etc.) are not recommended for cleaning sample equipment.

Appendix C
Decontamination Equipment

- Assorted brushes (long handle, short handle, nylon bristle, steel bristle, etc.)
- Kimwipes® (if air drying is not an option)
- Hand pump sprayer
- Pressure washer
- High-density polyethylene (HDPE) squeeze bottles for acids (with secondary container labels per HSP-1102, "Hazard Communication")
- HDPE spray bottles (with secondary container labels per HSP-1102, "Hazard Communication")
- Spill containment berms, liners, sumps, trays, etc. (see UltraTech International or Uline products)
- Plastic sheeting
- Plastic kiddie pools
- Plastic buckets
- Stainless-steel or HDPE funnels
- Steam cleaner
- Ziploc® bags
- Aluminum foil
- Trash bags
- Department of Transportation (DOT)-approved closed-top polyethylene drums for waste water/decon solution; various sizes
- DOT-approved open-top polyethylene or steel drums for waste debris, soil, mud; various sizes
- DOT-approved Super Sacks® or similar for waste debris, soil; various sizes
- Waste container labels
- Decontamination solution with applicable SDS

ENVP-2017
Rev. 0

Waste Management for Environmental Investigations

Applicability: Companywide	Effective Date: 06/21/19	Approver/ Title: Ray Peters, CIH, CSP ESH&Q Director
For the most recent revision, refer to the Document Management System.		Signature:

History of Revisions

Revision	Issue Date	Action	Description
0	06/21/19	New document.	Integration of North Wind documents.

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DEFINITIONS

Applicable or relevant and appropriate requirement (ARAR). An applicable requirement is a state or federal requirement that directly and fully addresses the hazardous substance, the action being taken, or other circumstance at a Superfund site. A requirement that is not applicable may be relevant and appropriate if it addresses problems or pertains to circumstances similar to those encountered at a Superfund site.

Abandoned. Disposed of; burned or incinerated; or accumulated, stored or treated (but not recycled) before being or in lieu of being abandoned by being disposed of, burned or incinerated [40 CFR 261.2(b)].

Discarded material. Any material that is abandoned, recycled, or considered inherently waste-like, as defined in 40 CFR 261.2(a)(2).

Empty. Containers are considered empty if, for hazardous waste:

- All wastes have been removed that can be removed using the practices commonly employed to remove material from that type of container, e.g., pouring, pumping, and aspirations, and
- No more than one inch of residue remains [40 CFR 261.7(b)(1)(ii)], or
- No more than 3% by weight of the total capacity of the container remains in the container if the container is less than 100 gallons in size [40 CFR 261.7(b)(1)(iii)(A)].

For acute hazardous waste:

- The container has been triple rinsed using a solvent capable of removing the chemical or by other approved methods [40 CFR 261.7(b)(3)]. NOTE: The rinsate is an acute hazardous waste. Empty container(s) may be disposed of as non-hazardous waste (40 CFR 261.7).

Environmental medium. Soil or water (including sediment, surface water, and groundwater) that results from an environmental investigation.

Generator. Any person, by site, whose act or process produces hazardous waste identified or listed in 40 CFR 261, or whose act first causes a hazardous waste to become subject to regulation (40 CFR 260.10).

Hazardous waste. Any solid waste defined in 40 CFR 261.2 that meets the definition of hazardous waste described in 40 CFR 261.3 and is consequently regulated.

Investigation-derived waste (IDW). Waste that is generated during the process of sampling or site investigation undertaken to determine if hazardous constituents are present. Examples of IDW include soil cuttings, drilling muds, purge water, decontamination fluids, personal protective equipment (PPE), and disposable sampling equipment.

Investigative activities. Any type of field activity designed to provide information on the type and extent of environmental contamination. These activities typically include soil borings; exploratory and

monitoring well installations; well development, purging and/or sampling; pump tests; waste sampling; and other similar activities.

Reclaimed. A material is reclaimed if it is processed to recover a useable product or if it is regenerated.

Recycled. A material that is used, reused, or reclaimed. For purposes of the Resource Conservation and Recovery Act (RCRA) definition of solid waste, a recycled material is subject to regulation if it is:

- Used in a manner constituting disposal by being applied to or placed on land or used in products that are applied to or placed on the land unless that material is a commercial chemical product used in its ordinary manner of use.
- Burned for energy recovery, used as a fuel, or otherwise contained in a fuel.
- A reclaimed material, including a spent material, sludge, by-product, or scrap metal.
- Accumulated speculatively (see speculative accumulation def.).

Solid waste. Any discarded material that is not excluded from regulation by 40 CFR 261.4(a) or that is not excluded by a variance granted under 40 CFR 260.30 and 260.31, “Spent Material.” A used material that can no longer serve the purpose for which it was produced without undergoing regeneration, reclamation, or reprocessing.

Speculative accumulation. A material is considered accumulated speculatively if it has no viable market or if the person accumulating the material cannot demonstrate that 75% or more of the material is recycled in a calendar year.

ACRONYMS

ARAR	applicable or relevant and appropriate requirement
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
EPA	Environmental Protection Agency
IDW	investigation-derived waste
NCP	National Contingency Plan
PM	project manager
PPE	personal protective equipment
RCRA	Resource Conservation and Recovery Act
SS	site supervisor

1. PURPOSE

This environmental procedure (ENVP) has been developed to provide project managers (PMs) and other personnel the information they need to properly manage contaminated environmental media and other wastes produced during environmental investigations. These are typically referred to as *investigation-derived wastes* (IDW; see def.). This ENVP also provides information for determining whether wastes managed on projects are *hazardous wastes* (see def.) as defined by the Resources Conservation and Recovery Act (RCRA).

2. SCOPE

This ENVP applies to all PMs and other personnel of North Wind Group and its wholly owned subsidiaries (referred to herein either individually or collectively as North Wind) whose projects involve any type of investigative procedures that result in waste generation, regardless of whether these activities are performed by North Wind personnel or by subcontractors. Project-specific procedures may be developed and approved to cover the requirements of this ENVP along with client- or site-specific requirements.

3. RESPONSIBILITIES/PREREQUISITES

Most North Wind projects are subject to numerous and often complex environmental laws, regulations, and policies. Failure to comply with these requirements can result in penalties for our clients and for North Wind. Each North Wind employee is responsible for performing his or her work in accordance with all applicable laws, regulations, and policies (both regulatory agency and customer policies, as well as North Wind corporate and approved project-specific procedures).

3.1 Responsibilities

Performer	Responsibilities
Project Manager	The PM has the ultimate responsibility for ensuring that all wastes generated on a project are managed in accordance with applicable federal, state, and local laws, regulations, and policies, as well as any client-specific requirements. The PM is required to: • Evaluate the project scope of work to identify types of waste that will or potentially may be generated during *investigative activities* (see def.; i.e., soil borings; exploratory and monitoring well installations; well development, purging, and/or sampling; pump tests; waste sampling; and other similar activities). • Identify all potential waste streams, contaminated environmental media, and other IDW that are generated or managed during the life of the project to determine the appropriate handling and disposal method.

Performer	Responsibilities
	• Determine the source of the environmental contamination. The source of the contamination will be important in determining if the IDW must be managed as RCRA hazardous waste. • Determine the chemical composition of waste using chemical analyses, knowledge of the process that generated the waste, or other forms of data pertaining to the waste stream. • Determine the federal, state, and local *applicable or relevant and appropriate requirements* (ARARs; see def.) for proper waste management. • Review contract and client requirements to ensure that they are incorporated into project-specific waste management procedures. • Establish project-specific waste management procedures to ensure that all contaminated environmental media will be managed in accordance with ARARs and project or client requirements. • Conduct a thorough review of state regulations to ensure that applicable state-specific regulatory requirements are incorporated into project procedures. • Maintain proper documentation on waste analyses in the project file and North Wind records per QAP-171, "Records Management," including documentation of waste determinations performed by waste disposal contractors or other subcontractors.
Site Supervisor	The site supervisor (SS) is responsible for ensuring that day-to-day site operations are conducted in accordance with regulatory requirements and project procedures. Where client site-specific procedures exist, those procedures must be followed in addition to the regulatory requirements specified in this ENVP. Specifically, the SS is required to: • Ensure that North Wind personnel evaluate all IDW that is generated and/or managed during the course of the project in accordance with this ENVP and the project-specific waste management procedures. • Maintain sufficient communication with project personnel to understand applicable regulatory requirements and be able to identify potential compliance issues. • Seek guidance from the PM when uncertain about specific regulatory requirements.

Performer	Responsibilities
All Employees	All North Wind employees are required to: • Perform assigned project tasks in compliance with applicable procedures. • Notify the SS or PM of any wastes that are generated during investigative activities. • Seek guidance from the SS and/or PM when new waste streams are identified or changes in existing waste streams become apparent. • Communicate all planned and unplanned project changes to the SS and/or PM.

3.2 Prerequisites

None

4. INSTRUCTIONS

4.1 Identification and Management of IDW

The PM or SS is responsible for identifying all types of IDW that are generated on the project. IDW includes waste that is generated in the process of investigating an actual or potentially contaminated site. It includes solid and hazardous waste that may pose a risk to human health and the environment.

Typical examples of IDW include, but are not limited to:

- Soil cuttings
- Drilling mud from soil boring and well installations
- Purge water removed from wells during well development and prior to collecting ground water samples
- Sediments
- Sludges, water, solvents, and other fluids used to decontaminate field equipment and personal protective equipment (PPE)
- PPE and other disposable equipment.

The PM is responsible for ensuring that the IDW identification and evaluation process is documented in the project files and North Wind records per QAP-171, “Records Management.”

In accordance with EPA, state, and local guidance, and North Wind environmental policy, as described in ENVM-2000, *North Wind Environmental Manual*, IDW must be managed in a manner that:

(1) Is protective of human health and the environment

(2) Complies with (or waives) all ARARs

(3) Meets contract requirements.

EPA's current guidance for management of IDW is included in Appendix A. This guidance should be reviewed to determine the proper means of managing specific IDW that is generated at a project site. The PM should also identify state and local regulations and policies for management of IDW since these may be more stringent than the federal EPA requirements.

The PM or SS is responsible for developing project-specific procedures for the management of IDW. The specific requirements for management of IDW depend on the following:

- The chemical characteristics of the waste being managed
- The regulatory program under which the investigation is being conducted
- The state or region in which the investigation occurs.

The project-specific procedures for management of IDW should be incorporated into project work plans, site procedures, and other documents that govern the performance of project work.

4.2 Identification of ARARs

The PM or SS is responsible for identifying the ARARs that pertain to the specific IDW being managed. This process should be documented in the project files and North Wind records per QAP-171, "Records Management."

The following subsections list some of the major regulatory programs that are pertinent to the management of IDW.

4.2.1 RCRA Requirements

Regulations promulgated under RCRA contain specific requirements for the management of wastes that are defined as hazardous wastes. Section 4.3 outlines the procedure for determining if a waste is a hazardous waste and thus subject to RCRA regulation.

Knowledge of the process that caused the environmental contamination is important in determining if a contaminated environmental medium (see def.) is subject to RCRA regulation. Contamination that resulted from a listed hazardous

waste must be managed in accordance with the regulatory requirements for the listed waste that caused the contamination. Contamination that resulted from a characteristic hazardous waste is subject to RCRA regulation if the IDW itself displays the hazardous waste characteristic.

4.2.2 CERCLA Requirements

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) does not impose any additional regulations on the management of IDW; however, CERCLA requires that IDW be managed in a manner that ensures protection of human health and the environment and complies with regulatory requirements that are ARARs. The National Oil and Hazardous Substances Pollution Contingency Plan (NCP) requires compliance with ARARs during removal and remedial actions (40 CFR 300) to the extent practicable. If an ARAR cannot be met, the PM may need to obtain a CERCLA waiver.

Onsite and offsite CERCLA response actions differ in two significant ways. First, ARAR provisions apply only to onsite actions; offsite actions must comply with any laws and regulations that legally apply to that action. Also, ARAR waivers are not available for any requirements that regulate offsite actions.

Additionally, onsite CERCLA actions must comply only with the substantive portions of a given ARAR; onsite activities need not comply with administrative requirements, such as obtaining a permit or recordkeeping and reporting. (Monitoring requirements are considered substantive requirements.) In contrast, offsite actions must comply with both substantive and administrative requirements of all applicable laws.

NOTE: *ARARs are the requirements of environmental and facility siting laws only. Independent of ARARs, onsite activities also must comply with requirements of non-environmental laws, including building codes and safety requirements such as Occupational Safety and Health Administration (OSHA) requirements.*

4.2.3 State/Region Requirements

Many states and Environmental Protection Agency (EPA) regions have IDW management requirements that differ from and are more restrictive than the federal requirements. The PM or SS is responsible for identifying these requirements and incorporating them into project-specific procedures.

4.3 Hazardous Waste Determination

This section outlines the process for determining if a waste is regulated as a hazardous waste under RCRA or a similar state law. The RCRA regulations allow for this determination to be made based on the *generator*'s (see def.) knowledge of the materials and process(es) that were used to generate the waste, or through the use of specified

analytical procedures. In either case, the PM is required to maintain written documentation of the method used to determine if the waste is a regulated hazardous waste. This written documentation must include the results of any analyses that are performed as part of the waste determination. Documentation shall be managed in accordance with QAP-171, "Records Management."

IDW is solid waste in nearly all cases, even if the source was not. In most cases the characterization is done according to the disposal facility waste acceptance criteria (WAC), not by a hazardous waste determination as described in this section, including solid waste determination. If personnel are investigating a waste cited as excluded in Section 4.3.3 (e.g., "40 CFR 261.8 – certain PCB-containing wastes that exhibit hazardous waste characteristics"), the IDW would be managed as hazardous if it is removed from the site. See additional information provided in Appendix A, EPA Guide to Management of Investigation-Derived Wastes.

4.3.1 Review of State Hazardous Waste Requirements

This section addresses the hazardous waste identification requirements contained in the federal RCRA regulations. Many states have received authorization from the EPA to administer their own RCRA program. The RCRA authorization process requires that the state program be at least as stringent as the federal program, but does not prevent the state form adopting more stringent regulations governing the identification and management of hazardous waste. While many states have adopted regulations that are identical or essentially identical to the federal RCRA program, some state regulations include additional regulated waste categories.

The PM is required to identify and comply with all state and local hazardous waste regulations in addition to the federal RCRA regulations. This state regulatory review must be performed not only for the state in which the waste is generated, but also for all additional states in which the waste may be further managed, including treatment, storage, re-use, or disposal of the waste. These state-specific requirements must be incorporated into the project-specific waste management procedures. The PM is responsible for ensuring that ENVF-2017.01, "Waste Evaluation Checklist," (see Appendix B) is completed for each waste stream being managed. If the client requires the use of a different waste evaluation form, it may be used in place of ENVF-2017.01. The completed checklist or client waste evaluation form must be maintained in the project file and North Wind records per QAP-171, "Records Management."

4.3.2 Determination whether Material is a Regulated Solid Waste

The PM is responsible for determining if any of the wastes being managed are regulated as RCRA *solid wastes* (see def.), and hence may potentially be regulated as RCRA hazardous wastes. This section briefly outlines the RCRA definition of solid waste. If greater detail is needed, the PM should consult Title

40 Section 261 of the Code of Federal Regulations (40 CFR 261) as well as any corresponding state or local regulations.

Table 1. List of secondary materials and regulatory status as solid wastes.

Secondary Materials	Use Constituting Disposal [40 CFR 261.2(c)(1)]	Energy Recovery/ Fuel [40 CFR 261.2(c)(2)]	Reclamation [40 CFR 261.2(c)(3)][1]	Speculative Accumulation [40 CFR 261.2(c)(4)]
Spent materials	YES	YES	YES	YES
Sludges listed in 40 CFR 261.31 or 261.32	YES	YES	YES	YES
Sludges exhibiting a characteristic of hazardous waste	YES	YES	NO	YES
By-products listed in 40 CFR 261.31 or 261.32	YES	YES	YES	YES
By-products exhibiting a characteristic of hazardous waste	YES	YES	NO	YES
Commercial chemical products listed in 40 CFR 261.33	YES[2]	YES[3]	NO	NO
Scrap metal other than excluded scrap metal [see 40 CFR 261.1(c)(9)]	YES	YES	YES	YES

1. Does not include reclamation provided in 40 CFR 261.4(a)(17), mineral processing – secondary materials.
2. Commercial products are not solid wastes when applied to the land if that is their normal use.
3. Commercial products are not solid wastes when burned for energy recovery if they are already fuels or normal constituents of fuels.

In order for a waste to be regulated under RCRA as a hazardous waste, it must meet the definition of a solid waste. The definition of solid waste includes any solid, semi-solid, liquid, or contained gaseous material that has been *discarded* (see def.), has served its intended purpose, or is a manufacturing or mining by-product. Specifically, the definition of solid waste includes:

- Materials that are *abandoned* (see def.)
- Materials that are *recycled* (see def.)
- Materials that are inherently waste-like
- Waste military munitions.

Certain materials are excluded from the RCRA definition of solid waste, as listed in 40 CFR 261.4(a). These exclusions apply to specific wastes that are managed in a specific manner. For example, the exclusion for industrial wastewater

discharges that are permitted under the Clean Water Act applies only at the point of discharge and does not apply while the wastewater is being treated prior to discharge.

The PM is responsible for ensuring that each waste stream is evaluated to determine if it is exempt from the RCRA definition of solid waste (or otherwise exempted from RCRA regulation) based on one of the specific exemptions listed in 40 CFR 261 (see Section 4.3.3). Such a determination must be documented on ENVF-2017.01, "Waste Evaluation Checklist" (see Appendix B).

Figure 1 (Appendix C) is a flowchart to aid in determining whether a material is a solid waste. Table 1 lists various types of secondary materials and the regulatory status of these materials as RCRA solid wastes.

4.3.3 Determination whether Waste Meets a Specific Waste Exclusion

Certain materials are solid wastes but are excluded from regulation under RCRA. The PM is responsible for determining if any of these exclusions apply and for documenting that determination in the project file and North Wind records per QAP-171, "Records Management." These exclusions are listed in 40 CFR 261.4 and apply to specific wastes that are managed in a specific manner. For example, the exclusion for industrial wastewater discharges that are permitted under the Clean Water Act applies only at the point of discharge and does not apply while the wastewater is being treated prior to discharge.

It should be noted that 40 CFR 261.4 lists only the exclusions to the definition of solid waste. Additional exclusions to the definition of hazardous waste are discussed in the following sections of 40 CFR 261:

- 40 CFR 261.6(a)(2) and (a)(3) – exclusions for certain recyclable materials
- 40 CFR 261.7 – residues in empty (see def.) containers
- 40 CFR 261.8 – certain PCB-containing wastes that exhibit hazardous waste characteristics
- 40 CFR 261.9 – universal wastes (batteries, pesticides, thermostats, and lamps).

Figure 2 (Appendix C) is a flowchart to aid in determining whether a waste meets one of the many exclusions from the definition of solid waste or from full regulation as a hazardous waste.

4.3.4 Determination whether Material is a Hazardous Waste

The PM is responsible for ensuring that all wastes are evaluated in accordance with applicable federal and state regulations to determine if they are hazardous wastes. Such a determination must be documented on ENVF-2017.01, "Waste Evaluation Checklist" (see Appendix B). The hazardous waste determination can

be made based on knowledge of the process that generated the waste or through chemical analysis. If chemical analysis is used, the proper analytical methods specified in 40 CFR 261 Subpart C, or the corresponding state regulation must be followed.

Figure 3 (Appendix C) is a flowchart to aid in determining whether a waste is regulated as a hazardous waste under RCRA. The regulatory status of a waste can be determined using knowledge of the materials and process that generated the waste, through chemical analysis, or using a combination of these two methods. If no knowledge of the process that generated the waste is available, the generator is not required to make assumptions regarding the waste-generating process. This is particularly important in the case of F- and K-listed wastes, which are wastes generated by listed manufacturing processes.

The federal RCRA regulations classify hazardous wastes into two general categories — characteristic hazardous wastes and listed hazardous wastes — as outlined below.

CHARACTERISTIC HAZARDOUS WASTES

The limits for the hazardous waste characteristics are found in 40 CFR, Subpart C. These are summarized below. The full definitions for these wastes can be found in 40 CFR 261.21 through 261.24.

- **Ignitability:** The characteristic of ignitability includes wastes with a low flashpoint (<140°F), that are self-igniting and burn vigorously under standard temperature and pressure, are ignitable compressed gases or are Department of Transportation (DOT) oxidizers. *40 CFR 261.21 and corresponding state regulations should be consulted for the detailed definition of ignitability*. These wastes are designated with the Hazardous Waste Number D001.
- **Corrosivity:** A waste exhibits the characteristic of corrosivity if it is an aqueous liquid that has a very low or high pH (less than or equal to 2.0 or greater than or equal to 12.5) or corrodes steel at a rate greater than 0.25 inches per year. *40 CFR 261.22 and corresponding state regulations should be consulted for the detailed definition of corrosivity*. Corrosive wastes are designated with the Hazardous Waste Number D002.
- **Reactivity:** A waste exhibits the characteristic of reactivity if it is unstable, reacts violently with or forms explosive mixtures with water, generates toxic gases with water, produces cyanide or sulfide between a pH of 2.0 and 12.5, can easily detonate or explode, or is a DOT forbidden explosive. *40CFR 261.23 and corresponding state regulations should be consulted for the detailed definition of reactivity.* Reactive wastes are designated with the Hazardous Waste Number D003.
- **Toxicity:** A waste exhibits the characteristics of toxicity if the extract from a sample of the waste that has been analyzed using the Toxicity Characteristic

Leaching Procedure (TCLP) exceeds any of the constituent concentrations listed in 40 CFR 261.24. The Toxicity characteristic list includes the eight drinking water metals, six drinking water pesticides, and 26 volatile and semi-volatile organic compounds. These wastes are designated with the Hazardous Waste Numbers D004 through D043, as shown in Table 2 above.

Table 2. Toxicity characteristic constituents and regulatory levels.

Waste Code	Contaminants	Concentration
D004	Arsenic	5.0
D005	Barium	100.0
D018	Benzene	0.5
D006	Cadmium	1.0
D019	Carbon tetrachloride	0.5
D020	Chlordane	0.03
D021	Chlorobenzene	100.0
D022	Chloroform	6.0
D007	Chromium	5.0
D023	o-Cresol*	200.0
D024	m-Cresol*	200.0
D025	p-Cresol*	200.0
D026	Total Cresols*	200.0
D016	2,4-D	10.0
D027	1,4-Dichlorobenzene	7.5
D028	1,2-Dichloroethane	0.5
D029	1,1-Dichloroethylene	0.7
D030	2,4-Dinitrotoluene	0.13
D012	Endrin	0.02
D031	Heptachlor (and its epoxide)	0.008
D032	Hexachlorobenzene	0.13
D033	Hexachlorobutadiene	0.5
D034	Hexachloroethane	3.0
D008	Lead	5.0
D013	Lindane	0.4
D009	Mercury	0.2
D014	Methoxychlor	10.0
D035	Methyl ethyl ketone	200.0
D036	Nitrobenzene	2.0
D037	Pentachlorophenol	100.0
D038	Pyridine	5.0
D010	Selenium	1.0
D011	Silver	5.0
D039	Tetrachloroethylene	0.7
D015	Toxaphene	0.5
D040	Trichloroethylene	0.5
D041	2,4,5-Trichlorophenol	400.0
D042	2,4,6-Trichlorophenol	2.0
D017	2,4,5-TP (Silvex)	1.0
D043	Vinyl chloride	0.2

*If o-, m-, and p-cresols cannot be individually measured, the regulatory level for total cresols is used.

LISTED HAZARDOUS WASTES

A waste may be regulated as a listed hazardous waste depending on the chemical composition of the material and the manufacturing process that generated that waste. The most significant difference between listed hazardous wastes and characteristic hazardous wastes is that a listed waste retains its "listing" even after treatment, no matter how innocuous it may be, until it is successfully delisted (see Section 4.3.8). This distinction is important because residues from the treatment of listed hazardous wastes are themselves considered listed hazardous wastes until delisted. The hazardous waste listing also applies to each container that had been used to hold listed hazardous waste unless the container has been cleaned to meet the RCRA definition of "Empty." Table 3 summarizes the four lists of hazardous wastes.

Table 3. Hazardous waste lists.

Name of List	Hazardous Waste Designation and Regulatory Citation	Description
Hazardous Wastes from Nonspecific Sources	F List 40 CFR 261.31	Wastes generated by manufacturing processes that are not specific to one type of industry.
Hazardous Wastes from Specific Sources	K List 40 CFR 261.32	Wastes that are generated by a manufacturing process that is specific to a particular industry or manufacturing operation.
Acute Hazardous Waste	P List 40 CFR 261.33(e) (Note: Wastes on the P List are subject to lower threshold quantities for determinations of small quantity generator status.)	Discarded commercial chemical products, off-specification species, container residues, and spills of materials listed by name on the list, including brand name products whose sole active ingredient is included on the list.
Toxic Hazardous Wastes	U List 40 CFR 261.33(f)	Discarded commercial chemical products, off-specification species, container residues, and spills of materials listed by name on the list, including brand name products whose sole active ingredient is included on the list.

4.3.5 Exclusion for Certain Recycled Materials

Hazardous wastes that are recycled are known as recyclable materials. Recyclable materials may be subject to less stringent regulations than hazardous wastes depending on the type of waste and the manner in which it is used. These

regulations, which are contained in 40 CFR 266, apply to the following categories of waste:

- Recyclable materials used in a manner constituting disposal
- Hazardous wastes burned for energy recovery
- Used oil burned for energy recovery
- Recyclable materials used for precious metal recovery
- Spent (see spent material def.) lead-acid batteries that are reclaimed (see def.)
- Hazardous waste burned in boilers and industrial furnaces.

4.3.6 Mixture and Derived-From Rules

The PM is responsible for determining if any secondary wastes, or waste management or treatment residues, are subject to the *mixture rule* or the *derived-from rule*. This determination must be documented in the project file and North Wind records per QAP-171, "Records Management."

The mixture rule applies to hazardous wastes that are mixed with other solid wastes, whereas the derived-from rule applies to secondary waste and waste residues that are derived from the treatment, storage, or disposal of listed hazardous waste.

LISTED WASTES

The mixture rule states that a mixture made up of any amount of a nonhazardous solid waste and any amount of a listed hazardous waste is considered a listed hazardous waste. This principle applies regardless of the mixture's chemical composition or the health threats posed by the mixture. The derived-from rule addresses the regulatory status of materials that are derived from the treatment or other handling of a hazardous waste. As with the mixture rule, waste residues derived from the treatment of a listed hazardous waste retain the same hazardous waste listing. Therefore, once a waste is identified as a listed hazardous waste, that waste (and any other material with which it comes in contact) remains a listed hazardous waste unless it is formally de-listed or otherwise exempted.

There are eight specific exemptions to the mixture rule for listed hazardous wastes. One of these applies to specific mining wastes [40 CFR 261.4(b)(7)] and the other seven apply to de minimis quantities of listed waste in wastewaters that are discharged to treatment facilities [40 CFR 261.3(a)(2)(iv)]. Likewise, there are five exemptions to the derived-from rule. The first one applies to wastes that are reclaimed from hazardous waste and are used beneficially to make new products or recover usable materials with economic value. Such reclaimed materials are no longer solid waste and, therefore, cannot be hazardous wastes.

The other four exemptions to the derived-from rule apply to residues from the treatment of specific wastes using specific treatment processes.

CHARACTERISTIC WASTES

A mixture of a nonhazardous solid waste and characteristic hazardous waste is only a hazardous waste if the resultant mixture itself exhibits a hazardous waste characteristic. Similarly, treatment residues and materials derived from characteristic hazardous wastes are hazardous wastes only if they themselves exhibit a hazardous waste characteristic.

4.3.7 Contained-In Policy

Because environmental media do not meet the RCRA definition of solid waste, the mixture rule does not strictly apply to environmental media that are mixed with hazardous waste. For this reason, EPA developed the contained-in policy to address environmental media (soil, sediment, and groundwater) and debris that are contaminated with hazardous waste.

In general, the contained-in policy requires that environmental media and debris contaminated with listed waste or exhibiting a characteristic be regulated as hazardous waste; however, such media and debris can be removed from RCRA regulation if the generator can demonstrate that the material no longer poses a threat. The requirements for demonstrating that the waste no longer poses a threat can vary by state or EPA Region, but generally involve demonstrating that the concentration of the hazardous waste and hazardous waste constituents are below published health-based criteria.

The Contained-In Policy is only a policy and is not codified in the Federal RCRA regulations. EPA guidance addressing the policy can be found on EPA's web site at: https://www.epa.gov/hw/contained-policy-soil-and-debris-contaminated-hazardous-waste.

4.3.8 Waste Delisting

EPA included a mechanism in 40 CFR 260.22 for generators of listed wastes to petition EPA to have their wastes delisted. The petition must demonstrate that the listed waste generated at the generator facility does not pose sufficient hazard to require regulation under RCRA. The delisting process is time-consuming and expensive, and will have limited applicability to North Wind projects.

5. RECORDS

The PM shall maintain the following records in accordance with QAP-171, "Records Management":

- All project records pertaining to the determination of ARARs for the purpose of determining the proper method for IDW management.
- ENVF-2017.01, "Waste Evaluation Checklist" (Appendix B)
- Waste analysis documentation used for determining regulatory status of waste.

6. REFERENCES

40 CFR 261, "Identification and Listing of Hazardous Waste."

40 CFR 266, "Standards for the Management of Specific Hazardous Wastes and Specific Types of Hazardous Waste Management Facilities."

40 CFR 300, "National Oil and Hazardous Substances Pollution Contingency Plan (NCP)."

EPA Office of Solid Waste and Emergency Response, *Guide to Management of Investigation-Derived Wastes,* Publication: 9345.3-03FS, January 1992.

ENVM-2000, *North Wind Environmental Manual*.

QAP-171, "Records Management."

7. APPENDIXES

Appendix A – EPA Guide to Management of Investigation-Derived Wastes

Appendix B – Example of ENVF-2017.01, "Waste Evaluation Checklist"

Appendix C – Flowcharts

Appendix A
EPA Guide to Management of Investigation-Derived Wastes

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

JAN 15 1992

9345.3-03FS
OFFICE OF
SOLID WASTE AND EMERGENCY RESPONSE

MEMORANDUM

SUBJECT: Guide to Management of Investigation-Derived Wastes

FROM: Henry L. Longest II, Director /s/
Office of Emergency and Remedial Response

TO: Waste Management Division Director
Regions I, IV, V, VII, VIII
Emergency and Remedial Response Division Director
Region II
Hazardous Waste Management Division Director
Regions III, VI
Toxics and Waste Management Division Director
Region IX
Hazardous Waste Division Director
Region X

The purpose of this memorandum is to distribute the final fact sheet entitled "Guide to Management of Investigation-Derived Wastes." This fact sheet was circulated for Regional review and comment in November 1991; comments have been incorporated into this final version.

Additional copies of the fact sheet can be obtained from EPA's Superfund Docket (FTS 260-3046). If you have any questions regarding the information in the fact sheet, please call your HSCD Regional Coordinator, or Andrea McLaughlin at FTS 678-8365 or 703-308-8365.

Enclosure

cc: Superfund Branch Chiefs, Regions I-X
Superfund Section Chiefs, Regions I-X

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United States Environmental Protection Agency | Office of Solid Waste and Emergency Response | Publication: 9345.3-03FS January 1992

EPA

Guide to Management of Investigation–Derived Wastes

Office of Emergency and Remedial Response
Hazardous Site Control Division OS-220W

Quick Reference Fact Sheet

CERCLA field investigation activities (e.g., remedial investigation/feasibility studies and remedial designs) may result in the generation of waste materials that may pose a risk to human health and the environment. These investigation-derived wastes (IDW) may include drilling muds, cuttings, and purge water from test pit and well installation; purge water, soil, and other materials from collection of samples; residues (e.g., ash, spent carbon, well development purge water) from testing of treatment technologies and pump and treat systems; contaminated personal protective equipment (PPE); and solutions (aqueous or otherwise) used to decontaminate non-disposable protective clothing and equipment. The management of IDW must ensure protection of human health and the environment and comply with (or waive) regulatory requirements that are applicable or relevant and appropriate requirements (ARAR). This fact sheet presents an overview of possible IDW management options, discusses the protectiveness requirements and ARARs associated with these options, and outlines general objectives established for IDW management under Superfund.[1]

The general options for managing IDW (see **Highlight 1**) are collection and either (1) immediate disposal or (2) some type of interim management. Interim management may include storage or other temporary. As dismissed below, the specific option selected will depend on the type of waste produced, its relative threat to human health and the environment, and other site-specific conditions.

IDW MANAGEMENT REQUIREMENTS

When managing IDW, site managers are required to choose an option that: (1) is protective of human health and the environment and (2) complies with (or waives) ARARs, as described below.

Protectiveness

In determining if a particular management/disposal option is protective, site managers should consider the following:

- The contaminants, their concentrations, and total Volume of IDW;
- Media potentially affected (e.g., ground water, soil) under management options;
- Location of the nearest population(s) and the likelihood and/or degree of site access;
- Potential exposures to workers; and
- Potential for environmental impacts.

As a general rule, it will be necessary to use best professional judgment, in light of the site-specific conditions, to determine whether an option is protective of human health and the environment. For example, a site manager may determine that storing IDW temporary until the final action or returning IDW to its source is protective, based on knowledge that the material poses low risk and/or that the final action will address any risks posed by the wastes and there will be no unacceptable risks in the interim.

Alternatively, if the site includes or is near residential areas, the site is unsecured, and/or contaminants appear to be present at unacceptable levels, it may not be protective to return excavated soil to the source. Storing IDW in containers in an on-site, secure location, or sending it off site immediately may be more appropriate.

Site managers also need to consider the potential effects of IDW management-related activities on environmental media. For example, pouring contaminated purge water on the ground around a well may not be prudent, because such an action could mobilize any hazardous constituents present in the soil or introduce contaminants into clean soil.

Compliance with ARARs

Remedial Investigation/Feasibility Study (RI/FS) and Remedial Design (RD) actions must comply with ARARs "to the extent practicable, considering the exigencies of the situation" (NCP, 55 FR 8756, emphasis added); therefore, it generally will not be necessary to obtain a waiver if an ARAR cannot be attained during these actions. If a site manager determines that, based on site-specific factors, compliance with an ARAR is practicable but an ARAR waiver is warranted for an RI/FS or RD action, an interim action waiver may be available if the final remedy will attain the ARAR. An action memorandum should be prepared for the waiver, the state given an opportunity to comment, and the decision document placed in the administrative record.

[1] Management of treatability study and treatment pilot wastes is discussed in Guide for Conducting Treatability Studies Under CERCLA. Interim Final, December 1989, EPA/540/2-89/058. Information on management of IDW generated during Preliminary Assessments and Site Investigations is provided in Management of Investigation-Derived Waste During Site Investigations, May 1990, EPA/540/G-91/009.

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Highlight 1: IDW MANAGEMENT OPTIONS

Type of IDW	Generation Processes*	Management Options
Soil	• Well/test pit installation • Borehole drilling • Soil sampling	• Return to boring, pit, or source immediately after generation • Spread around boring, pit, or source within the AOC+ • Consolidate in a pit (within the AOC) • Send to on-site TDU+ • Send to TDU off site immediately • Store for future treatment and/or disposal
Sludges/sediment	• Sludge pit/sediment sampling	• Return to boring, pit, or source immediately after generation • Send to on-site TDU • Send to TDU off site immediately • Store for future treatment and/or disposal
Aqueous liquids (ground water, surface water, drilling fluids, other wastewaters)	• Well installation/development • Well purging during sampling • Ground water discharge during pump tests • Surface water sampling	• Discharge to surface water • Pour onto ground close to well (non-hazardous waste) • Send to on-site TDU • Send to off-site commercial treatment unit • Send to POTW+ • Store for future treatment and/or disposal
Decontamination fluids	• Decontamination of PPE+ and equipment	• Send to on-site TDU • Evaporate (for small amounts of low contamination organic fluids) • Send to TDU off site immediately • Store for future treatment and/or disposal
Disposable PPE	• Sampling procedures or other on-site activities	• Send to on-site TDU • Place in on-site industrial dumpster • Send to TDU off site immediately • Store for future treatment and/or disposal

• The generation processes listed here are provided as examples. IDW may also be produced as a result of activities not listed here.
+ AOC: Area of Contamination (AOCs at a site may not yet have been identified at the time of the RI/FS); TDU: Treatment/disposal Unit; POTW: Publicly Owned Treatment Works; PPE: Personal Protective Equipment

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Potential ARARs for IDW at CERCLA sites include regulations under the Resource Conservation and Recovery Act (RCRA) (including both Federal and State underground injection control (UIC) regulations), the Clean Water Act (CWA), the Clean Air Act (CAA), the Toxic Substances Control Act (TSCA), and other State environmental laws. How these various requirements may direct or influence IDW management decisions is described below.

Resource Conservation and Recovery Act (RCRA). Certain sections of the RCRA Subtitle C hazardous waste regulations (e.g., land disposal restrictions and storage restrictions) may be ARARs for IDW should RCRA hazardous waste be identified at a site. (Note that RCRA may be relevant and appropriate even if the IDW is not a RCRA hazardous waste.) A waste is hazardous under RCRA if it is listed as such in 40 CFR 261.31 - 261.33 or if it exhibits one of four characteristics: ignitability, corrosivity, reactivity, or toxicity.

Site managers should not assume that a waste considered to pose a potential risk at a CERCLA site is a listed or characteristic RCRA hazardous waste. Until there is positive evidence (records, test results, other knowledge of waste properties) that the IDW is a RCRA hazardous waste, site managers should manage it in a protective manner (but not necessarily in accordance with Subtitle C requirements). Business records or facility processes should be examined to determine whether RCRA listed wastes were generated and are present in the IDW. For characteristic wastes, site managers should rely on testing results or on knowledge of the material's properties. If best professional judgment and available information indicate that, for protectiveness reasons (or because managed as a "hazardous waste" management in accordance with Subtitle C requirements is prudent, regardless of whether it is known to be a RCRA waste.

If aqueous liquid IDW is considered a RCRA hazardous waste, the site manager should determine whether the Domestic Sewage Exclusion (DSE) applies to the discharge of that IDW to a POTW. The RCRA DSE exempts domestic sewage and any mixture of domestic sewage and other wastes that passes through a sewer system to a POTW for treatment from classification as a solid waste and, therefore, as a RCRA hazardous waste (40 CFR 261.4).

- Land Disposal Restrictions

If IDW is determined to be a RCRA hazardous waste and subject to the land disposal restrictions (LDRs), "land disposal" of the IDW will be prohibited unless specified treatment standards are met (see Superfund LDR Guides #5 and #7, Determining When LDRs Are Applicable to CERCLA Response Actions and Determining When LDRs Are Relevant and Appropriate to CERCLA Response Actions, OSWER Directive 9347.3-05FS and 9347.3-08FS, June 1989 and December 1989 and the NCP, 55 FR 8759, March 8, 1990). "Land disposal" occurs when wastes from different AOCs are consolidated into one AOC; when wastes are moved outside an AOC (for treatment or storage) and returned to the same or a different AOC; or when wastes are excavated, placed in a separate hazardous waste management unit such as an incinerator or tank within the AOC, and then redeposited into the AOC.

Storing IDW in a container ("a portable device in which a material is stored, transported, treated, disposed of, or otherwise handled" (40 CFR 260.10)) within the AOC and then returning it to its source, however, is allowable without meeting the specified LDR treatment standards. Under the definition of "hazardous waste management until" (40 CFR 260.10), EPA states that "a container alone does not constitute a unit; the unit includes the containers and the land or pad upon which they are placed." Therefore, returning IDW that has been stored in containers (not tanks or other RCRA-regulated units) within the AOC to its source does not constitute land disposal, as long as containers are not managed in such a manner as to constitute a RCRA storage unit as defined in 40 CFR 260.10. In addition, sampling and direct replacement of wastes within an AOC do not constitute land disposal.

- Storage

Subtitle C outlines the storage requirements for RCRA hazardous wastes. Under RCRA, "storage" is defined as "the holding of hazardous waste for a temporary period, at the end of which the hazardous waste is treated, disposed of, or stored elsewhere" (40 CFR 260.10).

On-site Superfund actions are only required to comply with the substantive standards of other laws (see 40 CFR 300.5, definitions of applicable or relevant and appropriate requirements). Superfund sites are also exempt from permit requirements under CERCLA §121(e). Therefore, site managers are not required to comply with administrative requirements triggered by RCRA storage deadlines (e.g., contingency planning, inspections, recordkeeping). Generally equivalent administrative activities are undertaken at Superfund sites, however, under existing Superfund management practices.

Site managers storing known RCRA hazardous waste must comply with the substantive, technical requirements of 40 CFR Parts 264 and 265 Subparts I (containers), J (tanks), and L (waste piles), to the extent practicable. (See **Highlight 2** for a summary of these technical requirements for each type of unit). In addition, the ground-water monitoring requirements of 40 CFR Parts 264 and 265 Subpart F are potential ARARs, and to the extent they are determined to be ARARs at a site, they should be attained to the extent practicable (or waived). (In many cases, ground-water monitoring conducted during the RI/FS will provide protection equivalent to the Subpart F requirements.)

[NOTE: Under the LDRs, restricted RCRA hazardous waste may not be stored at a site unless the storage is solely for the purpose of accumulating sufficient quantities of the waste to facilitate proper disposal, treatment, or recovery (see 40 CFR 268.50). Generally, storing IDW until a final disposal option is selected in a Record of Decision (ROD) and implemented during the remedial action is allowable storage under the RCRA LDR storage prohibition.]

- Recordkeeping and Manifesting

If hazardous wastes are sent off site, the site manager must comply with both administrative and substantive elements of the RCRA generator requirements of 40 CFR Part 262 and LDR notification and certification requirements of Part 268. (For example, a site manager must prepare an LDR notification and certification when restricted wastes are sent off site to a land disposal facility.) These standards include requirements such as manifests for shipping waste that list all hazardous waste listings and characteristics applicable to the waste (see 40 CFR 262.11), packaging and transport requirements, and recordkeeping requirements.

If the LDRs are applicable, the following information should be collected and available before the removal of wastes to an off-site disposal facility: EPA hazardous waste number, LDR treatment

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Highlight 2:
EXAMPLES OF RCRA TECHNICAL STORAGE REQUIREMENTS*

RCRA storage requirements, applicable to both less-than-90-days generators and permitted or interim status storage facilities, may include the following substantive requirements:

Containers 40 CFR 264 Subpart I and 265 Subpart I

- Containers must be in good condition
- Wastes must be compatible with container
- Container must be closed during storage
- Container storage areas must have a containment system that can contain 10 percent of the volume of containers or of the largest container
- Spilled or leaked waste must be removed from the collection area as necessary to prevent overflow

Tanks 40 CFR 264 Subpart J and 265 Subpart J

- Tanks must have a secondary containment system that includes a liner, a vault, a double-walled tank, or an equivalent device (applies only to certain tanks)

Waste Piles 40 CFR 264 Subpart L and 265 Subpart L

- Waste piles must have a liner and a leachate collection and removal system
- Owners/operators must have a run-on control system to prevent flow onto the active portion of the pile during peak discharge from at least a 25-year storm
- Owners/operators must have a run-off management system to collect and control at least the water volume resulting from a 24-hour, 25-year storm

- This is a partial list of substantive requirements. For more detail, see 40 CFR Part 264 and 265.

standards, manifest number for the waste shipment, and waste analysis data.

- Underground Injection Control (UIC) Program

Under the UIC regulations, RCRA hazardous wastes may be injected into Class I permitted wells. In some cases, hazardous liquids, such as extracted ground water from pump and treat operations, may be injected into a Class IV UIC well. For example, ground water contaminated with RCRA hazardous wastes may be injected into Class IV permitted wells if it is part of a CERCLA response action or a RCRA corrective action and if it has been treated to "substantially reduce hazardous constituents prior to such injection..." (RCRA § 3020(b)). (See Applicability of Land Disposal Restrictions to RCRA and CERCLA Ground Water Treatment Reinjection, OSWER Directive #9234,1-06, December 1989.)

- Non-RCRA Hazardous Wastes

Some non-RCRA hazardous waste may be subject to management requirements under Subtitle D of RCRA as solid wastes. Subtitle D regulates disposal of solid waste in facilities such as municipal landfills. Therefore, non-RCRA hazardous IDW, such as decontaminated PPE or equipment, may need to be disposed of in a Subtitle D facility (depending on State requirements).

Clean Water Act (CWA). Discharges of aqueous IDW to surface water and publicly owned treatment works (POTWs) may be required to comply with CWA Federal, State, and local requirements. Requirements to be met may include water quality criteria, pre-treatment standards, State water quality standards, and NPDES permit conditions. Direct discharges to on-site waters are subject only to substantive requirements, while discharges to POTWs and other off-site discharges must comply with both substantive and administrative CWA requirements (including permitting requirements). (See Guide to Discharging CERCLA Aqueous Wastes to POTWs, June 1991 and CERCLA Compliance with the CWA and SDWA, #9234.2-06FS, January 1991.)

Toxic Substances Control Act (TSCA). If IDW contains PCBs, TSCA treatment and/or disposal requirements may apply during its management. TSCA requirements regulate the disposal of material contaminated with PCBs at concentrations of 50 ppm or greater as found on site (i.e., based on sample analysis and not the PCB concentration of the source material {e.g., transformer fluid}). (See PCB Guidance Manual, EPA/540/G-90/007, August 1990.) In addition, TSCA storage requirements may apply that limit the time that PCBs may be stored to one year. Furthermore, if PCB materials are mixed with a RCRA hazardous waste, they may be regulated by the LDR California list prohibitions. (See RCRA sections 3004(d)(2)(D) and (E).)

Department of Transportation (DOT) requirements. Where IDW will be disposed of off site or transported on public roads to a site, DOT requirements for containerizing, labeling, and transporting hazardous materials and substances may apply.

State requirements. Promulgated State regulations that are legally enforceable, timely identified, and more stringent than Federal regulations may be potential ARARs for IDW managed on site. Substantive requirements of State law that may be ARARs for IDW management include State water quality standards, direct discharge limits, and RCRA requirements (including underground injection control regulations) promulgated in a State with an authorized RCRA hazardous waste management program (as well as programs authorized by State laws). Off-site, substantive and administrative requirements of State law may apply.

Off-Site Policy. In addition to complying with requirements of Federal and State laws, all off-site disposal of wastes must comply with CERCLA section 121(d)(3) and the CERCLA Off-Site Policy (OSWER Directive No. 9834.11 (November 13, 1987)). The Off-Site Policy establishes criteria for selecting an appropriate treatment, storage, or disposal facility (TSDF), including release criteria for all facilities that receive wastes from CERCLA-authorized or funded response actions. In addition, receiving facilities must be in compliance with all "applicable laws."

Before shipping wastes off site, approval should be obtained for the proposed disposal facility from EPA's Regional Off-Site Policy Coordinator. In addition, EPA has adopted a policy for Superfund wastes shipped out of State that written notification should be provided to receiving States (OSWER Directive 9330.2-07, September 14, 1989).

GENERAL OBJECTIVES FOR IDW MANAGEMENT

In addition to the two requirements of protectiveness and compliance with ARARs to the extent practicable (on site) or

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compliance with applicable law (off site), EPA has identified two general objectives that Superfund site managers should consider when managing IDW: (1) minimization of IDW generation; and (2) management of IDW consistent with the final remedy for the site. The extent to which these objectives can be achieved is highly dependent on site-specific circumstances.

IDW Minimization

Site managers should strive to minimize the generation of IDW to reduce the need for special storage or disposal requirements that may result in substantial additional costs yet provide little or no reduction in site risks relative to the final remedial action. Generation of IDW can be minimized through proper planning of all remedial activities that may generate IDW, as well as through use of screening information from the site inspection. The potential problems of managing IDW should be a factor in choosing an investigative method. Site managers may wish to consider techniques such as replacing solvent-based cleaners with aqueous-based cleaners for decontamination of equipment, reuse of equipment (where it can be decontaminated), limitation of traffic between clean and hot zones, and drilling methods and sampling techniques that generate little waste. Examples of such techniques include using gridding techniques to minimize the number of test pits or using soil borings instead of test pits. Alternative drilling and subsurface sampling methods may include the use of small diameter boreholes, as well as borehole testing methods such as a core penetrometer instead of coring. Site managers should also be careful to keep hazardous wastes separate from nonhazardous wastes.

Management Consistent with Final Remedy

Most IDW (with the exception of non-indigenous IDW) generated during the course of an investigation are intrinsic elements of the site. If possible, IDW should be considered part of the site and should be managed with other wastes from the site, consistent with the final remedy. This will avoid the need for separate treatment and/or disposal arrangements.

Because early planning or IDW management can prevent unnecessary costs and the use of treatment or disposal capacity, IDW management should be considered as early as possible during the remedial process. A key decision to be made is whether the waste will best be treated/disposed of immediately or addressed with the final remedy. If addressed with the final remedy, IDW volumes should be considered in the FS. In addition, when IDW is stored on site, it should be managed as part of the first remedial action/operable unit that addresses the affected media.

SELECTION OF IDW DISPOSAL OPTIONS

The following sections present the Agency's presumptions for IDW management that have been established based on the above considerations. The actual option selected should be based upon best professional judgment and should take into account the following factors:

- The type and quantity of IDW generated (sludge/soil, aqueous liquid, non-indigenous IDW);
- Risk posed by managing the IDW on site (e.g., based on site access controls, contaminant concentrations);
- Compliance with ARARs, to the extent practicable (on site);
- IDW minimization; and
- Whether the final remedy is anticipated to be an off-site or on-site remedy (or this information is unknown) and whether IDW can be managed consistent with the final remedy.

Off-site Final Remedies

If a site manager believes that the final remedy will involve off-site disposal of wastes, EPA's presumption is to manage the IDW as part of the remedial action addressing the waste/medium. Thus, until the final action, the IDW may be stored (e.g., drummed, covered waste pile) or returned to its source. However, the management option selected should also take into account any protectiveness concerns, ARARs, and other relevant site-specific factors (e.g., weather, storage space, and public concern/perceptions).

There are several potential reasons why it may be advisable to store IDW until the final action. First, because wastes at the site will be shipped off site eventually, returning IDW (especially sludges and soil) to its source would require that it be excavated again. Thus, site managers may consider it practical to containerize IDW as soon as it is generated. Second, storing IDW in containers may be more protective than returning it to its source. Third, because off-site actions may trigger such requirements as the LDRs, temporary storage will eliminate the need to meet these additional requirements until the final remedy.

In some cases, circumstances may lead site managers to choose to return the IDW to its source. This may be appropriate if it is determined that returning IDW to the source is protective and that storage at the site is not possible or practicable (i.e., given State or community concerns). In other cases, long-term storage may not be protective, and immediate off-site disposal may be a better option.

> **Examples:** A site involves volatile organic RCRA hazardous wastes that will likely be sent off site for final treatment and disposal. Site conditions are such that temporary storage of IDW is considered protective until the remedial action begins. Because off-site disposal will trigger RCRA disposal requirements such as the LDRs and immediate containerization would be more protective than redepositing into the source area at the time of sampling, the site manager decides to containerize the IDW (and comply with RCRA substantive technical tank and container standards) until the final action is initiated.

On-site Final Remedies (or Final Management is as Unknown Location)

When final management of wastes is likely to occur on site, the management presumptions vary depending on the type of IDW produced.

Sludge/soil

Generally, the Agency expects sludge or soil IDW will be returned to its source if short-term protectiveness is not an issue. The reason behind this presumption is that IDW that may pose a risk to human health and the environment in the long term will be addressed by the final action. Storage of RCRA hazardous IDW in containers with the AOC prior to returning it to the source will not trigger the LDRs, as long as the containers are not managed in such a way as to constitute a RCRA storage unit as

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defined in 40 CFR 260.10. Therefore, it may be possible to store IDW temporarily before redisposing of it. However, EPA believes that, in many cases, returning sludges and soils to their source immediately will be protective and will avoid potentially increased costs and requirements associated with storage. Site-specific decisions on how to manage sludge and soil IDW may ultimately vary from the presumption based on protectiveness, ARARs, and/or community concerns.

Example 1: The soil at a site contains wastes that are expected to be stabilized on site during the final remedial action. The site manager determines that sending soil IDW off site is not cost-effective, because off-site disposal would involve testing and transport costs for a relatively small amount of waste. Instead, knowing that the site is secured and that redisposing the waste at the source will not increase site risk or violate ARARs, the site manager decides to return soil IDW to the source area from which it originated.

Example 2: A site manager determines that returning highly contaminated PCB wastes to the ground at a site is not protective because of the potential risks associated with the material; instead, the site manager chooses to drum the waste and send it off site (in compliance with TSCA). (Off-site disposal may occur immediately or at a later date.)

Example 3: Soil IDW contaminated with a RCRA hazardous waste is generated from a soil boring. The site manager decides to put the IDW back into the borehole immediately after generation, but ensures that site risks will not be increased (e.g., the contaminated soil will not be replaced at a greater depth than where it was originally so that it will not contaminate "clean" areas) and that the contamination will be addressed in the final remedy.

Aqueous liquids

EPA has not established a presumption for the management of aqueous liquid IDW (e.g., ground water). Site managers should determine the most appropriate disposal option for aqueous liquids on a site-specific basis. Parameters to consider, especially in making the protectiveness decision, include the volume of IDW, the contaminants present in the ground water, the presence of contaminants in the soil at the site, whether the ground or surface water is a drinking water supply, and whether the ground-water plume is contained or moving. Special disposal/handling may be needed for drilling fluids because they may contain significant solid components. Examples of aqueous liquid management decisions considering these factors are presented in the following box.

Example 1: A site manager has large volumes of ground water IDW and does not know if it is contaminated. Pouring this IDW on the ground would not be protective, because it may contaminate previously uncontaminated soil or may mobilize contaminants that are present in the soil. Therefore, the site manager stores the water in a mobile tank until a determination is made as to whether the water and soil are contaminated or until the final action.

Example 2: IDW is generated from the sampling of background, upgradient wells. Because there are no community concerns or evidence of any soil contamination from other sources, the site manager decides to pour this presumably uncontaminated IDW on the ground around the well.

Example 3: Purge water from a deep aquifer is known to be contaminated with a RCRA hazardous waste. At this site, if this water were poured on the ground, it could contaminate a previously uncontaminated shallow aquifer that is a potential drinking water source and would have to comply with the LDRs. The site manager decides to containerize the water within the AOC and store it until the final remedy.

Non-indigenous IDW

Non-indigenous IDW (e.g., sampling materials, disposable PPE, decontamination fluids) should be stored until the final remedy or disposed of immediately. If contaminated, such waste may not be disposed of onto the ground because such an action would add contamination that was not present when activities began at the site (e.g., solvents used for decontamination). If non-indigenous IDW is contaminated with RCRA hazardous waste, it must be managed in accordance with RCRA Subtitle C requirements. Otherwise, site managers may generally dispose of it in an on-site dumpster (for PPE).

Example 1: Disposable PPE (e.g., gloves, shoe covers) becomes contaminated with RCRA hazardous waste during the field investigation. The site manager containerizes and disposes of this IDW in compliance with RCRA Subtitle C requirements.

Example 2: Disposable equipment becomes contaminated during a field investigation. The site manager decontaminates them and sends them to a Subtitle D facility.

COMMUNITY CONCERNS

Residents of communities near a CERCLA site, local governments, or States may have concerns about certain disposal methods or long-term storage of IDW at the site. As with all CERCLA activities, site managers should evaluate community concerns regarding disposal of IDW in deciding what action to take. For example, if a community is concerned about the direct discharge of IDW water to surface water on site, site managers may want to consider sending the water to a POTW, if one is located nearby. In some instances, it may be appropriate to prepare fact sheets, include options in other community relations documents, or explain IDW management decisions at public meetings prior to actions.

NOTICE: The policies set out in this memorandum are not final agency action, but are intended solely as guidance. They are not intended, nor can they be relied upon, to create any rights enforceable by any party in litigation with the United States. EPA officials may decide to follow the guidance provided in this memorandum, or to act at variance with the guidance, based on an analysis of specific site circumstances. The Agency also reserves the right to change this guidance any time without public notice.

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Appendix B
Example of ENVF-2017.01, "Waste Evaluation Checklist"

NORTHWIND

Applicability: ESH&Q
Owner: ESH&Q Director

For the most recent revision, refer to the Document Management System.

WASTE EVALUATION CHECKLIST
For use with ENVP-2017

ENVF-2017.01
Revision: 0
Effective Date: 06/21/19
Page 1 of 2

This checklist must be completed by the Project Manager for all projects or task orders that involve the management of chemical waste or contaminated environmental media		
Project Name:		
Client:	Location:	
Provide a brief description of waste stream:		
Answer the following questions by initialing the appropriate box. ***Answers in the shaded boxes indicate waste streams that are subject to RCRA regulation unless otherwise exempted.***		
1. Review of state-specific and project-specific regulatory requirements.		
List the state(s) in which the waste was or will be: Generated – Treated, stored or otherwise managed – Recycled or re-used – Disposed of –		
Do any of the states listed above have state hazardous waste regulations that are more stringent than the Federal RCRA regulations?	☐ Yes	☐ No
Does the client/project have hazardous waste management requirements that are more stringent than the Federal RCRA regulations?	☐ Yes	☐ No
If yes to either of the questions above, summarize the additional requirements below and incorporate these requirements into the project waste management procedures.		
2. Document whether the waste meets a specific waste exclusion (Refer to Sections 4.2 and 4.3 for details). If waste is excluded, stop here.		
3. Determine if Waste is a Hazardous Waste		
A. Commercial Chemical Products Is the waste material a commercial chemical product? **NOTE:** *This includes only those commercial chemical products that are manufactured or formulated for commercial or manufacturing use and applies to the commercially pure grade of the chemical, any technical grades of the chemical that are produced or marketed, and all formulations in which the chemical is the sole active ingredient. It does NOT include a manufacturing process waste or a contaminated environmental medium that contains the commercial chemical product.*	☐ Yes	☐ No
If yes, is the commercial chemical product listed in 40 CFR 261.33 (P and U lists) or on any similar list in a state-specific regulation?	☐ Yes*	☐ No

EXAMPLE

NOTE: This completed form is a record and shall be completed entirely and maintained in accordance with project/program records management requirements.

WASTE EVALUATION CHECKLIST
For use with ENVP-2017

If yes, identify the commercial chemical product and corresponding waste code(s).		
B. Waste Generating Process Is sufficient information available to document the process that generated the waste? **NOTE:** *RCRA does not require the generator to make assumptions on the process that generated the waste if such knowledge is not available.*	☐ Yes	☐ No
If yes, was the waste generated from one of the processes listed in 40 CFR 261.31 (F list), 261.32 (K list) or a process listed in a state-specific regulation?	☐ Yes*	☐ No
If yes, briefly describe the waste generation process.		
C. Hazardous Waste Characteristics Does the waste exhibit any of the hazardous waste characteristics of ignitability, corrosivity, reactivity, or toxicity, or any state-specific hazardous waste characteristic?	☐ Yes*	☐ No
Identify the types of analyses that were performed, summarize results here, and include a copy of the analytical data in the project file:		

EXAMPLE

* Answers in the shaded boxes indicate waste streams that are subject to RCRA regulation unless otherwise exempted.

Project Manager Name: _____ Phone: _____

Signature: _____ Date: _____

Office Location: _____ Email: _____

NOTE: This completed form is a record and shall be completed entirely and maintained in accordance with project/program records management requirements.

Appendix C
Flowcharts

Figure 1 – Solid Waste Determination Flowchart

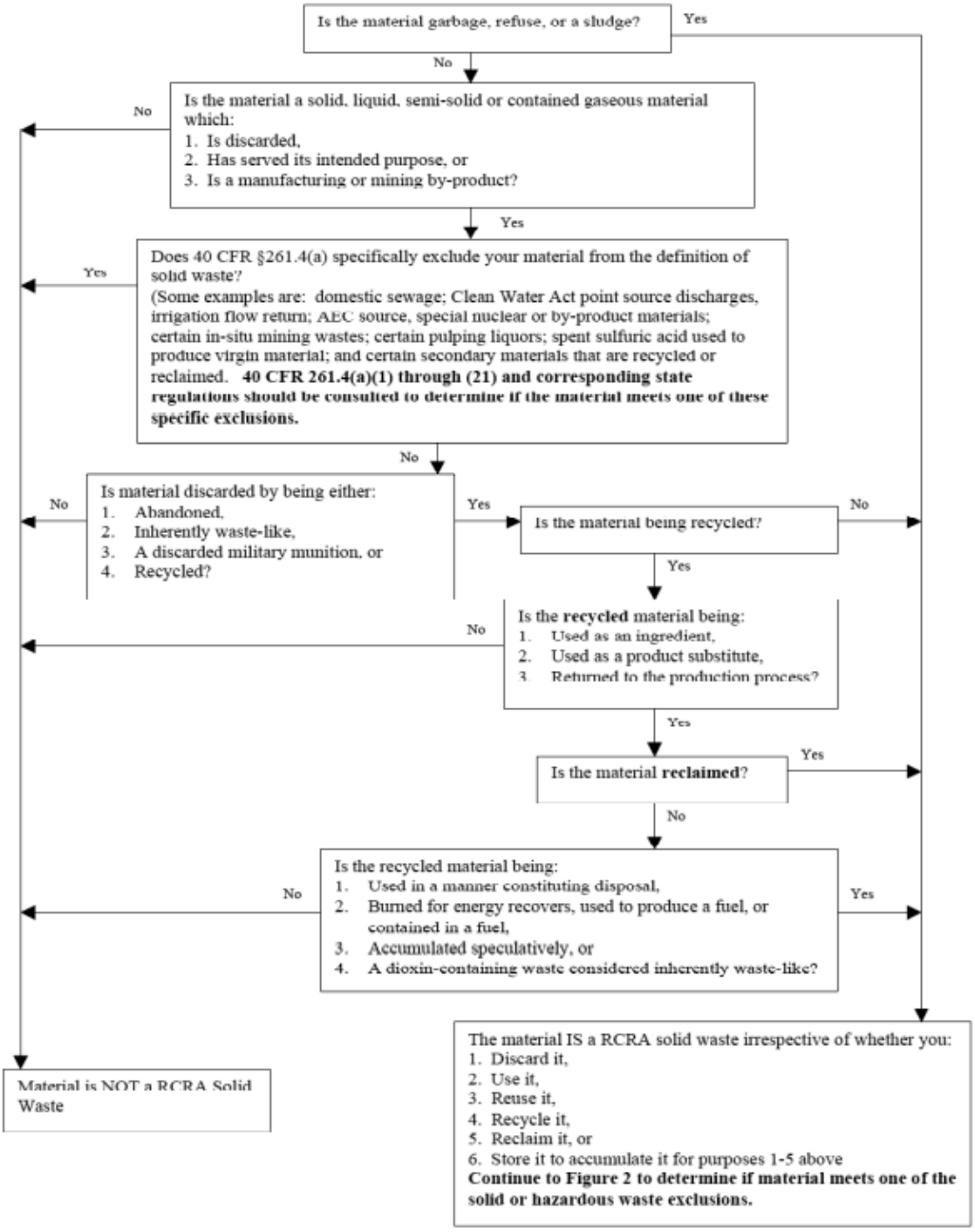


Figure 2 – Exclusions Flowchart

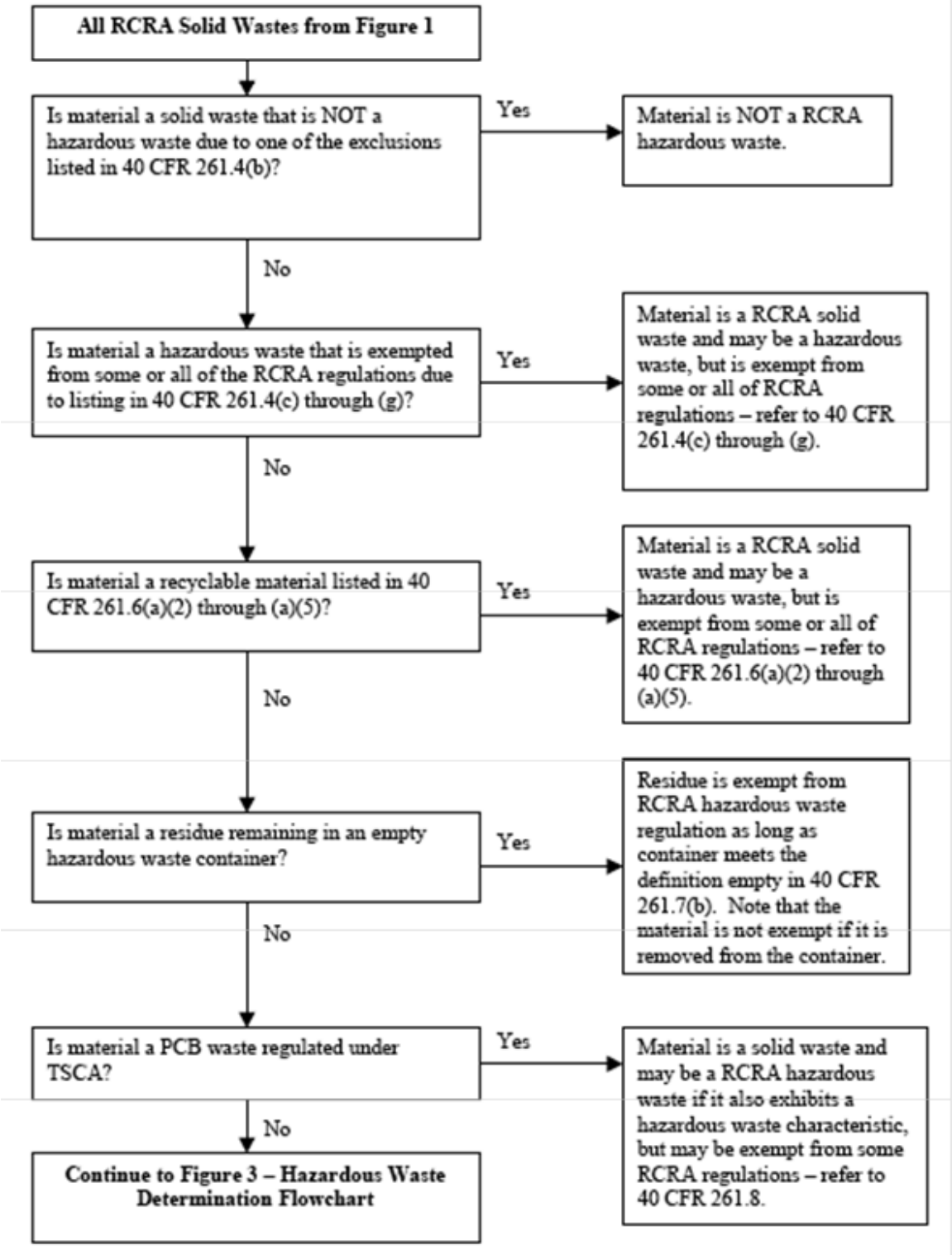
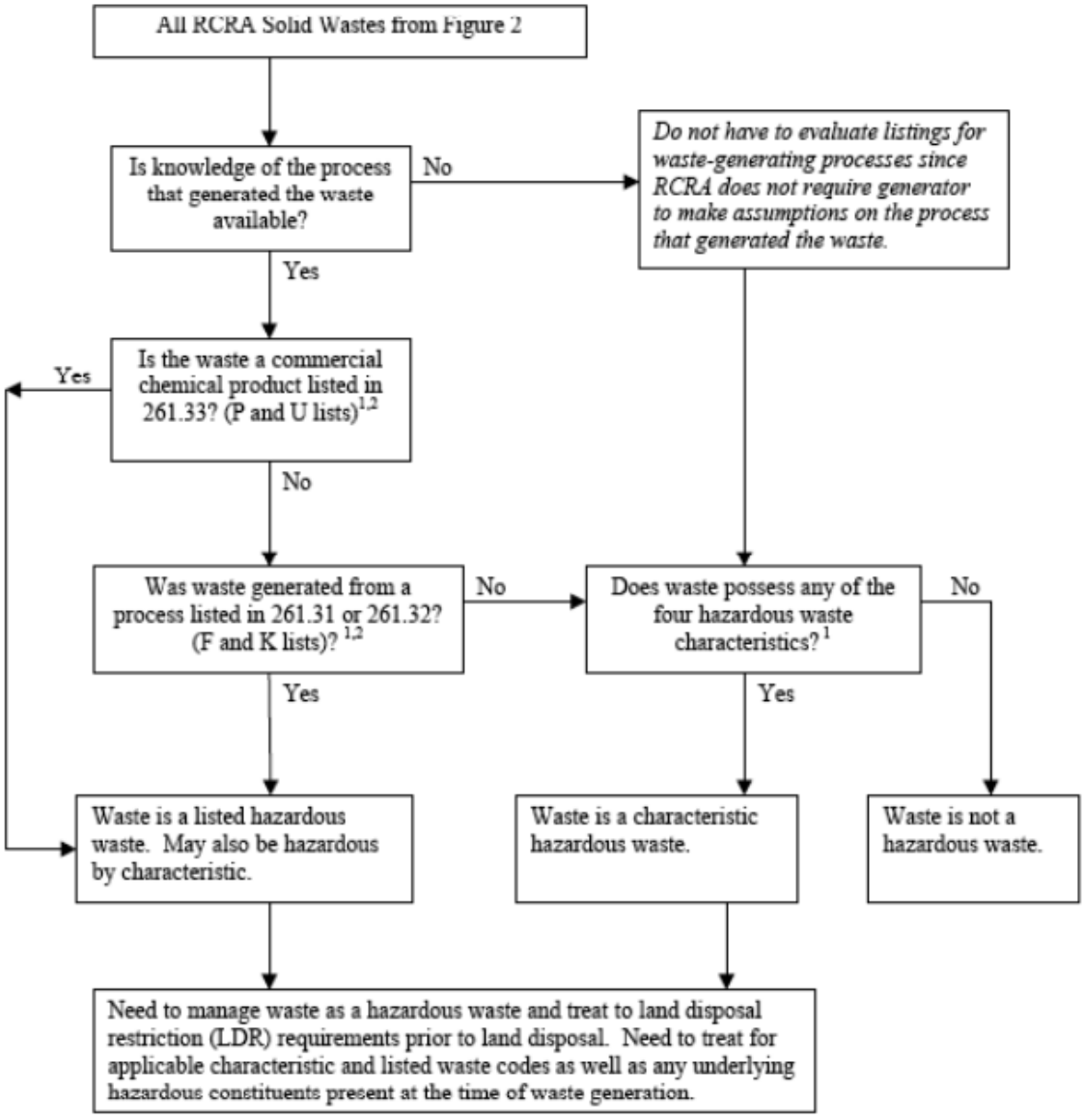


Figure 3 – Hazardous Waste Determination Flowchart



[1] Waste also needs to be evaluated for of any state-specific hazardous waste listings.
[2] All P List wastes and some F List wastes are Acute Hazardous Wastes

NORTHWIND SITE SERVICES

ENVP-2019
Rev. 0

Per- and Polyfluoroalkyl Substances (PFAS) Sample Collection Guidance

Applicability: Companywide	Effective Date: 12/06/2023	Approver/ Title: Ray Peters, CIH, CSP ES&H Director
For the most recent revision, refer to the Document Management System.		Signature: Ray Peters (Dec 7, 2023 12:21 EST)

History of Revisions

Revision	Issue Date	Action	Description
0	12/06/2023	New document.	Initial issue.

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ACRONYMS

APP	Accident Prevention Plan
ETFE	Ethylene fluoroethylene
FEP	Perfluorinated ethylene-propylene
FTL	Field Team Lead
H&S	Health and Safety
HDPE	High Density Polyethylene
HSM	Health and Safety Manager
NWG	North Wind Group
LDPE	Low Density Polyethylene
SDS	Safety Data Sheet
SOP	Standard Operating Procedure
SSHP	Site Safety and Health Plan
SSHO	Site Safety and Health Officer
PFASs	per-and polyfluoroalkyl substances
PPE	Personal Protective Equipment
PTFE	Polytetrafluoroethylene
PVC	polyvinyl chloride
PVDF	Polyvinylidene fluoride
TO	Toxic Organics

1. PURPOSE

This standard operating procedure (SOP) describes the methodology for collection of environmental samples for Perfluorinated Compounds (PFAs).

2. RESPONSIBILITIES

Performer	Responsibilities
Project Manager	The Project Manager (PM) is responsible for providing adequate resources and ensuring that field staff have adequate experience and training to successfully comply with and execute project-specific SOPs and implement the project health and safety (H&S) program. The PM will solicit the appropriate technical expertise to ensure that the project has identified the best sampling methods and technology for the job given the current understanding of the site and project goals.
Field Manager	The FM is responsible for the coordination and scheduling of daily field activities. In addition, the FM is responsible for ensuring compliance with this SOP and that all field staff engaged in this activity are trained in accordance with this SOP. The FM, or designee, is responsible for knowing the requirements for sampling and maintaining adequate documentation of sampling measurements and related activities.
Health and Safety Manager	The Health and Safety Manager (HSM) is assigned to oversee site-specific H&S and ensure overall compliance with project H&S requirements. The HSM conducts personal protective equipment (PPE) evaluations, selects the appropriate PPE for the project, lists the requirements in the Project-specific Accident Prevention Plan/Site Safety and Health Plan (APP/SSHP), coordinates with the FM and/or Site Safety and Health Officer (SSHO) to complete and certify the PPE program, and conducts project H&S audits on the effectiveness of H&S program.
Site Safety and Health Officer	The SSHO assists the FM and HSM with the H&S program, implements the PPE requirements described in the project APP/SSHP, and receives input from project staff that the assigned PPE requirements and on-going H&S procedures are effective.
Site Personnel	All site personnel who sample for PFAs are required to read this procedure before engaging in this activity. The Field Team Leader (FTL) will inform personnel who will be responsible for sampling and associated tasks.

3. GENERAL

PFASs are a class of emerging contaminants composed of more than 3,000 human-made, fluorinated, organic chemicals (Buck et al., 2011, Wang et al., 2017). The actual number of compounds is continuously changing, as some PFAS are no longer produced due to regulatory and voluntary actions, while new ones are created as alternatives. The carbon-fluorine bond that exists in PFAS is one of the strongest bonds in nature; they are tough to break and are resistant to thermal, chemical, and biological degradation.

Sampling for PFAs can present a special set of challenges, due to the widespread use of PFAs in everyday products and combined with the low detection limits associated with the analysis of PFAs, the possibility for cross contamination is high. The purpose of this document is to help direct field personal to reduce the chances of cross contamination to help collect high quality representative environmental samples.

4. INSTRUCTIONS

4.1 PPE/Clothing

- Do not wear clothing or have materials that are water resistant, waterproof, or stain- treated during field sampling.
- Field gear shall be made of cotton. As new clothing can contain PFAS, clothing worn out in the field should be “well laundered”, washed a minimum of 6 times from purchase and without fabric softeners which may contain PFAS.
- A good practice is to have well laundered cotton coveralls that are only worn during sampling over your field clothing (still using the above guidance for field clothing) and can be removed and stored when not sampling and washed after use.
- Do not wear footwear containing Gore-Tex® or similar membranes or treated with waterproofing materials. All safety footwear will consist of steel-toed boots made with polyurethane and polyvinyl chloride (PVC).
- Do not wear Tyvek® clothing on-site since it contains fluorinated compounds.
- Disposable nitrile gloves must be worn at all times. A new pair of nitrile gloves should be donned prior to the following activities at each sample location:
    - Decontamination of re-usable sampling equipment
    - Prior to contact with sample containers
    - Insertion of anything into the well
    - Insertion of silicon tubing into the peristaltic pump
    - Completion of monitor well purging, prior to sample collection
    - Handling of any quality assurance/quality control samples including field blanks and equipment blanks
    - After the handling of any non-dedicated sampling equipment, contact with non-decontaminated surfaces, or when judged necessary by field personnel.

4.2 Field Equipment

- Exclude materials known to contain PFAS, such as those containing polytetrafluoroethylene (PTFE), perfluorinated ethylene-propylene (FEP), ethylene fluoroethylene (ETFE), low-density polyethylene (LDPE), polyvinylidene fluoride.
- (PVDF), pipe thread compound and tape, and waterproof coatings containing PFAS. The Safety Data Sheets (SDS) of materials should be reviewed before considering materials for use.
- Teflon® containing materials should not be used on site. Teflon® is commonly used in sampling materials such as tubing, tread tape, pump components, bailers. High-density polyethylene (HDPE), stainless steel, or silicon materials should be used instead.
- Water resistant paper (such as Rite-in-the-Rain™) or other waterproof field books should not be used on site, use loose paper or a composition notebook such as those pictured below.



- Plastic clip boards, plastic binders, or spiral hard cover notebooks are not acceptable as they could contain PFAs. Instead, use a masonite or metal clipboard.
- Post-it notes or any adhesive paper products should not be used on site.
- Use a pen. If a marker is needed, use only Sharpie® brand markers. No dry-erase markers.
- Chemical ice packs should not be used, instead use double bagged wet ice.
- Samples should be sealed in LDPE zip-style bags (Ziploc) and stored in the sample cooler, ensuring the LDPE outer barrier does not come into direct contact with the PFA sample.
- Aluminum foil should not be used on site, instead use thin HDPE plastic sheeting.

4.3 Sample Containers

- Sample container, preservation, shipping, storage, and hold time requirements are included in USEPA Methods 537.1 (USEPA 2020), 533 (USEPA 2019), SW-846 Method 3512/8327, USEPA Draft 1633 (USEPA 2021), OTM 45 (USEPA 2021), and DOD AFFF01 (Willey 2021). Depending on the analytical method used or program (for example, state or DoD), container requirements for sample matrix may vary.
- Containers acceptable for sample collection include pre-cleaned polypropylene or HDPE bottles with an unlined polypropylene or HDPE screw cap. Do not use low-density polyethylene (LDPE) materials.
- Avoid the use of glass containers (glass can potentially absorb PFAS) and containers with Teflon lined caps.

4.4 Equipment Decontamination

- Whenever possible disposable or dedicated sampling equipment should be used.
- If equipment re-used is performed, thorough decontamination is necessary between each use. Use Alconox® or Liquinox® soap must be used as other brands contain PFCs. Water used for the decontamination of sampling equipment will be laboratory certified “PFAS-free” water.
- PFAContainer labels should be filled out using pen (NO MARKERS) after the caps have been placed back on each sample bottle.

4.5 Sampling

- Keep PFA sampling containers separate from containers for other types of samples, as other containers may have Teflon® or other PFAs.
- Collect PFAs samples first, and store in a separate cooler. Segregation will help reduce the chance for cross contamination.
- Confirm the laboratory hours. Samples shall be delivered or shipped daily to ensure temperature requirements are in compliance upon arrival to the laboratory.

4.6 Wet Weather

- PFA field sampling occurring during wet weather (e.g., rainfall and snowfall) should be conducted while wearing appropriate clothing that will not pose a risk for contamination. Teams should avoid synthetic gear that has been treated with water-repellant finishes containing PFAS. Use rain gear made from PVC, polyurethane, and wax- coated materials.
- The materials used for canopies or tents are likely treated with PFAs. If using a canopy or tent over a sample location to provide shelter from rain, gloves should be worn when moving the tent and changed immediately afterwards. Further contact

with the canopy or tent should be avoided until all sampling activities at the location are completed.

4.7 Personal Hygiene

- Field personnel shall not use cosmetics, moisturizers, hand cream, or other related products as part of their personal cleaning/showering routine on the morning of a sampling event, as these products represent a potential source of PFAs.
- Many manufactured sunblock and insect repellants contain PFAs and should not be brought or used on-site. Alternative sun/ insect protection should be considered such as long-sleeved light-colored cotton clothing/coveralls, wide brimmed cotton hats, or tucking in pant legs. It is best practice to avoid sunblock and insect repellants, but if it is absolutely necessary that they are used on-site should they need to consist of 100% natural ingredients a few examples:
    - Sunscreens: Alba Organics Natural, Yes to Cucumbers, Aubrey Organics, Jason Natural Sun Block, and Kiss My Face, Baby-safe sunscreens (‘free’ or ‘natural)
    - Insect Repellents: DEET, Jason Natural Quit Bugging Me, Repel Lemon Eucalyptus,
    - Herbal Armor, California Baby Natural Bug Spray, and BabyGanics
    - Sunscreen and Insect Repellents: Avon Skin So Soft Bug Guard-SPF 30
- For washroom breaks, field personnel will leave the exclusion zone and then remove gloves and overalls. Field personnel should wash as normal with extra time for rinsing with water after soap use. When finished washing, the use of a mechanical dryer is preferred and the use of a paper towel for drying is to be avoided (if possible).

4.8 Food Considerations

- No food or drink shall be brought on-site, with the exception of bottled water and hydration drinks (i.e., Gatorade® and Powerade®). Drinks should be stored and consumed in a staging area away from sampling area.

4.9 Visitors

- Visitors to the site are asked to remain outside of the exclusion zone during sampling activities.

4.10 Quality Control and Analytical Considerations

- Collection and analysis of QC samples, such as field blanks, equipment rinse blanks, and field duplicates, are important to determine if there were any background due to PFA very low detection limits and widespread commercial use of PFAS-containing products.
- Have a well-defined quality control program to help determine how many and when quality control samples will be taken.

- Ensure the selected laboratory that will be performing the analysis is experienced in analyzing for PFAs, and aware of the necessary precautions to prevent contamination.
- Provide clear communication and advance notice to the laboratory of when PFA samples will be collected, and when they will be received.

Table 1. Summary of Acceptable and Prohibited Items

Acceptable	Prohibited
Field	
High-density polyethylene (HDPE) materials	Teflon® containing materials
Acetate liners	Low density polyethylene (LDPE) materials
Silicon tubing	Waterproof field books
Loose paper (non-waterproof) or composition notebook with cardboard cover	Binders, spiral or plastic cover notebooks, Post-It Notes
Aluminum or Masonite Clipboards	Plastic clipboards
Sharpies®, pens	Markers or dry erase pens
Regular ice (Double bagged)	Chemical (blue) ice packs
Field Clothing /Personnel Hygiene	
Well-laundered clothing made of natural fibers (preferably cotton).	New cotton clothing or synthetic water resistant, waterproof, or stain-treated clothing, clothing containing Gore-Tex™, Clothing laundered using fabric softener
Boots made with polyurethane and PVC	Boots containing Gore-Tex ™ or Tyvek®
Sunscreens - Alba Organics Natural Sunscreen, Yes To Cucumbers, Aubrey Organics, Jason Natural Sun Block, Kiss my face, Baby sunscreens that are “free” or “natural” Insect Repellents - Jason Natural Quit Bugging Me, Repel Lemon Eucalyptus Insect repellant, Herbal Armor, California Baby Natural Bug Spray, BabyGanics Sunscreen and insect repellant - Avon Skin So Soft Bug Guard Plus - SPF 30 Lotion	No cosmetics, moisturizers, hand cream, or other related products as part of personal cleaning/showering routine on the morning of sampling.
Samples	
HDPE or polypropylene	LDPE or glass containers
Unlined polypropylene or HDPE caps	Teflon®-lined caps
Rain	
Gazebo/tent that is only touched with gloves and moved prior to and following sampling activities	Waterproof or water-resistant rain gear
Equipment	
Alconox® and/or Liquinox®	Decon 90
Laboratory certified PFAS free water for final rinse	Water from an on-site well
Food	
Bottled water and hydration drinks (i.e., Gatorade® and Powerade®) to be brought and consumed only in the staging area	All food and drink, with exceptions noted on the left

5. RECORDS

Details regarding the precautions and steps taken should be recorded in the Field Notebook.

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Attachment 1
Daily PFAS Protocol Checklist

Date: _____
Weather (temp./precipitation): _____

Project Name: _____
Personnel on Site: _____

Field Clothing and PPE:

☐ No clothing or boots containing Gore-Tex™

☐ Clothing being worn is well laundered (washed a minimum of six times.

☐ All safety boots made from polyurethane and PVC

☐ No materials containing Tyvek®

☐ Field crew has not used fabric softener on clothing

☐ Field crew has not used cosmetics, moisturizers, hand cream, or other related products this morning.

☐ Field crew has not applied unauthorized sunscreen or insect repellant.

Field Equipment

☐ No Teflon® or LDPE containing materials on-site.

☐All sampling materials made from stainless steel, HDPE, acetate, silicon, or polypropylene.

☐ No waterproof field books on-site.

☐ No plastic clipboards, binders, or spiral hard cover notebooks on-site.

☐ No adhesives (Post-It Notes) on-site.

Sample Containers:

☐All sample containers made of HDPE or polypropylene.

☐Caps are unlined and made of HDPE or polypropylene.

Wet Weather:

☐Wet weather gear made of polyurethane and PVC only.

Equipment Decontamination:

☐"PFA-free" water on-site for decontamination of sample equipment. No other water sources to be used.

☐Alconox and Liquinox to be used as decontamination materials.

Food Considerations:

☐No food or drink on-site with exception of bottled water and/or hydration drinks (i.e., Gatorade and Powerade) that is available for consumption only in the staging area.

If any applicable boxes cannot be checked, the Field Manager shall describe the noncompliance issues below and work with field personnel to address noncompliance issues prior to commencement of that day's work. Corrective action shall include removal of noncompliance items from the site or removal of worker offsite until in compliance. Repeated failure to comply with PFA sample protocols will result in the permanent removal of worker(s) from the site.

Describe the noncompliance issues (include personnel not in compliance) and action/outcome of noncompliance:

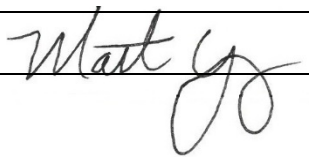
_____

_____

Field Manager Name: _____
Field Manager Signature: _____
Date: _____

QAP-3121
Rev. 1

Control of Measuring and Test Equipment

Applicability: Companywide	Effective Date: 03/13/2020	Approver/ Title:	Matt Young QA Manager
For the most recent revision, refer to the Document Management System.		Signature:	

History of Revisions

Revision	Issue Date	Action	Description
0	08/27/18	New document.	Integration of North Wind documents.
1	03/13/2020	Revise document.	Updates regarding QAP references and various other improvements to the procedure.

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DEFINITIONS

Accuracy. The degree of closeness of measurements of a parameter, such as quantity, concentration, etc., to that parameter's actual (true) value.

Activities affecting quality. The actions or activities that affect the quality of an item or service to meet or demonstrate compliance to requirements. Examples of activities affecting quality include, but are not limited to, siting, designing, procuring, fabricating, constructing, calibrating, handling, shipping, receiving, storing, cleaning, erecting, installing, inspecting, testing, operating, maintaining, repairing, refueling, modifying, and decommissioning.

Calibration (i.e., factory calibration). (1) Activities performed by a qualified organization, agency, or laboratory to compare readings of the M&TE to a known national standard; or (2) Comparison of a measurement standard or M&TE with a reference standard or instrument of higher accuracy to detect and quantify inaccuracies and to report or eliminate those inaccuracies by adjustments. May also include maintenance, repair, or adjustment of the equipment to improve performance.

Field calibration. Activities performed by the M&TE user to adjust the equipment performance as needed. Normally performed in a controlled environment following manufacturer's procedure to adjust instrument settings to match certified reference materials/standards.

Measuring and test equipment (M&TE). Devices or systems used to calibrate, measure, gage, test, or inspect in order to control or acquire data to verify conformance to specified requirements.

Original equipment manufacturer (OEM). The original manufacturer of a piece of M&TE.

Performance check. Activities performed by the M&TE user to confirm the operability of M&TE. This includes verifying equipment accuracy, alarms, sensors, and performance of the equipment using a certified reference material/standard. Also known as "bump test," "calibration check," or "daily QA check." Similar procedure as a field calibration, except that the equipment is not adjusted to match the certified reference material/standard.

Precision. The degree to which repeated measurements under unchanged conditions show the same results.

Reference material (or "Standard"). The material, such as span gas of certified purity and concentration, used to conduct a calibration. Normally purchased with specified accuracy and certified in association with a known standard, such as NIST or ISO.

Tolerance. The maximum allowable deviance or departure of a measured value from a specified value. Also referred to as "acceptance criterion."

Traceability. The ability to relate an individual measurement result to national or international standards of measurement.

ACRONYMS

ISO	International Organization for Standardization
M&TE	measuring and test equipment
NCR	Nonconformance Reports
NIST	National Institute of Standards and Technology
NW	North Wind
OEM	original equipment manufacturer
PQC	procurement quality clause
QA	quality assurance
QAF	quality assurance form
QAP	quality assurance procedure

1. PURPOSE

This procedure establishes the requirements for the control and *calibration* (see def.) of *measuring and test equipment* (M&TE; see def.), ensuring that this equipment operates within required *accuracy* (see def.) limits when used to verify conformance to requirements.

2. SCOPE

This procedure applies to all personnel of North Wind Group and its wholly owned subsidiaries (referred to herein either individually or collectively as NW) who select, use, or calibrate M&TE (rented or NW-owned) used for final acceptance on NW projects.

NOTE 1: *This may include NW employees and/or subcontractors procured to perform these activities.*

NOTE 2: *This procedure does not apply to fixed measuring devices, such as rulers, tape measures, and levels. Users shall verify that the device is undamaged prior to and during each use.*

3. RESPONSIBILITIES/PREREQUISITES

3.1 Responsibilities

Performer	Responsibilities
Project manager (PM)	• Responsible for the evaluation, selection, and use of M&TE as required by project and contract quality requirements. • Ensures M&TE is of the proper type, range, accuracy, and tolerance to determine conformance to specified requirements. • Ensures appropriate acquisition, control, maintenance, and documentation of M&TE, before and during its use. • Ensures that project users are qualified and trained. • Verifies that project records generated, in accordance with this procedure, are maintained to demonstrate conformance. • Assigns an M&TE custodian to maintain the M&TE inventory of equipment during the performance of a project.
Quality Assurance (QA) manager	• Responsible for the implementation of the M&TE program. • Assesses the effectiveness of the M&TE program. • Assists with determination of project quality requirements. • Assists in the selection of M&TE to ensure applicability. • Assists in the procurement of M&TE and calibration services. • Assists in evaluations for out-of-calibration M&TE. • Assigns certified individuals to perform receipt inspections on M&TE.

Performer	Responsibilities
M&TE custodian	• Determines calibration frequencies of M&TE, as appropriate. • Arranges for maintenance and calibration with approved suppliers. • Keeps the NW M&TE inventory up-to-date for M&TE under their control. • Assists users with proper storage and control of M&TE, including equipment inventory and identification. • Prepares purchase requisitions for new M&TE and calibration services. • Applies calibration status indicators (e.g., stickers) to M&TE. • Maintains the M&TE inventory of NW-owned equipment during the performance of a project, including calibration certificates. • Ensures that M&TE is available and ready for use. • Maintains knowledge and training related to equipment operation, capabilities, limitations, and expected results.
M&TE user(s)	• Responsible for protecting and maintaining M&TE while in use. • Properly selects and uses M&TE. • Ensures that standards used are not expired. • Ensures that M&TE is properly identified. • Performs performance checks as required. • Notifies M&TE custodian of any problems or concerns associated with M&TE selection, use, and calibration. • Documents field calibration and performance check results.

3.2 Prerequisites

Personnel performing tasks or fulfilling responsibilities identified by this procedure as requiring training, certification, and/or qualification shall complete such training/ documentation before the start of work.

M&TE shall be verified as meeting the requirements of this procedure before it is used in association with activities affecting quality.

4. INSTRUCTIONS

4.1 Selection and Use of M&TE

4.1.1 PM or designee: Selects M&TE and/or reference materials/standards based on the type, range, readability (graduations), accuracy, and *precision* (see def.) needed to accomplish the required measurement within its needed *tolerance* (see def.) as required by project and contract quality requirements.

4.1.2 Ensures that tools, gauges, instruments, and other M&TE used for final acceptance of activities for affecting quality are controlled, calibrated at specific periods, adjusted, and maintained to required accuracy limits.

NOTE: *Reference materials/standards shall be certified to meet national or equivalent international recognized standards. National Institute of Standards and Technology (NIST)* traceability *(see def.) is recommended. If nationally recognized standards are not applicable, then the basis for selection of reference materials/standards shall be defined in project records or project-specific work control documents. Additional requirements for M&TE and reference materials/standards based on contractual directives shall be followed, and shall be included in approved project-specific work control documents associated with M&TE. It is recommended that purchased or rented equipment have calibration documentation showing that calibration standards compliant with this procedure were utilized during calibration.*

4.1.3 Assigns an M&TE custodian to maintain M&TE for the duration of a project.

4.1.4 M&TE custodian: Maintains the M&TE for which he or she is responsible, for the duration of a project.

NOTE: *A copy of the calibration certification shall be maintained by the M&TE custodian during the performance of a project.*

4.1.5 Verifies that the M&TE is within the calibration due date, is not damaged, and is operating properly.

4.1.6 Maintains the methods for identification and traceability of M&TE.

4.1.7 Performs the following when M&TE is not within the calibration due date, is damaged, or its performance is otherwise suspect:

- Tags and/or segregates and removes the M&TE from service and does not use the M&TE until it is repaired and/or recalibrated.
- Notifies QA and the PM of the condition of the M&TE.
- Initiates a Nonconformance Report (NCR) as applicable per QAP-3151, “Control of Nonconforming Items.”

4.1.8 Evaluates the utilization, with the assistance of the QA manager, of M&TE that is not within the calibration due date, is damaged, or its performance is otherwise suspect.

4.1.9 M&TE user: Uses, handles, and stores M&TE in a manner that maintains the accuracy and precision of the M&TE by complying with manufacturer’s recommendations, and utilizing controlled environments to the extent necessary for use and storage.

4.1.10 Performs field calibrations or performance checks as required by the M&TE manufacturer or as delineated in project-specific documents, performs required measurements in accordance with established instructions and procedures, and records the measurements on an approved inspection record, data recording form, or logbook, as specified by established instructions and procedures.

NOTE: *M&TE must be traceable to its use by documentation of the M&TE (i.e., identification number or serial number, and the calibration due date) that was used to perform measurements for final acceptance.*

4.1.11 Records the M&TE used by listing the identification or serial number, including the calibration due date, on the approved inspection record, data recording form, or logbook, as specified by established instructions and procedures.

4.2 Control of M&TE

4.2.1 M&TE custodian: Creates an inventory list of the M&TE to be utilized for the project on a QAF-3121.01, "M&TE Inventory Log," or approved equivalent.

NOTE 1: *Equipment that is purchased or rented by NW shall be acquired with a certificate of calibration, preferably NIST-traceable, provided by the supplier, as applicable. Standards and reference materials shall be acquired with certificates of analysis or other documentation of accuracy and expiration, preferably NIST-traceable.*

NOTE 2: *Equipment that is transferred from another project shall be checked out through the QA manager or quality designee to ensure that the identification and/or calibration status has been maintained. Upon completion of the project, the M&TE shall be returned to the QA manager or quality designee.*

4.2.2 Identifies the M&TE, unless already identified, with a unique identifier by physically tagging or marking in a way that ties it to the applicable record in the inventory log.

NOTE: *Equipment shall be tagged or marked to indicate calibration status (see Section 4.4) and establish traceability to calibration records.*

4.2.3 Ensures that traceability to calibration records is maintained on all M&TE for the duration of the project.

NOTE: *Rental or subcontractor-owned equipment that is used by NW personnel on a temporary basis (e.g., less than 6 months) is not required to be listed in the M&TE inventory log or assigned a North Wind Asset Number. However, when not listed, and used, such equipment shall be described in project-specific documents (e.g., logbooks, rental agreements) with records (e.g., certificates of calibration, QAF-3132.01, "Receipt and Source Inspection Checklist") maintained in accordance with this procedure.*

4.3 Storage, Handling, and Use

4.3.1 M&TE users: Stores, uses, transports, and handles M&TE in a manner that will not adversely affect the accuracy, stability, or performance of the M&TE. M&TE users shall ensure that sensitive instruments are not inadvertently bumped, dropped, or otherwise mishandled.

4.3.2 Uses M&TE in environments that are controlled to the extent necessary to ensure that the required accuracy and precision are maintained, or otherwise documents environmental variables that could impact measurements.

NOTE: *M&TE users should refer to manufacturer manuals or instructions for guidance regarding proper handling and storage and potential environmental interferences.*

4.3.3 Documents the use of M&TE used for verification and/or acceptance on a QAF-3121.02, "M&TE Usage Log," or approved equivalent so that the impact of any malfunctions can be assessed.

4.4 Calibration

NW generally does not maintain the capability to perform calibration or recalibration activities beyond performing *field calibrations* (see def.) or *performance checks* (see def.) as recommended by the M&TE manufacturer. Such capability would include calibration procedures, accreditations, and a calibration facility with environmental controls and certified *reference materials/standards* (see def.). Thus, NW normally procures M&TE in a calibrated condition or procures the calibration or recalibration services. The requirements for calibration and recalibration are contained in this procedure and must be included in procurement documents as necessary for the M&TE and the application for which the M&TE is used. If necessary, M&TE-specific calibration or recalibration activities and procedures may be developed using manufacturer's recommendations and requirements have a minimum accuracy four times greater than the M&TE being calibrated. Where this 4:1 ratio cannot be maintained, the basis for not meeting this ratio shall be technically justified, and approved by the customer.

4.4.1 M&TE custodian: Creates an inventory log of the M&TE to be utilized for the project.

4.4.2 Confirms with calibration subcontractors that a pre-calibration check has been performed on any M&TE sent in for calibration and the as-found results recorded before any required adjustments or repairs are made.

4.4.3 Confirms that the calibration subcontractor's reference standards have a minimum accuracy of four times greater than the M&TE being calibrated. Where this 4:1 ratio cannot be maintained, the basis for selection of the certified reference standard shall be technically justified.

4.4.4 Confirms that any M&TE that contains embedded software, which is integral to the operation of M&TE, is calibrated as a unit. As such, the software is verified and validated by the calibration process, and the software QA requirements of QAP-3113, "Software Quality Assurance," are not applicable.

4.4.5 Extends calibration intervals, as appropriate, for M&TE that has not been used within the current calibration time frame. The calibration interval may be extended no more than two times before the M&TE is either sent out for re-calibration or removed from the system. The revised calibration frequency shall be documented on the company M&TE Log.

4.4.6 Prepares purchase requisitions for the procurement of calibrated M&TE or for calibration services using the process described in QAP-3041, "Quality Procurement Controls," for applicable QA procurement requirements, and obtains assistance from the QA organization. Includes the following requirements in the purchase requisition as applicable:

- Certificate of Calibration based on the requirements from Appendix C of QAP-3041, "Quality Procurement Controls" for procurement of calibration services. Refer to Procurement Quality Clause (PQC) PQC-27.
- Codes, standards, or specifications applicable to the M&TE and the application for which the M&TE is used. Refer to PQC descriptions in Appendix C of QAP-3041.
- Any additional requirement from the M&TE-specific calibration procedure development process that is applicable to the M&TE.
- Receipt inspection of the M&TE per QAP-3132, "Receipt and Source Inspection," to ensure that the necessary certifications are obtained, to ensure acceptable operation and capabilities of M&TE, and to assign calibration status indicators as required by Section 4.6 of this QAP.

NOTE 1: *For equipment that requires field calibration, the M&TE custodian and/or M&TE user will ensure that calibration procedures are completed prior to use or as otherwise specified by the original equipment manufacturer (OEM).*

NOTE 2: *For equipment that requires periodic factory calibration, the M&TE custodian shall ensure that the equipment is sent to a qualified vendor (e.g., Approved Suppliers List, or OEM), that calibration/maintenance records are recorded in the equipment inventory, and that the calibration status is indicated on equipment per Section 4.6.*

NOTE 3: *Calibration activities, whether performed by the OEM or user, shall be documented in project records (logbook, daily inspection log, etc.).*

4.5 Original Equipment Manufacturer

4.5.1 M&TE custodian or QA manager: Utilizes the OEM for calibration of a specific piece of M&TE, provided that the following criteria are met:

- OEM has been certified/accredited to ISO 17025 and/or ISO 9001.
- History of providing an identical or similar piece of M&TE that performs satisfactorily in actual use. Continued use of the M&TE between calibrations provides history of satisfactory performance of the piece of M&TE in use.
- The evaluation of the OEM is documented (Appendix C) and the OEM is placed on the Approved Suppliers List in accordance with QAP-3071, "Supplier Evaluation and Selection."

4.6 Identification of Calibration Status

4.5.1 QA manager or designee: Applies calibration status indicators to M&TE in a manner that meets the following requirements:

- The calibration status of all M&TE shall be identified on or with the M&TE.
- A unique identifier (identification number or serial number) shall be assigned to each item of M&TE, and this identifier shall be used to trace the M&TE to its calibration records. The unique identifier and calibration due date shall be on or with the M&TE.
    - The preferred method is the use of a calibration sticker. An example is shown below.



    - Alternate tagging or marking methods may be used as necessary depending upon the M&TE, the application, and the length or use of the M&TE with QA manager approval. For example, M&TE that is used for a short-term rental may use the M&TE serial number rather than a calibration sticker.
    - If the nature of the equipment makes the placement of a sticker not possible, a sticker should be placed on the protective case or similar item instead of on the equipment itself.

4.5.2 PM or M&TE custodian: Applies calibration status indicators to M&TE in a manner that meets the following requirements:

- Maintains a listing of calibrated M&TE for his or her projects in the company M&TE log.
- Adds/removes calibrated equipment to the log and ensures that the log is current for calibration status and calibration due dates.

4.7 Evaluation of M&TE

4.6.1 M&TE custodian: Evaluates M&TE, when not within the calibration due date, to initiate a recalibration of the M&TE.

NOTE: *For M&TE that is lost, damaged, or its performance is otherwise suspect, the M&TE custodian shall initiate an action to replace, or repair and recalibrate the M&TE, and will determine if an evaluation of the previously completed measurements, inspections, or tests must be re-performed.*

4.6.2 Evaluates M&TE, when found to be out-of-calibration (i.e., measurements or results are not within the required accuracy limits) during use or recalibration, to verify the validity of previous measurements, inspections, or test results, and the acceptability of items previously inspected or tested.

4.6.3 Notifies the QA manager of the as-found condition.

4.6.4 Performs the following steps:

- Initiates a QAF-3151.01, "Nonconformance Report," in accordance with QAP-3151, "Control of Nonconforming Items," to report and document the evaluation.
- Tags and segregates/removes the M&TE from service to preclude it from use until the M&TE has been repaired and/or recalibrated.
- Performs an evaluation of its use for a time period beginning no later than the last acceptable calibration of the M&TE.
- Determines the significance of the condition as well as its application.
- Determines, if M&TE is consistently found to be out-of-tolerance, if it is to be repaired or replaced.
- Logs NCR number in the M&TE inventory log to document as-found condition.

5. RECORDS

The following records shall be maintained as necessary to trace sources, usage, and performance in accordance with QAP-3171, "Records Management":

- Certificates of Calibration from manufacturer or supplier, as applicable
- Certificates of Analysis for reference materials/standards, as applicable
- Calibration records with performance check results/field calibration results, as applicable
- Completed QAF-3121.01, "M&TE Inventory Log"
- Completed QAF-3121.02, "M&TE Usage Log"
- Completed QAF-3121.03, "Original Equipment Manufacturer Evaluation"

NOTE: *Calibration records are QA records. Records shall be established and maintained by each project, program, and office that has custody of North Wind–owned M&TE in accordance with QAP-3171, "Records Management," or any additional project or program records management requirements. The records shall be readily available to the project or office personnel. The records provide the calibration status and history of the M&TE. Records shall be traceable to the unique identification of each M&TE.*

6. REFERENCES

QAF-3121.01, "M&TE Inventory Log"

QAF-3121.02, "M&TE Usage Log"

QAF-3121.03, "Original Equipment Manufacturer Evaluation"

QAF-3132.01, "Receipt and Source Inspection Checklist"

QAF-3151.01, "Nonconformance Report"

QAP-3041, "Quality Procurement Controls"

QAP-3071, "Supplier Evaluation and Selection"

QAP-3113, "Software Quality Assurance"

QAP-3132, "Receipt and Source Inspection"

QAP-3151, "Control of Nonconforming Items"

QAP-3171, "Records Management"

7. APPENDIXES

Appendix A – Example of QAF-3121.01, "M&TE Inventory Log"

Appendix B – Example of QAF-3121.02, "M&TE Usage Log"

Appendix C – Example of QAF-3121.03, "Original Equipment Manufacturer Evaluation"

Appendix A
Example of QAF-3121.01, "M&TE Inventory Log"

NORTHWIND

Applicability: Companywide
Owner: QA Manager

For the most recent revision, refer to the Document Management System.

M&TE INVENTORY LOG
For use with QAP-3121

QAF-3121.01
Revision: 1
Effective Date: 03/13/2020
Page 1 of 1

Project Number:

Location:

Name of M&TE Custodian:

M&TE Asset No.	Calibration Date	Calibration Due Date	Calibration Frequency	* Comments (if any)

EXAMPLE

* If an NCR has been initiated during the project, list the NCR No(s) in the Comments column.

NOTE: This completed form is a record and shall be completed entirely and maintained in accordance with project/program records management requirements.

Appendix B
Example of QAF-3121.02, "M&TE Usage Log"

NORTHWIND A CIRI COMPANY

Applicability: Companywide
Owner: QA Manager

For the most recent revision, refer to the Document Management System.

M&TE USAGE LOG
For use with QAP-3121

QAF-3121.02
Revision: 1
Effective Date: 03/13/2020
Page 1 of 1

Project Number:				
Location:				
Name of M&TE Custodian:				
M&TE Asset No.	*** Check-out Date**	**Check-in Date**	**User's Initials**	**** Comments Regarding Equipment Function (if any)**

EXAMPLE

* If M&TE is being checked-in for the first time, enter "NEW" in the check-out column.

** If an NCR has been initiated, list the NCR No. in the Comments column.

NOTE: This completed form is a record and shall be completed entirely and maintained in accordance with project/program records management requirements.

Appendix C
Example of QAF-3121.03, "Original Equipment Manufacturer Evaluation"

NORTHWIND A CIRI COMPANY

Applicability: Companywide
Owner: QA Manager

For the most recent revision, refer to the Document Management System.

ORIGINAL EQUIPMENT MANUFACTURER EVALUATION
For use with QAP-3121

QAF-3121.03
Revision: 1
Effective Date: 03/13/2020
Page 1 of 1

OEM:	
Address:	
Telephone Number:	
Fax Number:	
Description of M&TE:	
Evaluation to the intent of:	
Documents Reviewed:	
Evaluation Results:	
☐	OEM is approved for calibration of the above-identified piece of M&TE.
☐	OEM is NOT approved.
☐	OEM is approved with the following restrictions:

QA Manager: _____ Date: _____

EXAMPLE

NOTE: This completed form is a record and shall be completed entirely and maintained in accordance with project/program records management requirements.

M&TE INVENTORY LOG

For use with QAP-3121

Project Number:

Location:

Name of M&TE Custodian:

M&TE Asset No.	Calibration Date	Calibration Due Date	Calibration Frequency	* Comments (if any)

* If an NCR has been initiated during the project, list the NCR No(s) in the Comments column.

M&TE USAGE LOG

For use with QAP-3121

Project Number:
Location:
Name of M&TE Custodian:

M&TE Asset No.	* Check-out Date	Check-in Date	User's Initials	** Comments Regarding Equipment Function (if any)

* If M&TE is being checked-in for the first time, enter "NEW" in the check-out column.

** If an NCR has been initiated, list the NCR No. in the Comments column.

NOTE: This completed form is a record and shall be completed entirely and maintained in accordance with project/program records management requirements.

ORIGINAL EQUIPMENT MANUFACTURER EVALUATION

For use with QAP-3121

OEM:	
Address:	
Telephone Number:	
Fax Number:	
Description of M&TE:	
Evaluation to the intent of:	
Documents Reviewed:	
Evaluation Results:	
☐	OEM is approved for calibration of the above-identified piece of M&TE.
☐	OEM is NOT approved.
☐	OEM is approved with the following restrictions:

QA Manager: _____ Date: _____

NORTH WIND
A CIRI COMPANY

QAP-3171
Rev. 1

Records Management

Applicability: Companywide	Effective Date: 03/14/2023	Approver/ Russell Barnes Title: Quality Programs Manager
For the most recent revision, refer to the Document Management System.		Signature: 

History of Revisions

Revision	Issue Date	Action	Description
0	08/16/19	New document.	Integration of North Wind procedures.
1	03/14/2023	Revise document.	Incorporate NNSS program requirements.

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DEFINITIONS

Active records. Records necessary to conduct day-to-day business, organization, program, or project. They are usually maintained in close proximity to that business entity.

Authenticate. To review a record to ensure that it is legible, complete and traceable to the project and/or facility, and sign and date as such.

Disposition. Those actions taken regarding records no longer needed to conduct the regular current business of North Wind.

Dual record storage. The act of storing duplicate copies of records in separate facilities or containers that are located sufficiently remote from one another to eliminate the chance of exposure to a simultaneous hazard.

Electronic record. Any information that is recorded on a form that only a computer can process and that satisfies the definition of a record.

Inactive record. A record that is no longer needed for day-to-day operation or reference, that has no need to be changed nor revised, but whose retention has not expired.

Lifetime records. Records which would be of significant value in demonstrating capability for safe operation; maintaining, reworking, repairing, replacing, or modifying an item; determining the cause of an accident or malfunction of an item; and provide required baseline data for in-service inspections.

Nonpermanent records. Those required for evidence that an activity was performed in accordance with the applicable requirements, but need not be retained for the life of the item because they do not meet the criteria for lifetime records.

Nonrecord. Informational material not meeting the statutory definition of a record (44 USC §3301) or has been excluded from coverage by the definition. Excluded materials are extra copies of documents kept only for reference, stocks of publications and processed documents, blank forms, and library or museum materials intended solely for reference or exhibit.

QA records. QA records shall be defined as those that provide evidence that the items or activities meet specified quality requirements. QA records shall also include all quality data such as personnel qualifications, procedures, drawings, equipment, data, etc. A document shall be considered a valid record only if stamped, initialed, or signed and dated by authorized personnel, or if otherwise authenticated. These records may be originals or reproduced copies.

Record. Any information created, received and/or maintained by a business or one of its representatives as evidence of conformance to legal obligations and information of transactions of business.

Records management. The planning, controlling, directing, organizing, training, promoting, and other managerial activities related to records creation, maintenance and use, and disposition to achieve adequate and proper documentation of the policies and transactions of the federal government and effective and economical management of agency operations.

Records management system. This system provides for the identification, retention, protection, preservation, revisions, traceability, and retrievability of electronic records.

Records retention schedule. A listing of record types, record owner, and retention schedule. The records retention schedule link can be found on the North Wind intranet.

Record owner. Individual responsible for ensuring that records are complete, accurate, stored appropriately and sent to the records management coordinator upon completion.

Retention period. The length of time records are to be kept. The approved retention schedules for current North Wind records are presented in the record retention schedule on the Document Management System.

Working files. Preliminary drafts, rough notes, and other similar material maintained for purposes of adequate and proper documentation. These materials may become records when circulated for official purposes such as approval, comment, action, recommendation, follow-up, or communication.

ACRONYMS

NNSS	Nevada National Security Site
QA	quality assurance
QAP	quality assurance procedure
RWAP	Radiological Waste Acceptance Program
WCO	Waste Certification Official
WCP	Waste Certification Program

1. PURPOSE

This quality assurance procedure (QAP) provides requirements for the identification, *authentication*, classification, storage, protection, retrieval, *retention*, and *disposition* of *records* (see defs.).

2. SCOPE

This procedure applies to personnel of North Wind Group and its wholly owned subsidiaries (referred to herein either individually or collectively as North Wind) who are providing and/or generating records.

NOTE 1: *Other records management requirements invoked by customers for specific contracts, such as National Archives and Records Administration records requirements, shall be included in contract-specific project quality plans.*

NOTE 2: *Appendix C provides supplemental requirements that apply during the performance of this procedure for records associated with the Waste Certification Program for the purpose of waste disposal at the Nevada National Security Site (NNSS).*

3. RESPONSIBILITIES/PREREQUISITES

3.1 Responsibilities

Performer	Responsibilities
Responsible managers	• Identify records that will be generated during a project or by their organization. • Ensure that adequate training is provided to project and program personnel on recordkeeping requirements responsibilities, including restrictions against removing records from the project or program. • Ensure that project records retention schedules are followed, and provide reasonable protection to *active records* (see def.). • Responsible for records being legible, accurate, and complete for all project and program phases. • Ensure that records received from subcontractors and suppliers are in compliance with this QAP. • Responsible for the reasonable protection of active records awaiting transfer to the records management coordinator.
Records management coordinator	• Receives records from project managers at the completion of projects. • Maintains the North Wind records storage space, including permanent and temporary storage.

Performer	Responsibilities
	• Maintains the North Wind records retention schedule with input from all responsible managers. • Serves as the single point-of-contact regarding records management. • Assures that records are uploaded to the North Wind records management system and filed in appropriate folders. • Complies with established record storage, retention, and disposition instructions as defined by this QAP.
Employees	• Create legible and accurate records using the forms or other record formats prescribed by the document(s) governing the process they are performing. • Submit records to the appropriate responsible managers.
Quality assurance (QA) manager	• Maintains this QAP. • Responsible for the authentication of all QA records. • Reviews this document for compliance with quality requirements and consistency with established policies, objectives, and other North Wind quality processes. • Responsible for the development, coordination, and direction of the records management system.

3.2 Prerequisites

None.

4. INSTRUCTIONS

4.1 General

4.1.1 QA manager or designee: Establishes the *records management* (see def.) requirements for records defined in the North Wind QA Program and projects.

4.1.2 Directs the development and use of approved records schedules.

4.1.3 Reviews and approves any organization/project-specific records plans.

4.1.4 Assists responsible managers in determining records requirements for their organization, or requirements from their project/contract or statement of work.

NOTE: *This determination may also identify any potential new records types that may need to be incorporated into the* records retention schedule *(see def.).*

4.1.5 Provides awareness information on records management responsibilities to all employees.

4.1.6 Provides initial records training and applicable refresher training as needed.

4.1.7 Ensures that personnel authenticating, storing, and/or dispositioning records are appropriately trained.

4.1.8 Ensures that records are properly stored and maintained.

4.2 Generation of Records

4.2.1 Responsible manager: Determines the record requirements of the assigned project or organization and/or works with the QA manager, as needed.

4.2.2 Ensures that requirements for records schedules are documented and communicated to the QA manager.

NOTE: *If a regulatory and/or customer record retention requirement conflicts with this QAP, the most conservative* retention period *(see def.) shall be followed.*

4.2.3 Ensures that hard-copy storage requirements are established, documented, and communicated to the QA manager, when required.

4.2.4 Ensures that the organization and/or project records:

- Contain accurate and complete documentation of the organization's and/or project's functions, policies, decisions, procedures, and essential transactions
- Are designed in a manner that furnishes the information necessary to protect the legal and financial rights of North Wind and of persons directly affected by North Wind's activities.

4.2.5 Employees: Determine if the information created while performing the work activities is a record, as defined by this QAP and/or customer. (See Appendix B for a guide on determining what constitutes a "record.")

NOTE: *Non-records are to be retained by the employee and may be disposed of at completion of a project.*

4.2.6 Performs any changes and/or corrections to records by drawing a single line through the incorrect entry, so that it may still be read, entering the correct information, and dating/initialing or signing, so that the change will be traceable to the person who made the changes.

NOTE: *Correct information shall be entered in black or blue ink.*

4.2.7 Ensures that the record is legible, accurate, reproducible, and complete (including required signatures and dates).

4.2.8 Forwards the completed records, in a timely manner, to the responsible manager for classification.

4.3 Classification of Records

4.3.1 Responsible manager or designee: Reviews the record to assure that it is complete, including all required signatures, and that the document is capable of being reproduced.

4.3.2 Ensures that the record is traceable to the controlled (internal/external) document associated with that record.

4.3.3 Ensures that records are legible, completely filled out, and sufficiently detailed to permit traceability to the item or activity involved.

4.3.4 Classifies the type of record (*lifetime* or non-permanent) in accordance with Appendix A.

NOTE: *Any questions regarding classification shall be directed to the QA manager.*

4.3.5 Develops a transmittal document (letter, email, memo, etc.) identifying the records and their classification (e.g., types of records).

4.3.6 For records identified in QAPs, forward the transmittal document to the QA manager or designee for authentication as *QA records* (see def.).

4.3.7 For all other records, forward to the records management coordinator for storage and retention (see Section 4.5).

4.4 Authentication of QA Records

4.4.1 QA manager or designee: Reviews the records to ensure that they are in an acceptable condition, including:

- Record is readable
- The record is numbered to uniquely identify the record
- Record has no “whiteout” or correction tape
- Record has been completed in black or blue ink or is an acceptable photocopy
- Record is not torn or soiled by dirt, oil, food, or drink
- Record is acceptable for copying or scanning.

4.4.2 Verifies that any changes and/or corrections to the records have been made

appropriately, in black or blue ink.

4.4.3 Authenticates the records by stamping, initialing, signing, etc., on the record.

NOTE: *Upon completion of the review and acknowledgment/approval of the transmittal document, the record has been authenticated as a QA record.*

4.4.4 Forwards the QA record to the records management coordinator for storage and retention.

4.5 Receipt of Records

4.5.1 Records management coordinator: Verifies that records are in overall good condition and have been authenticated.

NOTE: *If the records are not in good condition, proceed to Section 4.6. The records management coordinator will determine the extent of the discrepancy, identify the discrepant records, and may add an explanatory note. The incorrect/ damaged records shall then be returned to the responsible manager for resolution.*

4.5.2 Stores the record in the *records management system* (see def.).

NOTE: *Records are indexed, for easy retrievability, when entered into the records management system.*

4.5.3 Files the submitted records and transmittal record.

4.6 Correction of Records

4.6.1 Responsible manager or designee: Reviews the returned record to identify discrepant conditions.

4.6.2 Corrects the record with the appropriate information, and obtains the proper prior approvals performed by the organization(s)/employee(s) originating the record.

NOTE: *The correction shall include the date and the identification of the person(s) authorized to make or issue such corrections or supplements. Any corrections made shall be of the same level as the original approval.*

4.6.3 If the record is a *QA record* (see def.), forward corrected QA records to the QA manager for re-authentication.

4.6.4 Forwards all other corrected records to the records management coordinator for storage and retention.

4.6.5 QA manager or designee: Reviews changes made to QA records and forwards the corrected record to the records management coordinator for storage and retention.

4.7 Storage of Records (Single or Dual)

4.7.1 Records management coordinator: Selects the appropriate storage type for the records based on the following:

- Single storage consisting of a storage facility, vault, room, or container(s) with a minimum 2-hour fire rating.

NOTE: *Historically hard-copies and/or originals are stored in single storage, but may be discarded if the records meet the* dual storage *(see def.) requirements.*

- Dual storage consisting of facilities, containers, or a combination thereof at locations sufficiently remote from each other to eliminate the chance of exposure to a simultaneous hazard.

NOTE: *Typically records are stored electronically on servers located at separate facilities. Facilities used for dual storage are not required to meet the single storage requirements. Records that are in-process, review, or use are required to meet the dual storage requirements or are to be stored in a storage facility or container that provides at least a 1-hour fire rating.*

4.7.2 Protects records in such a way as to minimize the risk of damage or destruction from items such as:

- Natural disasters such as winds, floods, or fires
- Environmental conditions such as high and low temperatures and humidity
- Infestation of insects, mold, or rodents.

4.7.3 Protects project records until they are dispositioned.

NOTE: *Special processed records (such as radiographs, photographs, negatives) shall be packaged and stored in accordance with industry standards or as recommended by the manufacturer of these materials.*

4.8 Access and Control of Records

4.8.1 QA manager or designee: Designates those individuals who may have direct access to records.

4.8.2 Records management coordinator: Limits personnel accessing records to only authorized individuals.

4.9 Retention and Disposition of QA Records

4.9.1 Records management coordinator: Retains QA records designated as lifetime QA records for the lifetime of the company.

NOTE: *Hard-copy QA lifetime records may be disposed of or destroyed provided that the electronic copies meet either the single or dual storage requirements.*

4.9.2 Retains records designated as *nonpermanent records* (see def.) as required by the records retention schedule.

NOTE: *Project records that are to be provided to a customer for ultimate retention are to be maintained by North Wind to protect itself against future liability.*

4.10 Disposition of Records

4.10.1 Records management coordinator: Periodically reviews the records management system for expiring records.

4.10.2 Notifies responsible managers who were responsible for the record origination that the records that the retention time has expired.

4.10.3 Removes and/or deletes the expired record from the records management system after approval from responsible manager.

NOTE: *Records that no longer require retention may remain stored in the records management system for historical purposes as information only.*

5. RECORDS

The records management coordinator will maintain the following records in accordance with this QAP:

- Records transmittals and associated documentation

6. REFERENCES

None.

7. APPENDIXES

Appendix A – QA Record Classifications

Appendix B – Is it a Record?

Appendix C – North Wind Waste Certification Program

Appendix A
QA Record Classifications

Lifetime Records

North Wind corporate quality assurance (QA) records are those records that document the status of the North Wind QA Program during the execution of quality-related activities. These records shall be maintained for the life of the company.

Examples of these records are:

- QA Program documents (North Wind Group QA Manual and quality assurance procedures)
- Active training and qualifications records (QA Program training records, inspection and test personnel qualification records, and auditor qualification records).

NOTE: *Training and/or qualification records of personnel no longer employed at North Wind shall be reclassified as a nonpermanent record with a 7 year retention period unless a longer time period is specified by industry code or standard.*

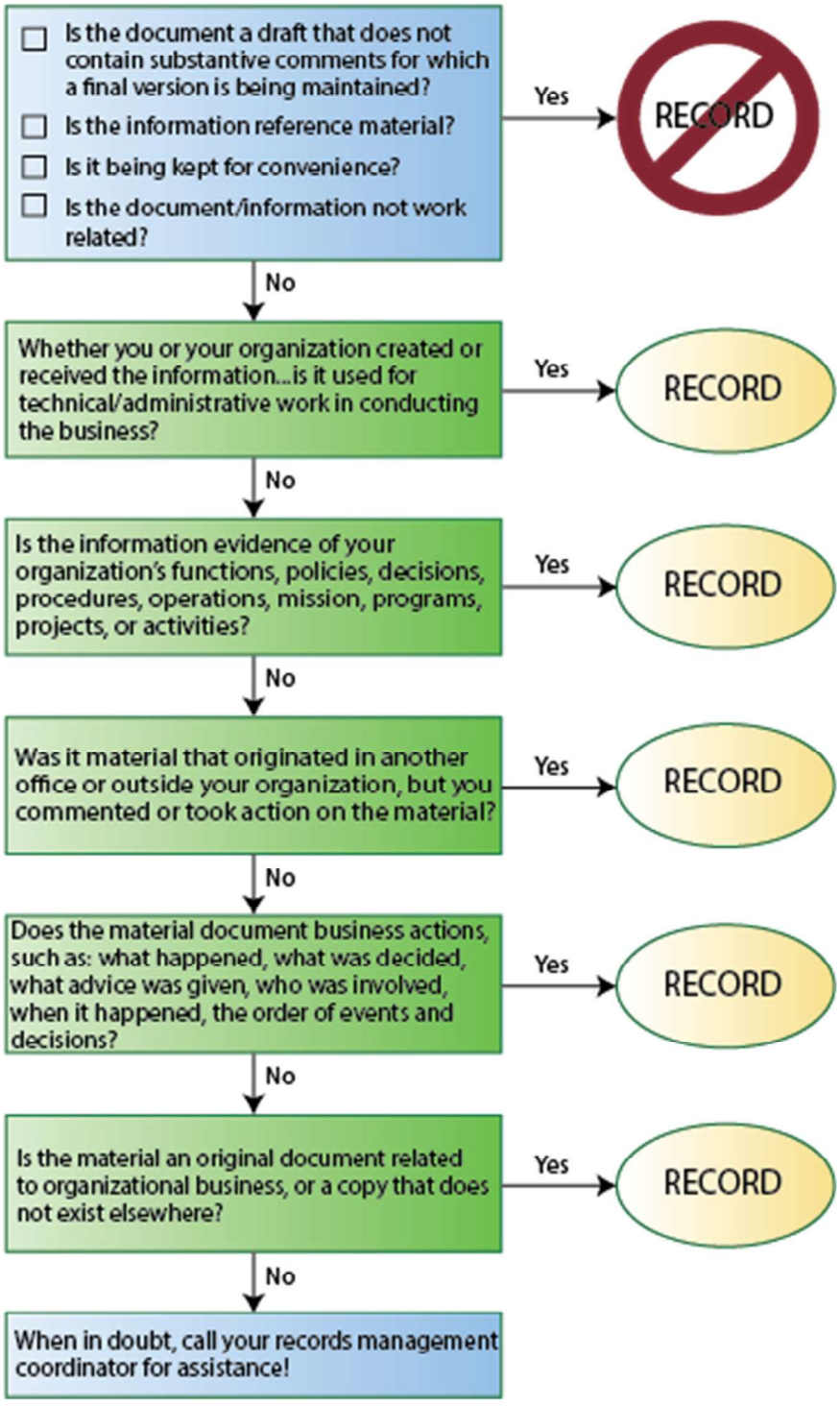
Nonpermanent Records

QA nonpermanent records do not meet the criteria for lifetime records, and are required to show evidence that an activity was performed in accordance with the applicable requirements, such as project QA records.

Examples of these are:

- Design files – Includes drawings, specifications, design analysis, calculations, analysis verifications, verification checklist and design change notices. These files shall be retained for 7 years.
- Procurement files – Includes material requisitions, requests for quotation, purchase orders, vendor data, and changes thereto. These files shall be retained for 7 years.
- Special processes – Includes personnel qualifications and qualified procedures. These files shall be retained for 7 years unless a longer time period is specified by industry code or standard.
- Inspection/test data – Includes inspection records, test records, material test reports, certificates of conformance, and inspection and test procedures. These files shall be retained for 7 years.
- Calibration records – Includes calibration history and utilization records. These files shall be retained for 3 years.
- Approved supplier history – Includes approved suppliers list, supplier performance history, and supplier audits. These files shall be retained for 3 years.
- Audits and assessments – Includes management assessment results, internal audits, and audit schedules. These files shall be retained for 3 years.

Appendix B
Is it a Record?



Appendix C
North Wind Waste Certification Program

1. PURPOSE

The purpose of this appendix is to provide supplemental requirements for the identification, authentication, classification, storage, protection, retrieval, retention, and disposition of records for the North Wind Waste Certification Program (WCP) used to meet disposal requirements at the Nevada National Security Site (NNSS).

2. SCOPE

No additional requirements.

3. RESPONSIBILITIES/PREREQUISITES

3.1 Responsibilities

The Waste Certification Officer (WCO) will ensure records for the North Wind WCP used to meet disposal requirements at the NNSS for each project are maintained in accordance with this procedure.

3.2 Prerequisites

No additional requirements.

4. INSTRUCTIONS

4.1 General

No additional requirements.

4.2 Generation of Records

WCP records are generated as a result of implementing the WCP plans and procedures. Those records will be provided to the WCO for short-term project storage. The WCO will act as the responsible manager in the execution of this procedure for WCP records.

4.3 Classification of Records

No additional requirements.

4.4 Authentication of QA Records

No additional requirements.

4.5 Receipt of Records

No additional requirements.

4.6 Correction of Records

The WCO will be notified of any corrections to WCP records. Corrections to records may require communication of corrections and updated records to the Radiological Waste Acceptance Program (RWAP) Manager.

4.7 Storage of Records (Single or Dual)

No additional requirements.

4.8 Access and Control of Records

No additional requirements.

4.9 Retention and Disposition of QA Records

Project records will be provided to a customer per the contract for ultimate retention, interim records will be maintained by North Wind following the project's records file plan and retention schedule.

The North Wind shall maintain records for time periods equivalent to onsite records retention requirements, but not less than three years (or for time periods designated by applicable regulatory authorities).

4.10 Disposition of Records

No additional requirements.

5. RECORDS

No additional requirements.

6. REFERENCES

No additional requirements.

7. APPENDIXES

Added this appendix.

Appendix D

Laboratory DoD Environmental Laboratory Accreditation Program and ADEC Environmental Laboratory Approval Program Certificates and SOP

THE STATE of ALASKA
GOVERNOR MICHAEL J. DUNLEAVY

Department of Environmental Conservation

DIVISION OF SPILL PREVENTION AND RESPONSE
Contaminated Sites Program
Laboratory Approval Program

555 Cordova Street
Anchorage, Alaska 99501
Main: 907.465.5390
Fax: 907.269.7649
cs.lab.cert@alaska.gov

February 11, 2021

Chris Williams
Eurofins TestAmerica – Sacramento
880 Riverside Parkway
West Sacramento, CA 95605

RE: Contaminated Sites Laboratory Approval **17-020**

Thank you for submitting a completed application to the Alaska Department of Environmental Conservation's Contaminated Sites Laboratory Approval Program (CS-LAP), on February 8, 2021. Based on your lab's National Environmental Laboratory Accreditation Program (NELAP) approval through the Oregon Environmental Laboratory Accreditation Program (ORELAP), and Department of Defense Environmental Laboratory Accreditation Program (DoD-ELAP) approval through the ANSI-ASQ National Accreditation Board (ANAB), Eurofins TestAmerica – Sacramento, located at the above address, is granted ***Approved*** status to perform the analyses listed in the attached *Scope of Approval*, for Alaska contaminated sites projects, including underground storage tanks and leaking underground storage tank sites (UST/LUST), under the July 1, 2017 amendments to 18 AAC 78. This approval is effective January 20, 2021 and expires on ***February 20, 2024***.

Be aware that **any** changes in your NELAP or DoD-ELAP approval status must be reported to the CS program within 3 business days. Failure to do so will result in revocation of **all** CS-LAP approvals for a period of one year. Notification should be in writing sent to cs.lab.cert@alaska.gov. We recommend also contacting the CS-LAP by telephone to verify that the message was received.

Please remember to include the laboratory's ID number, listed above, on all correspondence concerning the laboratory. To apply for renewal of your approval, please complete the application found on the CS-LAP webpage and submit to cs.submittals@alaska.gov. The required documentation must be submitted for renewal no later than 30 days before your date of expiration.

If you have any questions, please contact the CS-LAP at (907) 465-5390, or by email at cs.lab.cert@alaska.gov. Labs are also highly encouraged to join the CS-LAP listserv by going to http://list.state.ak.us/mailman/listinfo/cs.lab.approval.

Respectfully,

Brian Englund

Brian Englund

Attachment: Scope of Approval

Scope of Approval

CAS Number	Matrix	Hazardous Substance	Method	Accreditation Body
120226-60-0	Soil	10:2 Fluorotelomer sulfonic acid	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	ANAB
120226-60-0	Water	10:2 Fluorotelomer sulfonic acid	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	ANAB
763051-92-9	Soil	11-chloroeicosafluoro-3-oxaundecane-1-sulfonic acid (11Cl-PF3OUdS)	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	ANAB
763051-92-9	Water	11-chloroeicosafluoro-3-oxaundecane-1-sulfonic acid (11Cl-PF3OUdS)	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	ANAB
919005-14-4	Soil	4,8-dioxa-3H-perfluorononanoic acid (ADONA)	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	ANAB
919005-14-4	Water	4,8-dioxa-3H-perfluorononanoic acid (ADONA)	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	ANAB

Scope of Approval

CAS Number	Matrix	Hazardous Substance	Method	Accreditation Body
757124-72-4	Soil	4:2 Fluorotelomer sulfonic acid	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	ANAB
757124-72-4	Water	4:2 Fluorotelomer sulfonic acid	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	ANAB
27619-97-2	Soil	6:2 Fluorotelomer sulfonic acid	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	ANAB
27619-97-2	Water	6:2 Fluorotelomer sulfonic acid	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	ANAB
39108-34-4	Soil	8:2 Fluorotelomer sulfonic acid	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	ANAB
39108-34-4	Water	8:2 Fluorotelomer sulfonic acid	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	ANAB

Scope of Approval

CAS Number	Matrix	Hazardous Substance	Method	Accreditation Body
756426-58-1	Soil	9-chlorohexadecafluoro-3-oxanone-1-sulfonic acid (9Cl-PF3ONS)	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	ANAB
756426-58-1	Water	9-chlorohexadecafluoro-3-oxanone-1-sulfonic acid (9Cl-PF3ONS)	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	ANAB
83-32-9	Soil	Acenaphthene	8270C	ANAB
83-32-9	Water	Acenaphthene	8270C	ANAB
83-32-9	Soil	Acenaphthene	8270C-SIM	ANAB
83-32-9	Water	Acenaphthene	8270C-SIM	ANAB
83-32-9	Soil	Acenaphthene	8270D	ANAB
83-32-9	Water	Acenaphthene	8270D	ANAB
83-32-9	Soil	Acenaphthene	8270D-SIM	ANAB
83-32-9	Water	Acenaphthene	8270D-SIM	ANAB
83-32-9	Air	Acenaphthene	TO-13A SIM	ANAB
208-96-8	Soil	Acenaphthylene	8270C	ANAB
208-96-8	Water	Acenaphthylene	8270C	ANAB
208-96-8	Soil	Acenaphthylene	8270C-SIM	ANAB
208-96-8	Water	Acenaphthylene	8270C-SIM	ANAB
208-96-8	Soil	Acenaphthylene	8270D	ANAB
208-96-8	Water	Acenaphthylene	8270D	ANAB
208-96-8	Soil	Acenaphthylene	8270D-SIM	ANAB
208-96-8	Water	Acenaphthylene	8270D-SIM	ANAB
208-96-8	Air	Acenaphthylene	TO-13A SIM	ANAB
67-64-1	Soil	Acetone	8260B	ANAB
67-64-1	Water	Acetone	8260B	ANAB
67-64-1	Soil	Acetone	8260C	ANAB
67-64-1	Water	Acetone	8260C	ANAB
309-00-2	Soil	Aldrin	8081A	ANAB

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309-00-2	Water	Aldrin	8081A	ANAB
309-00-2	Soil	Aldrin	8081B	ANAB
309-00-2	Water	Aldrin	8081B	ANAB
309-00-2	Air	Aldrin	TO-10A	ORELAP
120-12-7	Soil	Anthracene	8270C	ANAB
120-12-7	Water	Anthracene	8270C	ANAB
120-12-7	Soil	Anthracene	8270C-SIM	ANAB
120-12-7	Water	Anthracene	8270C-SIM	ANAB
120-12-7	Soil	Anthracene	8270D	ANAB
120-12-7	Water	Anthracene	8270D	ANAB
120-12-7	Soil	Anthracene	8270D-SIM	ANAB
120-12-7	Water	Anthracene	8270D-SIM	ANAB
120-12-7	Air	Anthracene	TO-13A SIM	ANAB
7440-36-0	Soil	Antimony (metallic)	6010B	ANAB
7440-36-0	Water	Antimony (metallic)	6010B	ANAB
7440-36-0	Soil	Antimony (metallic)	6010C	ANAB
7440-36-0	Water	Antimony (metallic)	6010C	ANAB
7440-36-0	Soil	Antimony (metallic)	6020A	ANAB
7440-36-0	Water	Antimony (metallic)	6020A	ANAB
7440-38-2	Soil	Arsenic, Inorganic	6010B	ANAB
7440-38-2	Water	Arsenic, Inorganic	6010B	ANAB
7440-38-2	Soil	Arsenic, Inorganic	6010C	ANAB
7440-38-2	Water	Arsenic, Inorganic	6010C	ANAB
7440-38-2	Soil	Arsenic, Inorganic	6020A	ANAB
7440-38-2	Water	Arsenic, Inorganic	6020A	ANAB
7440-39-3	Soil	Barium	6010B	ANAB
7440-39-3	Water	Barium	6010B	ANAB
7440-39-3	Soil	Barium	6010C	ANAB
7440-39-3	Water	Barium	6010C	ANAB
7440-39-3	Soil	Barium	6020A	ANAB
7440-39-3	Water	Barium	6020A	ANAB
56-55-3	Soil	Benz[a]anthracene	8270C	ANAB
56-55-3	Water	Benz[a]anthracene	8270C	ANAB

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56-55-3	Soil	Benz[a]anthracene	8270C-SIM	ANAB
56-55-3	Water	Benz[a]anthracene	8270C-SIM	ANAB
56-55-3	Soil	Benz[a]anthracene	8270D	ANAB
56-55-3	Water	Benz[a]anthracene	8270D	ANAB
56-55-3	Soil	Benz[a]anthracene	8270D-SIM	ANAB
56-55-3	Water	Benz[a]anthracene	8270D-SIM	ANAB
56-55-3	Air	Benz[a]anthracene	TO-13A SIM	ANAB
100-52-7	Soil	Benzaldehyde	8270C	ORELAP
100-52-7	Water	Benzaldehyde	8270C	ORELAP
100-52-7	Soil	Benzaldehyde	8270D	ORELAP
100-52-7	Water	Benzaldehyde	8270D	ORELAP
71-43-2	Soil	Benzene	8260B	ANAB
71-43-2	Water	Benzene	8260B	ANAB
71-43-2	Soil	Benzene	8260C	ANAB
71-43-2	Water	Benzene	8260C	ANAB
71-43-2	Soil	Benzene	8260C-SIM	ANAB
71-43-2	Water	Benzene	8260C-SIM	ANAB
50-32-8	Soil	Benzo[a]pyrene	8270C	ANAB
50-32-8	Water	Benzo[a]pyrene	8270C	ANAB
50-32-8	Soil	Benzo[a]pyrene	8270C-SIM	ANAB
50-32-8	Water	Benzo[a]pyrene	8270C-SIM	ANAB
50-32-8	Soil	Benzo[a]pyrene	8270D	ANAB
50-32-8	Water	Benzo[a]pyrene	8270D	ANAB
50-32-8	Soil	Benzo[a]pyrene	8270D-SIM	ANAB
50-32-8	Water	Benzo[a]pyrene	8270D-SIM	ANAB
50-32-8	Air	Benzo[a]pyrene	TO-13A SIM	ANAB
205-99-2	Soil	Benzo[b]fluoranthene	8270C	ANAB
205-99-2	Water	Benzo[b]fluoranthene	8270C	ANAB
205-99-2	Soil	Benzo[b]fluoranthene	8270C-SIM	ANAB
205-99-2	Water	Benzo[b]fluoranthene	8270C-SIM	ANAB
205-99-2	Soil	Benzo[b]fluoranthene	8270D	ANAB
205-99-2	Water	Benzo[b]fluoranthene	8270D	ANAB
205-99-2	Soil	Benzo[b]fluoranthene	8270D-SIM	ANAB

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CAS Number	Matrix	Hazardous Substance	Method	Accreditation Body
205-99-2	Water	Benzo[b]fluoranthene	8270D-SIM	ANAB
205-99-2	Air	Benzo[b]fluoranthene	TO-13A SIM	ANAB
191-24-2	Soil	Benzo[g,h,i]perylene	8270C	ANAB
191-24-2	Water	Benzo[g,h,i]perylene	8270C	ANAB
191-24-2	Soil	Benzo[g,h,i]perylene	8270C-SIM	ANAB
191-24-2	Water	Benzo[g,h,i]perylene	8270C-SIM	ANAB
191-24-2	Soil	Benzo[g,h,i]perylene	8270D	ANAB
191-24-2	Water	Benzo[g,h,i]perylene	8270D	ANAB
191-24-2	Soil	Benzo[g,h,i]perylene	8270D-SIM	ANAB
191-24-2	Water	Benzo[g,h,i]perylene	8270D-SIM	ANAB
191-24-2	Air	Benzo[g,h,i]perylene	TO-13A SIM	ANAB
207-08-9	Soil	Benzo[k]fluoranthene	8270C	ANAB
207-08-9	Water	Benzo[k]fluoranthene	8270C	ANAB
207-08-9	Soil	Benzo[k]fluoranthene	8270C-SIM	ANAB
207-08-9	Water	Benzo[k]fluoranthene	8270C-SIM	ANAB
207-08-9	Soil	Benzo[k]fluoranthene	8270D	ANAB
207-08-9	Water	Benzo[k]fluoranthene	8270D	ANAB
207-08-9	Soil	Benzo[k]fluoranthene	8270D-SIM	ANAB
207-08-9	Water	Benzo[k]fluoranthene	8270D-SIM	ANAB
207-08-9	Air	Benzo[k]fluoranthene	TO-13A SIM	ANAB
65-85-0	Soil	Benzoic Acid	8270C	ANAB
65-85-0	Water	Benzoic Acid	8270C	ANAB
65-85-0	Soil	Benzoic Acid	8270D	ANAB
65-85-0	Water	Benzoic Acid	8270D	ANAB
100-51-6	Soil	Benzyl Alcohol	8270C	ANAB
100-51-6	Water	Benzyl Alcohol	8270C	ANAB
100-51-6	Soil	Benzyl Alcohol	8270D	ANAB
100-51-6	Water	Benzyl Alcohol	8270D	ANAB
7440-41-7	Soil	Beryllium and compounds	6010B	ANAB
7440-41-7	Water	Beryllium and compounds	6010B	ANAB
7440-41-7	Soil	Beryllium and compounds	6010C	ANAB
7440-41-7	Water	Beryllium and compounds	6010C	ANAB
7440-41-7	Soil	Beryllium and compounds	6020A	ANAB

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CAS Number	Matrix	Hazardous Substance	Method	Accreditation Body
7440-41-7	Water	Beryllium and compounds	6020A	ANAB
111-44-4	Soil	Bis(2-chloroethyl)ether	8270C	ANAB
111-44-4	Water	Bis(2-chloroethyl)ether	8270C	ANAB
111-44-4	Soil	Bis(2-chloroethyl)ether	8270D	ANAB
111-44-4	Water	Bis(2-chloroethyl)ether	8270D	ANAB
111-44-4	Soil	Bis(2-chloroethyl)ether	8270D-SIM	ANAB
111-44-4	Water	Bis(2-chloroethyl)ether	8270D-SIM	ANAB
117-81-7	Soil	Bis(2-ethylhexyl)phthalate (DEHP)	8270C	ANAB
117-81-7	Water	Bis(2-ethylhexyl)phthalate (DEHP)	8270C	ANAB
117-81-7	Soil	Bis(2-ethylhexyl)phthalate (DEHP)	8270D	ANAB
117-81-7	Water	Bis(2-ethylhexyl)phthalate (DEHP)	8270D	ANAB
108-86-1	Soil	Bromobenzene	8260B	ANAB
108-86-1	Water	Bromobenzene	8260B	ANAB
108-86-1	Soil	Bromobenzene	8260C	ANAB
108-86-1	Water	Bromobenzene	8260C	ANAB
75-27-4	Soil	Bromodichloromethane	8260B	ANAB
75-27-4	Water	Bromodichloromethane	8260B	ANAB
75-27-4	Soil	Bromodichloromethane	8260C	ANAB
75-27-4	Water	Bromodichloromethane	8260C	ANAB
75-27-4	Soil	Bromodichloromethane	8260C-SIM	ANAB
75-27-4	Water	Bromodichloromethane	8260C-SIM	ANAB
75-25-2	Soil	Bromoform	8260B	ANAB
75-25-2	Water	Bromoform	8260B	ANAB
75-25-2	Soil	Bromoform	8260C	ANAB
75-25-2	Water	Bromoform	8260C	ANAB
75-25-2	Soil	Bromoform	8260C-SIM	ANAB
75-25-2	Water	Bromoform	8260C-SIM	ANAB
74-83-9	Soil	Bromomethane	8260B	ANAB
74-83-9	Water	Bromomethane	8260B	ORELAP
74-83-9	Soil	Bromomethane	8260C	ANAB
74-83-9	Water	Bromomethane	8260C	ORELAP
74-83-9	Soil	Bromomethane	8260C-SIM	ANAB
74-83-9	Water	Bromomethane	8260C-SIM	ANAB

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CAS Number	Matrix	Hazardous Substance	Method	Accreditation Body
106-99-0	Soil	Butadiene, 1,3-	8260C-SIM	ANAB
106-99-0	Water	Butadiene, 1,3-	8260C-SIM	ANAB
85-68-7	Soil	Butyl Benzyl Phthalate	8270C	ANAB
85-68-7	Water	Butyl Benzyl Phthalate	8270C	ANAB
85-68-7	Soil	Butyl Benzyl Phthalate	8270D	ANAB
85-68-7	Water	Butyl Benzyl Phthalate	8270D	ANAB
104-51-8	Soil	Butylbenzene, n-	8260B	ANAB
104-51-8	Water	Butylbenzene, n-	8260B	ANAB
104-51-8	Soil	Butylbenzene, n-	8260C	ANAB
104-51-8	Water	Butylbenzene, n-	8260C	ANAB
135-98-8	Soil	Butylbenzene, sec-	8260B	ANAB
135-98-8	Water	Butylbenzene, sec-	8260B	ANAB
135-98-8	Soil	Butylbenzene, sec-	8260C	ANAB
135-98-8	Water	Butylbenzene, sec-	8260C	ANAB
98-06-6	Soil	Butylbenzene, tert-	8260B	ANAB
98-06-6	Water	Butylbenzene, tert-	8260B	ANAB
98-06-6	Soil	Butylbenzene, tert-	8260C	ANAB
98-06-6	Water	Butylbenzene, tert-	8260C	ANAB
7440-43-9	Soil	Cadmium	6010B	ANAB
7440-43-9	Water	Cadmium	6010B	ANAB
7440-43-9	Soil	Cadmium	6010C	ANAB
7440-43-9	Water	Cadmium	6010C	ANAB
7440-43-9	Soil	Cadmium	6020A	ANAB
7440-43-9	Water	Cadmium	6020A	ANAB
75-15-0	Soil	Carbon Disulfide	8260B	ANAB
75-15-0	Water	Carbon Disulfide	8260B	ANAB
75-15-0	Soil	Carbon Disulfide	8260C	ANAB
75-15-0	Water	Carbon Disulfide	8260C	ANAB
56-23-5	Soil	Carbon Tetrachloride	8260B	ANAB
56-23-5	Water	Carbon Tetrachloride	8260B	ANAB
56-23-5	Soil	Carbon Tetrachloride	8260C	ANAB
56-23-5	Water	Carbon Tetrachloride	8260C	ANAB
5103-71-9	Soil	Chlordane, α-	8081A	ANAB

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CAS Number	Matrix	Hazardous Substance	Method	Accreditation Body
5103-71-9	Water	Chlordane, α-	8081A	ANAB
5103-71-9	Soil	Chlordane, α-	8081B	ANAB
5103-71-9	Water	Chlordane, α-	8081B	ANAB
5103-74-2	Soil	Chlordane, γ-	8081A	ANAB
5103-74-2	Water	Chlordane, γ-	8081A	ANAB
5103-74-2	Soil	Chlordane, γ-	8081B	ANAB
5103-74-2	Water	Chlordane, γ-	8081B	ANAB
12789-03-6	Soil	Chlordane, Total	8081A	ANAB
12789-03-6	Water	Chlordane, Total	8081A	ANAB
12789-03-6	Soil	Chlordane, Total	8081B	ANAB
12789-03-6	Water	Chlordane, Total	8081B	ANAB
106-47-8	Soil	Chloroaniline, p-	8270C	ANAB
106-47-8	Water	Chloroaniline, p-	8270C	ANAB
106-47-8	Soil	Chloroaniline, p-	8270D	ANAB
106-47-8	Water	Chloroaniline, p-	8270D	ANAB
108-90-7	Soil	Chlorobenzene	8260B	ANAB
108-90-7	Water	Chlorobenzene	8260B	ANAB
108-90-7	Soil	Chlorobenzene	8260C	ANAB
108-90-7	Water	Chlorobenzene	8260C	ANAB
67-66-3	Soil	Chloroform	8260B	ANAB
67-66-3	Water	Chloroform	8260B	ANAB
67-66-3	Soil	Chloroform	8260C	ANAB
67-66-3	Water	Chloroform	8260C	ANAB
67-66-3	Soil	Chloroform	8260C-SIM	ANAB
67-66-3	Water	Chloroform	8260C-SIM	ANAB
74-87-3	Soil	Chloromethane	8260B	ANAB
74-87-3	Water	Chloromethane	8260B	ORELAP
74-87-3	Soil	Chloromethane	8260C	ANAB
74-87-3	Water	Chloromethane	8260C	ORELAP
91-58-7	Soil	Chloronaphthalene, Beta-	8270C	ANAB
91-58-7	Water	Chloronaphthalene, Beta-	8270C	ANAB
91-58-7	Soil	Chloronaphthalene, Beta-	8270D	ANAB
91-58-7	Water	Chloronaphthalene, Beta-	8270D	ANAB

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CAS Number	Matrix	Hazardous Substance	Method	Accreditation Body
95-57-8	Soil	Chlorophenol, 2-	8270C	ANAB
95-57-8	Water	Chlorophenol, 2-	8270C	ANAB
95-57-8	Soil	Chlorophenol, 2-	8270D	ANAB
95-57-8	Water	Chlorophenol, 2-	8270D	ANAB
7440-47-3	Soil	Chromium (Total)	6010B	ANAB
7440-47-3	Water	Chromium (Total)	6010B	ANAB
7440-47-3	Soil	Chromium (Total)	6010C	ANAB
7440-47-3	Water	Chromium (Total)	6010C	ANAB
7440-47-3	Soil	Chromium (Total)	6020A	ANAB
7440-47-3	Water	Chromium (Total)	6020A	ANAB
18540-29-9	Water	Chromium (VI)	7196A	ANAB
218-01-9	Soil	Chrysene	8270C	ANAB
218-01-9	Water	Chrysene	8270C	ANAB
218-01-9	Soil	Chrysene	8270C-SIM	ANAB
218-01-9	Water	Chrysene	8270C-SIM	ANAB
218-01-9	Soil	Chrysene	8270D	ANAB
218-01-9	Water	Chrysene	8270D	ANAB
218-01-9	Soil	Chrysene	8270D-SIM	ANAB
218-01-9	Water	Chrysene	8270D-SIM	ANAB
7440-50-8	Soil	Copper	6010B	ANAB
7440-50-8	Water	Copper	6010B	ANAB
7440-50-8	Soil	Copper	6010C	ANAB
7440-50-8	Water	Copper	6010C	ANAB
7440-50-8	Soil	Copper	6020A	ANAB
7440-50-8	Water	Copper	6020A	ANAB
N/A	Soil	Cresol, m- (3-Methylphenol) + Cresol, p- (4-Methylphenol)	8270C	ANAB
N/A	Water	Cresol, m- (3-Methylphenol) + Cresol, p- (4-Methylphenol)	8270C	ANAB
N/A	Soil	Cresol, m- (3-Methylphenol) + Cresol, p- (4-Methylphenol)	8270D	ANAB
N/A	Water	Cresol, m- (3-Methylphenol) + Cresol, p- (4-Methylphenol)	8270D	ANAB
95-48-7	Soil	Cresol, o- (2-Methylphenol)	8270C	ANAB
95-48-7	Water	Cresol, o- (2-Methylphenol)	8270C	ANAB
95-48-7	Soil	Cresol, o- (2-Methylphenol)	8270D	ANAB
95-48-7	Water	Cresol, o- (2-Methylphenol)	8270D	ANAB

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CAS Number	Matrix	Hazardous Substance	Method	Accreditation Body
98-82-8	Soil	Cumene (Isopropylbenzene)	8260B	ANAB
98-82-8	Water	Cumene (Isopropylbenzene)	8260B	ANAB
98-82-8	Soil	Cumene (Isopropylbenzene)	8260C	ANAB
98-82-8	Water	Cumene (Isopropylbenzene)	8260C	ANAB
110-82-7	Soil	Cyclohexane	8260B	ANAB
110-82-7	Water	Cyclohexane	8260B	ANAB
110-82-7	Soil	Cyclohexane	8260C	ANAB
110-82-7	Water	Cyclohexane	8260C	ANAB
72-54-8	Soil	DDD, 4,4'-	8081A	ANAB
72-54-8	Water	DDD, 4,4'-	8081A	ANAB
72-54-8	Soil	DDD, 4,4'-	8081B	ANAB
72-54-8	Water	DDD, 4,4'-	8081B	ANAB
72-55-9	Soil	DDE, 4,4'-	8081A	ANAB
72-55-9	Water	DDE, 4,4'-	8081A	ANAB
72-55-9	Soil	DDE, 4,4'-	8081B	ANAB
72-55-9	Water	DDE, 4,4'-	8081B	ANAB
72-55-9	Air	DDE, 4,4'-	TO-10A	ORELAP
50-29-3	Soil	DDT, 4,4'-	8081A	ANAB
50-29-3	Water	DDT, 4,4'-	8081A	ANAB
50-29-3	Soil	DDT, 4,4'-	8081B	ANAB
50-29-3	Water	DDT, 4,4'-	8081B	ANAB
50-29-3	Air	DDT, 4,4'-	TO-10A	ORELAP
53-70-3	Soil	Dibenz[a,h]anthracene	8270C	ANAB
53-70-3	Water	Dibenz[a,h]anthracene	8270C	ANAB
53-70-3	Soil	Dibenz[a,h]anthracene	8270C-SIM	ANAB
53-70-3	Water	Dibenz[a,h]anthracene	8270C-SIM	ANAB
53-70-3	Soil	Dibenz[a,h]anthracene	8270D	ANAB
53-70-3	Water	Dibenz[a,h]anthracene	8270D	ANAB
53-70-3	Soil	Dibenz[a,h]anthracene	8270D-SIM	ANAB
53-70-3	Water	Dibenz[a,h]anthracene	8270D-SIM	ANAB
53-70-3	Air	Dibenz[a,h]anthracene	TO-13A SIM	ORELAP
132-64-9	Soil	Dibenzofuran	8270C	ANAB
132-64-9	Water	Dibenzofuran	8270C	ANAB

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CAS Number	Matrix	Hazardous Substance	Method	Accreditation Body
132-64-9	Soil	Dibenzofuran	8270D	ANAB
132-64-9	Water	Dibenzofuran	8270D	ANAB
124-48-1	Soil	Dibromochloromethane	8260B	ANAB
124-48-1	Water	Dibromochloromethane	8260B	ANAB
124-48-1	Soil	Dibromochloromethane	8260C	ANAB
124-48-1	Water	Dibromochloromethane	8260C	ANAB
124-48-1	Soil	Dibromochloromethane	8260C-SIM	ANAB
124-48-1	Water	Dibromochloromethane	8260C-SIM	ANAB
106-93-4	Soil	Dibromoethane, 1,2- (Ethylene Dibromide)	8260B	ANAB
106-93-4	Water	Dibromoethane, 1,2- (Ethylene Dibromide)	8260B	ANAB
106-93-4	Soil	Dibromoethane, 1,2- (Ethylene Dibromide)	8260C	ANAB
106-93-4	Water	Dibromoethane, 1,2- (Ethylene Dibromide)	8260C	ANAB
106-93-4	Soil	Dibromoethane, 1,2- (Ethylene Dibromide)	8260C-SIM	ANAB
106-93-4	Water	Dibromoethane, 1,2- (Ethylene Dibromide)	8260C-SIM	ANAB
74-95-3	Soil	Dibromomethane (Methylene Bromide)	8260B	ANAB
74-95-3	Water	Dibromomethane (Methylene Bromide)	8260B	ANAB
74-95-3	Soil	Dibromomethane (Methylene Bromide)	8260C	ANAB
74-95-3	Water	Dibromomethane (Methylene Bromide)	8260C	ANAB
74-95-3	Soil	Dibromomethane (Methylene Bromide)	8260C-SIM	ANAB
74-95-3	Water	Dibromomethane (Methylene Bromide)	8260C-SIM	ORELAP
95-50-1	Soil	Dichlorobenzene, 1,2-	8260B	ANAB
95-50-1	Water	Dichlorobenzene, 1,2-	8260B	ANAB
95-50-1	Soil	Dichlorobenzene, 1,2-	8260C	ANAB
95-50-1	Water	Dichlorobenzene, 1,2-	8260C	ANAB
95-50-1	Soil	Dichlorobenzene, 1,2-	8270C	ANAB
95-50-1	Water	Dichlorobenzene, 1,2-	8270C	ANAB
95-50-1	Soil	Dichlorobenzene, 1,2-	8270D	ANAB
95-50-1	Water	Dichlorobenzene, 1,2-	8270D	ANAB
541-73-1	Soil	Dichlorobenzene, 1,3-	8260B	ANAB
541-73-1	Water	Dichlorobenzene, 1,3-	8260B	ANAB
541-73-1	Soil	Dichlorobenzene, 1,3-	8260C	ANAB
541-73-1	Water	Dichlorobenzene, 1,3-	8260C	ANAB
541-73-1	Soil	Dichlorobenzene, 1,3-	8270C	ANAB

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CAS Number	Matrix	Hazardous Substance	Method	Accreditation Body
541-73-1	Water	Dichlorobenzene, 1,3-	8270C	ANAB
541-73-1	Soil	Dichlorobenzene, 1,3-	8270D	ANAB
541-73-1	Water	Dichlorobenzene, 1,3-	8270D	ANAB
106-46-7	Soil	Dichlorobenzene, 1,4-	8260B	ANAB
106-46-7	Water	Dichlorobenzene, 1,4-	8260B	ANAB
106-46-7	Soil	Dichlorobenzene, 1,4-	8260C	ANAB
106-46-7	Water	Dichlorobenzene, 1,4-	8260C	ANAB
106-46-7	Soil	Dichlorobenzene, 1,4-	8260C-SIM	ANAB
106-46-7	Water	Dichlorobenzene, 1,4-	8260C-SIM	ANAB
106-46-7	Soil	Dichlorobenzene, 1,4-	8270C	ANAB
106-46-7	Water	Dichlorobenzene, 1,4-	8270C	ANAB
106-46-7	Soil	Dichlorobenzene, 1,4-	8270D	ANAB
106-46-7	Water	Dichlorobenzene, 1,4-	8270D	ANAB
91-94-1	Soil	Dichlorobenzidine, 3,3'-	8270C	ANAB
91-94-1	Water	Dichlorobenzidine, 3,3'-	8270C	ANAB
91-94-1	Soil	Dichlorobenzidine, 3,3'-	8270D	ANAB
91-94-1	Water	Dichlorobenzidine, 3,3'-	8270D	ANAB
91-94-1	Water	Dichlorobenzidine, 3,3'-	8270D-SIM	ANAB
75-71-8	Soil	Dichlorodifluoromethane (Freon-12)	8260B	ANAB
75-71-8	Water	Dichlorodifluoromethane (Freon-12)	8260B	ANAB
75-71-8	Soil	Dichlorodifluoromethane (Freon-12)	8260C	ANAB
75-71-8	Water	Dichlorodifluoromethane (Freon-12)	8260C	ANAB
75-34-3	Soil	Dichloroethane, 1,1-	8260B	ANAB
75-34-3	Water	Dichloroethane, 1,1-	8260B	ANAB
75-34-3	Soil	Dichloroethane, 1,1-	8260C	ANAB
75-34-3	Water	Dichloroethane, 1,1-	8260C	ANAB
107-06-2	Soil	Dichloroethane, 1,2-	8260B	ANAB
107-06-2	Water	Dichloroethane, 1,2-	8260B	ANAB
107-06-2	Soil	Dichloroethane, 1,2-	8260C	ANAB
107-06-2	Water	Dichloroethane, 1,2-	8260C	ANAB
107-06-2	Soil	Dichloroethane, 1,2-	8260C-SIM	ANAB
107-06-2	Water	Dichloroethane, 1,2-	8260C-SIM	ANAB
75-35-4	Soil	Dichloroethylene, 1,1-	8260B	ANAB

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CAS Number	Matrix	Hazardous Substance	Method	Accreditation Body
75-35-4	Water	Dichloroethylene, 1,1-	8260B	ANAB
75-35-4	Soil	Dichloroethylene, 1,1-	8260C	ANAB
75-35-4	Water	Dichloroethylene, 1,1-	8260C	ANAB
156-59-2	Soil	Dichloroethylene, 1,2-cis-	8260B	ANAB
156-59-2	Water	Dichloroethylene, 1,2-cis-	8260B	ANAB
156-59-2	Soil	Dichloroethylene, 1,2-cis-	8260C	ANAB
156-59-2	Water	Dichloroethylene, 1,2-cis-	8260C	ANAB
156-60-5	Soil	Dichloroethylene, 1,2-trans-	8260B	ANAB
156-60-5	Water	Dichloroethylene, 1,2-trans-	8260B	ANAB
156-60-5	Soil	Dichloroethylene, 1,2-trans-	8260C	ANAB
156-60-5	Water	Dichloroethylene, 1,2-trans-	8260C	ANAB
120-83-2	Soil	Dichlorophenol, 2,4-	8270C	ANAB
120-83-2	Water	Dichlorophenol, 2,4-	8270C	ANAB
120-83-2	Soil	Dichlorophenol, 2,4-	8270D	ANAB
120-83-2	Water	Dichlorophenol, 2,4-	8270D	ANAB
78-87-5	Soil	Dichloropropane, 1,2-	8260B	ANAB
78-87-5	Water	Dichloropropane, 1,2-	8260B	ANAB
78-87-5	Soil	Dichloropropane, 1,2-	8260C	ANAB
78-87-5	Water	Dichloropropane, 1,2-	8260C	ANAB
10061-01-5	Soil	Dichloropropene, cis-1,3-	8260B	ANAB
10061-01-5	Water	Dichloropropene, cis-1,3-	8260B	ANAB
10061-01-5	Soil	Dichloropropene, cis-1,3-	8260C	ANAB
10061-01-5	Water	Dichloropropene, cis-1,3-	8260C	ANAB
10061-02-6	Soil	Dichloropropene, trans-1,3-	8260B	ANAB
10061-02-6	Water	Dichloropropene, trans-1,3-	8260B	ANAB
10061-02-6	Soil	Dichloropropene, trans-1,3-	8260C	ANAB
10061-02-6	Water	Dichloropropene, trans-1,3-	8260C	ANAB
60-57-1	Soil	Dieldrin	8081A	ANAB
60-57-1	Water	Dieldrin	8081A	ANAB
60-57-1	Soil	Dieldrin	8081B	ANAB
60-57-1	Water	Dieldrin	8081B	ANAB
N/A	Soil	Diesel Range Organics (C10 – C25)	AK 102	ANAB
N/A	Water	Diesel Range Organics (C10 – C25)	AK 102	ANAB

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CAS Number	Matrix	Hazardous Substance	Method	Accreditation Body
84-66-2	Soil	Diethyl Phthalate	8270C	ANAB
84-66-2	Water	Diethyl Phthalate	8270C	ANAB
84-66-2	Soil	Diethyl Phthalate	8270D	ANAB
84-66-2	Water	Diethyl Phthalate	8270D	ANAB
105-67-9	Soil	Dimethylphenol, 2,4-	8270C	ANAB
105-67-9	Water	Dimethylphenol, 2,4-	8270C	ANAB
105-67-9	Soil	Dimethylphenol, 2,4-	8270D	ANAB
105-67-9	Water	Dimethylphenol, 2,4-	8270D	ANAB
131-11-3	Soil	Dimethylphthalate	8270C	ANAB
131-11-3	Water	Dimethylphthalate	8270C	ANAB
131-11-3	Soil	Dimethylphthalate	8270D	ANAB
131-11-3	Water	Dimethylphthalate	8270D	ANAB
99-65-0	Soil	Dinitrobenzene, 1,3-	8270C	ANAB
99-65-0	Water	Dinitrobenzene, 1,3-	8270C	ANAB
99-65-0	Soil	Dinitrobenzene, 1,3-	8270D	ANAB
99-65-0	Water	Dinitrobenzene, 1,3-	8270D	ANAB
51-28-5	Soil	Dinitrophenol, 2,4-	8270C	ANAB
51-28-5	Water	Dinitrophenol, 2,4-	8270C	ANAB
51-28-5	Soil	Dinitrophenol, 2,4-	8270D	ANAB
51-28-5	Water	Dinitrophenol, 2,4-	8270D	ANAB
121-14-2	Soil	Dinitrotoluene, 2,4- (2,4-DNT)	8270C	ANAB
121-14-2	Water	Dinitrotoluene, 2,4- (2,4-DNT)	8270C	ANAB
121-14-2	Soil	Dinitrotoluene, 2,4- (2,4-DNT)	8270D	ANAB
121-14-2	Water	Dinitrotoluene, 2,4- (2,4-DNT)	8270D	ANAB
606-20-2	Soil	Dinitrotoluene, 2,6- (2,6-DNT)	8270C	ANAB
606-20-2	Water	Dinitrotoluene, 2,6- (2,6-DNT)	8270C	ANAB
606-20-2	Soil	Dinitrotoluene, 2,6- (2,6-DNT)	8270D	ANAB
606-20-2	Water	Dinitrotoluene, 2,6- (2,6-DNT)	8270D	ANAB
123-91-1	Soil	Dioxane, 1,4-	8260B	ORELAP
123-91-1	Water	Dioxane, 1,4-	8260B	ORELAP
123-91-1	Soil	Dioxane, 1,4-	8260C	ORELAP
123-91-1	Water	Dioxane, 1,4-	8260C	ORELAP
122-39-4	Soil	Diphenylamine	8270C	ORELAP

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CAS Number	Matrix	Hazardous Substance	Method	Accreditation Body
122-39-4	Water	Diphenylamine	8270C	ORELAP
122-39-4	Soil	Diphenylamine	8270D	ORELAP
122-39-4	Water	Diphenylamine	8270D	ORELAP
959-98-8	Soil	Endosulfan I	8081B	ANAB
959-98-8	Soil	Endosulfan I	8081B	ANAB
959-98-8	Water	Endosulfan I	8081B	ANAB
33213-65-9	Soil	Endosulfan II	8081B	ANAB
33213-65-9	Water	Endosulfan II	8081B	ANAB
1031-07-8	Soil	Endosulfan sulfate	8081A	ANAB
1031-07-8	Water	Endosulfan sulfate	8081A	ANAB
1031-07-8	Soil	Endosulfan sulfate	8081B	ANAB
1031-07-8	Water	Endosulfan sulfate	8081B	ANAB
72-20-8	Soil	Endrin	8081A	ANAB
72-20-8	Water	Endrin	8081A	ANAB
72-20-8	Soil	Endrin	8081B	ANAB
72-20-8	Water	Endrin	8081B	ANAB
75-00-3	Soil	Ethyl Chloride	8260B	ANAB
75-00-3	Water	Ethyl Chloride	8260B	ANAB
75-00-3	Soil	Ethyl Chloride	8260C	ANAB
75-00-3	Water	Ethyl Chloride	8260C	ANAB
100-41-4	Soil	Ethylbenzene	8260B	ANAB
100-41-4	Water	Ethylbenzene	8260B	ANAB
100-41-4	Soil	Ethylbenzene	8260C	ANAB
100-41-4	Water	Ethylbenzene	8260C	ANAB
206-44-0	Soil	Fluoranthene	8270C	ANAB
206-44-0	Water	Fluoranthene	8270C	ANAB
206-44-0	Soil	Fluoranthene	8270C-SIM	ANAB
206-44-0	Water	Fluoranthene	8270C-SIM	ANAB
206-44-0	Soil	Fluoranthene	8270D	ANAB
206-44-0	Water	Fluoranthene	8270D	ANAB
206-44-0	Soil	Fluoranthene	8270D-SIM	ANAB
206-44-0	Water	Fluoranthene	8270D-SIM	ANAB
206-44-0	Air	Fluoranthene	TO-13A SIM	ANAB

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CAS Number	Matrix	Hazardous Substance	Method	Accreditation Body
86-73-7	Soil	Fluorene	8270C	ANAB
86-73-7	Water	Fluorene	8270C	ANAB
86-73-7	Soil	Fluorene	8270C-SIM	ANAB
86-73-7	Water	Fluorene	8270C-SIM	ANAB
86-73-7	Soil	Fluorene	8270D	ANAB
86-73-7	Water	Fluorene	8270D	ANAB
86-73-7	Soil	Fluorene	8270D-SIM	ANAB
86-73-7	Water	Fluorene	8270D-SIM	ANAB
86-73-7	Air	Fluorene	TO-13A SIM	ANAB
N/A	Soil	Gasoline Range Organics (C6 – C10)	AK 101	ANAB
N/A	Water	Gasoline Range Organics (C6 – C10)	AK 101	ANAB
76-44-8	Soil	Heptachlor	8081A	ANAB
76-44-8	Water	Heptachlor	8081A	ANAB
76-44-8	Soil	Heptachlor	8081B	ANAB
76-44-8	Water	Heptachlor	8081B	ANAB
76-44-8	Air	Heptachlor	TO-10A	ORELAP
1024-57-3	Soil	Heptachlor Epoxide	8081A	ANAB
1024-57-3	Water	Heptachlor Epoxide	8081A	ANAB
1024-57-3	Soil	Heptachlor Epoxide	8081B	ANAB
1024-57-3	Water	Heptachlor Epoxide	8081B	ANAB
1024-57-3	Air	Heptachlor Epoxide	TO-10A	ORELAP
118-74-1	Soil	Hexachlorobenzene	8270C	ANAB
118-74-1	Water	Hexachlorobenzene	8270C	ANAB
118-74-1	Soil	Hexachlorobenzene	8270D	ANAB
118-74-1	Soil	Hexachlorobenzene	8270D	ANAB
118-74-1	Water	Hexachlorobenzene	8270D	ANAB
118-74-1	Soil	Hexachlorobenzene	8270D-SIM	ANAB
118-74-1	Water	Hexachlorobenzene	8270D-SIM	ANAB
87-68-3	Soil	Hexachlorobutadiene	8260B	ANAB
87-68-3	Water	Hexachlorobutadiene	8260B	ANAB
87-68-3	Soil	Hexachlorobutadiene	8260C	ANAB
87-68-3	Water	Hexachlorobutadiene	8260C	ANAB
87-68-3	Soil	Hexachlorobutadiene	8260C-SIM	ANAB

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CAS Number	Matrix	Hazardous Substance	Method	Accreditation Body
87-68-3	Water	Hexachlorobutadiene	8260C-SIM	ANAB
87-68-3	Soil	Hexachlorobutadiene	8270C	ANAB
87-68-3	Water	Hexachlorobutadiene	8270C	ANAB
87-68-3	Soil	Hexachlorobutadiene	8270D	ANAB
87-68-3	Soil	Hexachlorobutadiene	8270D	ANAB
87-68-3	Water	Hexachlorobutadiene	8270D	ANAB
319-84-6	Soil	Hexachlorocyclohexane, Alpha- (α-BHC)	8081A	ANAB
319-84-6	Water	Hexachlorocyclohexane, Alpha- (α-BHC)	8081A	ANAB
319-84-6	Soil	Hexachlorocyclohexane, Alpha- (α-BHC)	8081B	ANAB
319-84-6	Water	Hexachlorocyclohexane, Alpha- (α-BHC)	8081B	ANAB
319-84-6	Air	Hexachlorocyclohexane, Alpha- (α-BHC)	TO-10A	ORELAP
319-85-7	Soil	Hexachlorocyclohexane, Beta- (β-BHC)	8081A	ANAB
319-85-7	Water	Hexachlorocyclohexane, Beta- (β-BHC)	8081A	ANAB
319-85-7	Soil	Hexachlorocyclohexane, Beta- (β-BHC)	8081B	ANAB
319-85-7	Water	Hexachlorocyclohexane, Beta- (β-BHC)	8081B	ANAB
319-85-7	Air	Hexachlorocyclohexane, Beta- (β-BHC)	TO-10A	ORELAP
319-86-8	Soil	Hexachlorocyclohexane, Delta- (δ-BHC)	8081A	ANAB
319-86-8	Water	Hexachlorocyclohexane, Delta- (δ-BHC)	8081A	ANAB
319-86-8	Soil	Hexachlorocyclohexane, Delta- (δ-BHC)	8081B	ANAB
319-86-8	Water	Hexachlorocyclohexane, Delta- (δ-BHC)	8081B	ANAB
58-89-9	Soil	Hexachlorocyclohexane, Gamma- (Lindane)	8081A	ANAB
58-89-9	Water	Hexachlorocyclohexane, Gamma- (Lindane)	8081A	ANAB
58-89-9	Soil	Hexachlorocyclohexane, Gamma- (Lindane)	8081B	ANAB
58-89-9	Water	Hexachlorocyclohexane, Gamma- (Lindane)	8081B	ANAB
58-89-9	Air	Hexachlorocyclohexane, Gamma- (Lindane)	TO-10A	ORELAP
77-47-4	Soil	Hexachlorocyclopentadiene	8270C	ANAB
77-47-4	Water	Hexachlorocyclopentadiene	8270C	ANAB
77-47-4	Soil	Hexachlorocyclopentadiene	8270D	ANAB
77-47-4	Water	Hexachlorocyclopentadiene	8270D	ANAB
77-47-4	Soil	Hexachlorocyclopentadiene	8270D-SIM	ANAB
67-72-1	Soil	Hexachloroethane	8270C	ANAB
67-72-1	Water	Hexachloroethane	8270C	ANAB
67-72-1	Soil	Hexachloroethane	8270D	ANAB

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CAS Number	Matrix	Hazardous Substance	Method	Accreditation Body
67-72-1	Water	Hexachloroethane	8270D	ANAB
13252-13-6	Soil	Hexafluoropropylene oxide dimer acid (HFPO-DA)	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	ANAB
13252-13-6	Water	Hexafluoropropylene oxide dimer acid (HFPO-DA)	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	ANAB
110-54-3	Soil	Hexane, N-	8260B	ANAB
110-54-3	Water	Hexane, N-	8260B	ANAB
110-54-3	Soil	Hexane, N-	8260C	ANAB
110-54-3	Water	Hexane, N-	8260C	ANAB
591-78-6	Soil	Hexanone, 2-	8260B	ANAB
591-78-6	Water	Hexanone, 2-	8260B	ANAB
591-78-6	Soil	Hexanone, 2-	8260C	ANAB
591-78-6	Water	Hexanone, 2-	8260C	ANAB
35822-46-9	Soil	HPCDD, 1,2,3,4,6,7,8-	8290	ANAB
35822-46-9	Water	HPCDD, 1,2,3,4,6,7,8-	8290	ANAB
35822-46-9	Soil	HPCDD, 1,2,3,4,6,7,8-	8290A	ANAB
35822-46-9	Water	HPCDD, 1,2,3,4,6,7,8-	8290A	ANAB
37871-00-4	Soil	HpCDD, Total	8290A	ANAB
37871-00-4	Water	HpCDD, Total	8290A	ANAB
67562-39-4	Soil	HPCDF, 1,2,3,4,6,7,8-	8290	ANAB
67562-39-4	Water	HPCDF, 1,2,3,4,6,7,8-	8290	ANAB
67562-39-4	Soil	HPCDF, 1,2,3,4,6,7,8-	8290A	ANAB
67562-39-4	Water	HPCDF, 1,2,3,4,6,7,8-	8290A	ANAB
55673-89-7	Soil	HPCDF, 1,2,3,4,7,8,9-	8290	ANAB
55673-89-7	Water	HPCDF, 1,2,3,4,7,8,9-	8290	ANAB
55673-89-7	Soil	HPCDF, 1,2,3,4,7,8,9-	8290A	ANAB
55673-89-7	Water	HPCDF, 1,2,3,4,7,8,9-	8290A	ANAB

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CAS Number	Matrix	Hazardous Substance	Method	Accreditation Body
38998-75-3	Soil	HpCDF, Total	8290A	ANAB
38998-75-3	Water	HpCDF, Total	8290A	ANAB
39227-28-6	Soil	HXCDD, 1,2,3,4,7,8-	8290	ANAB
39227-28-6	Water	HXCDD, 1,2,3,4,7,8-	8290	ANAB
39227-28-6	Soil	HXCDD, 1,2,3,4,7,8-	8290A	ANAB
39227-28-6	Water	HXCDD, 1,2,3,4,7,8-	8290A	ANAB
57653-85-7	Soil	HXCDD, 1,2,3,6,7,8-	8290	ANAB
57653-85-7	Water	HXCDD, 1,2,3,6,7,8-	8290	ANAB
57653-85-7	Soil	HXCDD, 1,2,3,6,7,8-	8290A	ANAB
57653-85-7	Water	HXCDD, 1,2,3,6,7,8-	8290A	ANAB
19408-74-3	Soil	HXCDD, 1,2,3,7,8,9-	8290	ANAB
19408-74-3	Water	HXCDD, 1,2,3,7,8,9-	8290	ANAB
19408-74-3	Soil	HXCDD, 1,2,3,7,8,9-	8290A	ANAB
19408-74-3	Water	HXCDD, 1,2,3,7,8,9-	8290A	ANAB
34465-46-8	Soil	HxCDD, Total	8290A	ANAB
34465-46-8	Water	HxCDD, Total	8290A	ANAB
70648-26-9	Soil	HXCDF, 1,2,3,4,7,8-	8290	ANAB
70648-26-9	Water	HXCDF, 1,2,3,4,7,8-	8290	ANAB
70648-26-9	Soil	HXCDF, 1,2,3,4,7,8-	8290A	ANAB
70648-26-9	Water	HXCDF, 1,2,3,4,7,8-	8290A	ANAB
57117-44-9	Soil	HXCDF, 1,2,3,6,7,8-	8290	ANAB
57117-44-9	Water	HXCDF, 1,2,3,6,7,8-	8290	ANAB
57117-44-9	Soil	HXCDF, 1,2,3,6,7,8-	8290A	ANAB
57117-44-9	Water	HXCDF, 1,2,3,6,7,8-	8290A	ANAB
72918-21-9	Soil	HXCDF, 1,2,3,7,8,9-	8290	ANAB
72918-21-9	Water	HXCDF, 1,2,3,7,8,9-	8290	ANAB
72918-21-9	Soil	HXCDF, 1,2,3,7,8,9-	8290A	ANAB
72918-21-9	Water	HXCDF, 1,2,3,7,8,9-	8290A	ANAB
60851-34-5	Soil	HXCDF, 2,3,4,6,7,8-	8290	ANAB
60851-34-5	Water	HXCDF, 2,3,4,6,7,8-	8290	ANAB
60851-34-5	Soil	HXCDF, 2,3,4,6,7,8-	8290A	ANAB
60851-34-5	Water	HXCDF, 2,3,4,6,7,8-	8290A	ANAB
55684-94-1	Soil	HxCDF, Total	8290A	ANAB

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CAS Number	Matrix	Hazardous Substance	Method	Accreditation Body
55684-94-1	Water	HxCDF, Total	8290A	ANAB
193-39-5	Soil	Indeno[1,2,3-cd]pyrene	8270C	ANAB
193-39-5	Water	Indeno[1,2,3-cd]pyrene	8270C	ANAB
193-39-5	Soil	Indeno[1,2,3-cd]pyrene	8270C-SIM	ANAB
193-39-5	Water	Indeno[1,2,3-cd]pyrene	8270C-SIM	ANAB
193-39-5	Soil	Indeno[1,2,3-cd]pyrene	8270D	ANAB
193-39-5	Water	Indeno[1,2,3-cd]pyrene	8270D	ANAB
193-39-5	Soil	Indeno[1,2,3-cd]pyrene	8270D-SIM	ANAB
193-39-5	Water	Indeno[1,2,3-cd]pyrene	8270D-SIM	ANAB
193-39-5	Air	Indeno[1,2,3-cd]pyrene	TO-13A SIM	ANAB
78-59-1	Soil	Isophorone	8270C	ANAB
78-59-1	Water	Isophorone	8270C	ANAB
78-59-1	Soil	Isophorone	8270D	ANAB
78-59-1	Water	Isophorone	8270D	ANAB
7439-92-1	Soil	Lead, Total	6010B	ANAB
7439-92-1	Water	Lead, Total	6010B	ANAB
7439-92-1	Soil	Lead, Total	6010C	ANAB
7439-92-1	Water	Lead, Total	6010C	ANAB
7439-92-1	Soil	Lead, Total	6020A	ANAB
7439-92-1	Water	Lead, Total	6020A	ANAB
7439-97-6	Water	Mercury (elemental)	7470A	ANAB
7439-97-6	Soil	Mercury (elemental)	7471A	ANAB
7439-97-6	Soil	Mercury (elemental)	7471B	ANAB
72-43-5	Soil	Methoxychlor	8081A	ANAB
72-43-5	Water	Methoxychlor	8081A	ANAB
72-43-5	Soil	Methoxychlor	8081B	ANAB
72-43-5	Water	Methoxychlor	8081B	ANAB
72-43-5	Air	Methoxychlor	TO-10A	ORELAP
78-93-3	Soil	Methyl Ethyl Ketone (2-Butanone)	8260B	ANAB
78-93-3	Water	Methyl Ethyl Ketone (2-Butanone)	8260B	ANAB
78-93-3	Soil	Methyl Ethyl Ketone (2-Butanone)	8260C	ANAB
78-93-3	Water	Methyl Ethyl Ketone (2-Butanone)	8260C	ANAB
108-10-1	Soil	Methyl Isobutyl Ketone (4-methyl-2-pentanone)	8260B	ANAB

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CAS Number	Matrix	Hazardous Substance	Method	Accreditation Body
108-10-1	Water	Methyl Isobutyl Ketone (4-methyl-2-pentanone)	8260B	ANAB
108-10-1	Soil	Methyl Isobutyl Ketone (4-methyl-2-pentanone)	8260C	ANAB
108-10-1	Water	Methyl Isobutyl Ketone (4-methyl-2-pentanone)	8260C	ANAB
1634-04-4	Soil	Methyl tert-Butyl Ether (MTBE)	8260B	ANAB
1634-04-4	Water	Methyl tert-Butyl Ether (MTBE)	8260B	ANAB
1634-04-4	Soil	Methyl tert-Butyl Ether (MTBE)	8260C	ANAB
1634-04-4	Water	Methyl tert-Butyl Ether (MTBE)	8260C	ANAB
75-09-2	Soil	Methylene Chloride	8260B	ANAB
75-09-2	Water	Methylene Chloride	8260B	ANAB
75-09-2	Soil	Methylene Chloride	8260C	ANAB
75-09-2	Water	Methylene Chloride	8260C	ANAB
90-12-0	Soil	Methylnaphthalene, 1-	8270C	ANAB
90-12-0	Water	Methylnaphthalene, 1-	8270C	ANAB
90-12-0	Soil	Methylnaphthalene, 1-	8270C-SIM	ANAB
90-12-0	Water	Methylnaphthalene, 1-	8270C-SIM	ANAB
90-12-0	Soil	Methylnaphthalene, 1-	8270D	ANAB
90-12-0	Water	Methylnaphthalene, 1-	8270D	ANAB
90-12-0	Soil	Methylnaphthalene, 1-	8270D-SIM	ANAB
90-12-0	Water	Methylnaphthalene, 1-	8270D-SIM	ANAB
91-57-6	Soil	Methylnaphthalene, 2-	8270C	ANAB
91-57-6	Water	Methylnaphthalene, 2-	8270C	ANAB
91-57-6	Soil	Methylnaphthalene, 2-	8270C-SIM	ANAB
91-57-6	Water	Methylnaphthalene, 2-	8270C-SIM	ANAB
91-57-6	Soil	Methylnaphthalene, 2-	8270D	ANAB
91-57-6	Water	Methylnaphthalene, 2-	8270D	ANAB
91-57-6	Soil	Methylnaphthalene, 2-	8270D-SIM	ANAB
91-57-6	Water	Methylnaphthalene, 2-	8270D-SIM	ANAB
91-20-3	Soil	Naphthalene	8260B	ANAB
91-20-3	Water	Naphthalene	8260B	ANAB
91-20-3	Soil	Naphthalene	8260C	ANAB
91-20-3	Water	Naphthalene	8260C	ANAB
91-20-3	Soil	Naphthalene	8260C-SIM	ANAB
91-20-3	Water	Naphthalene	8260C-SIM	ANAB

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CAS Number	Matrix	Hazardous Substance	Method	Accreditation Body
91-20-3	Soil	Naphthalene	8270C	ANAB
91-20-3	Water	Naphthalene	8270C	ANAB
91-20-3	Soil	Naphthalene	8270C-SIM	ANAB
91-20-3	Water	Naphthalene	8270C-SIM	ANAB
91-20-3	Soil	Naphthalene	8270D	ANAB
91-20-3	Water	Naphthalene	8270D	ANAB
91-20-3	Soil	Naphthalene	8270D-SIM	ANAB
91-20-3	Water	Naphthalene	8270D-SIM	ANAB
91-20-3	Air	Naphthalene	TO-13A SIM	ANAB
4151-50-2	Soil	N-Ethyl perfluorooctane sulfonamide (EtFOSA)	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	ANAB
4151-50-2	Water	N-Ethyl perfluorooctane sulfonamide (EtFOSA)	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	ANAB
1691-99-2	Soil	N-Ethyl perfluorooctane sulfonamidoethanol (EtFOSE)	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	ANAB
1691-99-2	Water	N-Ethyl perfluorooctane sulfonamidoethanol (EtFOSE)	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	ANAB

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CAS Number	Matrix	Hazardous Substance	Method	Accreditation Body
2991-50-6	Soil	N-ethyl perfluorooctanesulfonamidoacetic acid (NEtFOSAA)	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	ANAB
2991-50-6	Water	N-ethyl perfluorooctanesulfonamidoacetic acid (NEtFOSAA)	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	ANAB
7440-02-0	Soil	Nickel, Total	6010B	ANAB
7440-02-0	Water	Nickel, Total	6010B	ANAB
7440-02-0	Soil	Nickel, Total	6010C	ANAB
7440-02-0	Water	Nickel, Total	6010C	ANAB
7440-02-0	Soil	Nickel, Total	6020A	ANAB
7440-02-0	Water	Nickel, Total	6020A	ANAB
98-95-3	Soil	Nitrobenzene	8270C	ANAB
98-95-3	Water	Nitrobenzene	8270C	ANAB
98-95-3	Soil	Nitrobenzene	8270D	ANAB
98-95-3	Water	Nitrobenzene	8270D	ANAB
62-75-9	Soil	Nitrosodimethylamine, N-	8270C	ANAB
62-75-9	Water	Nitrosodimethylamine, N-	8270C	ANAB
62-75-9	Soil	Nitrosodimethylamine, N-	8270D	ANAB
62-75-9	Water	Nitrosodimethylamine, N-	8270D	ANAB
62-75-9	Water	Nitrosodimethylamine, N-	8270D-SIM	ANAB
621-64-7	Soil	Nitroso-di-N-propylamine, N-	8270C	ANAB
621-64-7	Water	Nitroso-di-N-propylamine, N-	8270C	ANAB
621-64-7	Soil	Nitroso-di-N-propylamine, N-	8270D	ANAB
621-64-7	Water	Nitroso-di-N-propylamine, N-	8270D	ANAB
621-64-7	Soil	Nitroso-di-N-propylamine, N-	8270D-SIM	ANAB
621-64-7	Water	Nitroso-di-N-propylamine, N-	8270D-SIM	ANAB
86-30-6	Soil	Nitrosodiphenylamine, N-	8270C	ANAB
86-30-6	Water	Nitrosodiphenylamine, N-	8270C	ANAB

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CAS Number	Matrix	Hazardous Substance	Method	Accreditation Body
86-30-6	Soil	Nitrosodiphenylamine, N-	8270D	ANAB
86-30-6	Water	Nitrosodiphenylamine, N-	8270D	ANAB
31506-32-8	Soil	N-Methyl perfluorooctane sulfonamide (MeFOSA)	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	ANAB
31506-32-8	Water	N-Methyl perfluorooctane sulfonamide (MeFOSA)	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	ANAB
24448-09-7	Soil	N-Methyl perfluorooctane sulfonamidoethanol (MeFOSE)	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	ANAB
24448-09-7	Water	N-Methyl perfluorooctane sulfonamidoethanol (MeFOSE)	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	ANAB
2355-31-9	Soil	N-methyl perfluorooctanesulfonamidoacetic acid (NMeFOSAA)	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	ANAB
2355-31-9	Water	N-methyl perfluorooctanesulfonamidoacetic acid (NMeFOSAA)	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	ANAB
3268-87-9	Soil	OCDD	8290	ANAB

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CAS Number	Matrix	Hazardous Substance	Method	Accreditation Body
3268-87-9	Water	OCDD	8290	ANAB
3268-87-9	Soil	OCDD	8290A	ANAB
3268-87-9	Water	OCDD	8290A	ANAB
39001-02-0	Soil	OCDF	8290	ANAB
39001-02-0	Water	OCDF	8290	ANAB
39001-02-2	Soil	OCDF	8290A	ANAB
39001-02-2	Water	OCDF	8290A	ANAB
117-84-0	Soil	Octyl Phthalate, di-N-	8270C	ANAB
117-84-0	Water	Octyl Phthalate, di-N-	8270C	ANAB
117-84-0	Soil	Octyl Phthalate, di-N-	8270D	ANAB
117-84-0	Water	Octyl Phthalate, di-N-	8270D	ANAB
12674-11-2	Soil	PCB - Aroclor-1016	8082A	ANAB
12674-11-2	Water	PCB - Aroclor-1016	8082A	ANAB
11104-28-2	Soil	PCB - Aroclor-1221	8082A	ANAB
11104-28-2	Water	PCB - Aroclor-1221	8082A	ANAB
11141-16-5	Soil	PCB - Aroclor-1232	8082A	ANAB
11141-16-5	Water	PCB - Aroclor-1232	8082A	ANAB
53469-21-9	Soil	PCB - Aroclor-1242	8082A	ANAB
53469-21-9	Water	PCB - Aroclor-1242	8082A	ANAB
53469-21-9	Air	PCB - Aroclor-1242	TO-10A	ORELAP
12672-29-6	Soil	PCB - Aroclor-1248	8082A	ANAB
12672-29-6	Water	PCB - Aroclor-1248	8082A	ANAB
12672-29-6	Air	PCB - Aroclor-1248	TO-10A	ORELAP
11097-69-1	Soil	PCB - Aroclor-1254	8082A	ANAB
11097-69-1	Water	PCB - Aroclor-1254	8082A	ANAB
11097-69-1	Air	PCB - Aroclor-1254	TO-10A	ORELAP
11096-82-5	Soil	PCB - Aroclor-1260	8082A	ANAB
11096-82-5	Water	PCB - Aroclor-1260	8082A	ANAB
11096-82-5	Air	PCB - Aroclor-1260	TO-10A	ORELAP
37324-23-5	Soil	PCB - Aroclor-1262	8082A	ANAB
37324-23-5	Water	PCB - Aroclor-1262	8082A	ANAB
11100-14-4	Soil	PCB - Aroclor-1268	8082A	ANAB
11100-14-4	Water	PCB - Aroclor-1268	8082A	ANAB

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CAS Number	Matrix	Hazardous Substance	Method	Accreditation Body
40321-76-4	Soil	PECDD, 1,2,3,7,8-	8290	ANAB
40321-76-4	Water	PECDD, 1,2,3,7,8-	8290	ANAB
40321-76-4	Soil	PECDD, 1,2,3,7,8-	8290A	ANAB
40321-76-4	Water	PECDD, 1,2,3,7,8-	8290A	ANAB
36088-22-9	Soil	PeCDD, Total	8290A	ANAB
36088-22-9	Water	PeCDD, Total	8290A	ANAB
57117-41-6	Soil	PECDF, 1,2,3,7,8-	8290	ANAB
57117-41-6	Water	PECDF, 1,2,3,7,8-	8290	ANAB
57117-41-6	Soil	PECDF, 1,2,3,7,8-	8290A	ANAB
57117-41-6	Water	PECDF, 1,2,3,7,8-	8290A	ANAB
57117-31-4	Soil	PECDF, 2,3,4,7,8-	8290	ANAB
57117-31-4	Water	PECDF, 2,3,4,7,8-	8290	ANAB
57117-31-4	Soil	PECDF, 2,3,4,7,8-	8290A	ANAB
57117-31-4	Water	PECDF, 2,3,4,7,8-	8290A	ANAB
30402-15-4	Soil	PeCDF, Total	8290A	ANAB
30402-15-4	Water	PeCDF, Total	8290A	ANAB
87-86-5	Soil	Pentachlorophenol	8270C	ANAB
87-86-5	Water	Pentachlorophenol	8270C	ANAB
87-86-5	Soil	Pentachlorophenol	8270D	ANAB
87-86-5	Water	Pentachlorophenol	8270D	ANAB
87-86-5	Soil	Pentachlorophenol	8270D-SIM	ANAB
14797-73-0	Soil	Perchlorate and Perchlorate Salts	6850	ANAB
14797-73-0	Water	Perchlorate and Perchlorate Salts	6850	ANAB
375-73-5	Soil	Perfluorobutanesulfonic acid (PFBS)	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	ANAB
375-73-5	Soil	Perfluorobutanesulfonic acid (PFBS)	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	ANAB

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CAS Number	Matrix	Hazardous Substance	Method	Accreditation Body
375-73-5	Water	Perfluorobutanesulfonic acid (PFBS)	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	ANAB
375-73-5	Water	Perfluorobutanesulfonic acid (PFBS)	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	ANAB
375-22-4	Soil	Perfluorobutanoic acid (PFBA)	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	ANAB
375-22-4	Water	Perfluorobutanoic acid (PFBA)	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	ANAB
335-77-3	Soil	Perfluorodecane sulfonic acid (PFDS)	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	ANAB
335-77-3	Water	Perfluorodecane sulfonic acid (PFDS)	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	ANAB

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CAS Number	Matrix	Hazardous Substance	Method	Accreditation Body
335-76-2	Soil	Perfluorodecanoic acid (PFDA)	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	ANAB
335-76-2	Water	Perfluorodecanoic acid (PFDA)	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	ANAB
307-55-1	Soil	Perfluorododecanoic acid (PFDoA)	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	ANAB
307-55-1	Water	Perfluorododecanoic acid (PFDoA)	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	ANAB
375-92-8	Soil	Perfluoroheptane sulfonic acid (PFHpS)	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	ANAB
375-92-8	Water	Perfluoroheptane sulfonic acid (PFHpS)	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	ANAB

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CAS Number	Matrix	Hazardous Substance	Method	Accreditation Body
375-85-9	Soil	Perfluoroheptanoic acid (PFHpA)	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	ANAB
375-85-9	Soil	Perfluoroheptanoic acid (PFHpA)	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	ANAB
375-85-9	Water	Perfluoroheptanoic acid (PFHpA)	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	ANAB
375-85-9	Water	Perfluoroheptanoic acid (PFHpA)	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	ANAB
67905-19-5	Soil	Perfluorohexadecanoic acid (PFHxDA)	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	ANAB
67905-19-5	Water	Perfluorohexadecanoic acid (PFHxDA)	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	ANAB

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CAS Number	Matrix	Hazardous Substance	Method	Accreditation Body
355-46-4	Soil	Perfluorohexanesulfonic acid (PFHxS)	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	ANAB
355-46-4	Soil	Perfluorohexanesulfonic acid (PFHxS)	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	ANAB
355-46-4	Water	Perfluorohexanesulfonic acid (PFHxS)	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	ANAB
355-46-4	Water	Perfluorohexanesulfonic acid (PFHxS)	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	ANAB
307-24-4	Soil	Perfluorohexanoic acid (PFHxA)	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	ANAB
307-24-4	Water	Perfluorohexanoic acid (PFHxA)	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	ANAB

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CAS Number	Matrix	Hazardous Substance	Method	Accreditation Body
68259-12-1	Soil	Perfluorononanesulfonic acid (PFNS)	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	ANAB
68259-12-1	Water	Perfluorononanesulfonic acid (PFNS)	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	ANAB
375-95-1	Soil	Perfluorononanoic acid (PFNA)	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	ANAB
375-95-1	Soil	Perfluorononanoic acid (PFNA)	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	ANAB
375-95-1	Water	Perfluorononanoic acid (PFNA)	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	ANAB
375-95-1	Water	Perfluorononanoic acid (PFNA)	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	ANAB

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CAS Number	Matrix	Hazardous Substance	Method	Accreditation Body
16517-11-6	Soil	Perfluorooctadecanoic acid (PFODA)	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	ANAB
16517-11-6	Water	Perfluorooctadecanoic acid (PFODA)	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	ANAB
1763-23-1	Soil	Perfluorooctane Sulphonic Acid (PFOS)	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	ANAB
1763-23-1	Water	Perfluorooctane Sulphonic Acid (PFOS)	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	ANAB
754-91-6	Soil	Perfluorooctanesulfonamide (PFOSA)	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	ANAB
754-91-6	Water	Perfluorooctanesulfonamide (PFOSA)	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	ANAB

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CAS Number	Matrix	Hazardous Substance	Method	Accreditation Body
1763-23-1	Soil	Perfluorooctanesulfonic acid (PFOS)	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	ANAB
335-67-1	Soil	Perfluorooctanoic acid (PFOA)	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	ANAB
335-67-1	Water	Perfluorooctanoic acid (PFOA)	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	ANAB
335-67-1	Water	Perfluorooctanoic acid (PFOA)	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	ANAB
2706-91-4	Soil	Perfluoropentanesulfonic acid (PFPeS)	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	ANAB
2706-91-4	Water	Perfluoropentanesulfonic acid (PFPeS)	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	ANAB

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CAS Number	Matrix	Hazardous Substance	Method	Accreditation Body
2706-90-3	Soil	Perfluoropentanoic acid (PFPeA)	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	ANAB
2706-90-3	Water	Perfluoropentanoic acid (PFPeA)	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	ANAB
376-06-7	Soil	Perfluorotetradecanoic acid (PFTA)	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	ANAB
376-06-7	Water	Perfluorotetradecanoic acid (PFTA)	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	ANAB
72629-94-8	Soil	Perfluorotridecanoic acid (PFTrDA)	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	ANAB
72629-94-8	Water	Perfluorotridecanoic acid (PFTrDA)	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	ANAB

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CAS Number	Matrix	Hazardous Substance	Method	Accreditation Body
2058-94-8	Soil	Perfluoroundecanoic acid (PFUnA)	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	ANAB
2058-94-8	Water	Perfluoroundecanoic acid (PFUnA)	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	ANAB
85-01-8	Soil	Phenanthrene	8270C	ANAB
85-01-8	Water	Phenanthrene	8270C	ANAB
85-01-8	Soil	Phenanthrene	8270C-SIM	ANAB
85-01-8	Water	Phenanthrene	8270C-SIM	ANAB
85-01-8	Soil	Phenanthrene	8270D	ANAB
85-01-8	Water	Phenanthrene	8270D	ANAB
85-01-8	Soil	Phenanthrene	8270D-SIM	ANAB
85-01-8	Water	Phenanthrene	8270D-SIM	ANAB
85-01-8	Air	Phenanthrene	TO-13A SIM	ANAB
108-95-2	Soil	Phenol	8270C	ANAB
108-95-2	Water	Phenol	8270C	ANAB
108-95-2	Soil	Phenol	8270D	ANAB
108-95-2	Water	Phenol	8270D	ANAB
103-65-1	Soil	Propyl benzene	8260B	ANAB
103-65-1	Water	Propyl benzene	8260B	ANAB
103-65-1	Soil	Propyl benzene	8260C	ANAB
103-65-1	Water	Propyl benzene	8260C	ANAB
129-00-0	Soil	Pyrene	8270C	ANAB
129-00-0	Water	Pyrene	8270C	ANAB
129-00-0	Soil	Pyrene	8270C-SIM	ANAB
129-00-0	Water	Pyrene	8270C-SIM	ANAB
129-00-0	Soil	Pyrene	8270D	ANAB
129-00-0	Water	Pyrene	8270D	ANAB

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CAS Number	Matrix	Hazardous Substance	Method	Accreditation Body
129-00-0	Soil	Pyrene	8270D-SIM	ANAB
129-00-0	Water	Pyrene	8270D-SIM	ANAB
129-00-0	Air	Pyrene	TO-13A SIM	ANAB
N/A	Soil	Residual Range Organics (C25 – C36)	AK 103	ANAB
N/A	Water	Residual Range Organics (C25 – C36)	AK 103	ANAB
7782-49-2	Soil	Selenium	6010B	ANAB
7782-49-2	Water	Selenium	6010B	ANAB
7782-49-2	Soil	Selenium	6010C	ANAB
7782-49-2	Water	Selenium	6010C	ANAB
7782-49-2	Soil	Selenium	6020A	ANAB
7782-49-2	Water	Selenium	6020A	ANAB
7440-22-4	Soil	Silver	6010B	ANAB
7440-22-4	Water	Silver	6010B	ANAB
7440-22-4	Soil	Silver	6010C	ANAB
7440-22-4	Water	Silver	6010C	ANAB
7440-22-4	Soil	Silver	6020A	ANAB
7440-22-4	Water	Silver	6020A	ANAB
100-42-5	Soil	Styrene	8260B	ANAB
100-42-5	Water	Styrene	8260B	ANAB
100-42-5	Soil	Styrene	8260C	ANAB
100-42-5	Water	Styrene	8260C	ANAB
1746-01-6	Water	TCDD, 2,3,7,8-	8290	ANAB
1746-01-6	Soil	TCDD, 2,3,7,8-	8290A	ANAB
1746-01-6	Water	TCDD, 2,3,7,8-	8290A	ANAB
41903-57-5	Soil	TCDD, Total	8290A	ANAB
41903-57-5	Water	TCDD, Total	8290A	ANAB
51207-31-9	Soil	TCDF, 2,3,7,8-	8290	ANAB
51207-31-9	Water	TCDF, 2,3,7,8-	8290	ANAB
51207-31-9	Soil	TCDF, 2,3,7,8-	8290A	ANAB
51207-31-9	Water	TCDF, 2,3,7,8-	8290A	ANAB
55722-27-5	Soil	TCDF, Total	8290A	ANAB
55722-27-5	Water	TCDF, Total	8290A	ANAB
630-20-6	Soil	Tetrachloroethane, 1,1,1,2-	8260B	ANAB

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CAS Number	Matrix	Hazardous Substance	Method	Accreditation Body
630-20-6	Water	Tetrachloroethane, 1,1,1,2-	8260B	ANAB
630-20-6	Soil	Tetrachloroethane, 1,1,1,2-	8260C	ANAB
630-20-6	Water	Tetrachloroethane, 1,1,1,2-	8260C	ANAB
79-34-5	Soil	Tetrachloroethane, 1,1,2,2-	8260B	ANAB
79-34-5	Water	Tetrachloroethane, 1,1,2,2-	8260B	ANAB
79-34-5	Soil	Tetrachloroethane, 1,1,2,2-	8260C	ANAB
79-34-5	Water	Tetrachloroethane, 1,1,2,2-	8260C	ANAB
79-34-5	Soil	Tetrachloroethane, 1,1,2,2-	8260C-SIM	ANAB
79-34-5	Water	Tetrachloroethane, 1,1,2,2-	8260C-SIM	ANAB
127-18-4	Soil	Tetrachloroethylene	8260B	ANAB
127-18-4	Water	Tetrachloroethylene	8260B	ANAB
127-18-4	Soil	Tetrachloroethylene	8260C	ANAB
127-18-4	Water	Tetrachloroethylene	8260C	ANAB
127-18-4	Soil	Tetrachloroethylene	8260C-SIM	ANAB
127-18-4	Water	Tetrachloroethylene	8260C-SIM	ANAB
7440-28-0	Soil	Thallium, Total	6010B	ANAB
7440-28-0	Water	Thallium, Total	6010B	ANAB
7440-28-0	Soil	Thallium, Total	6010C	ANAB
7440-28-0	Water	Thallium, Total	6010C	ANAB
7440-28-0	Soil	Thallium, Total	6020A	ANAB
7440-28-0	Water	Thallium, Total	6020A	ANAB
108-88-3	Soil	Toluene	8260B	ANAB
108-88-3	Water	Toluene	8260B	ANAB
108-88-3	Soil	Toluene	8260C	ANAB
108-88-3	Water	Toluene	8260C	ANAB
8001-35-2	Soil	Toxaphene	8081A	ANAB
8001-35-2	Water	Toxaphene	8081A	ANAB
8001-35-2	Soil	Toxaphene	8081B	ANAB
8001-35-2	Water	Toxaphene	8081B	ANAB
76-13-1	Soil	Trichloro-1,2,2-trifluoroethane, 1,1,2- (Freon 113)	8260B	ANAB
76-13-1	Water	Trichloro-1,2,2-trifluoroethane, 1,1,2- (Freon 113)	8260B	ANAB
76-13-1	Soil	Trichloro-1,2,2-trifluoroethane, 1,1,2- (Freon 113)	8260C	ANAB
76-13-1	Water	Trichloro-1,2,2-trifluoroethane, 1,1,2- (Freon 113)	8260C	ANAB

Scope of Approval

CAS Number	Matrix	Hazardous Substance	Method	Accreditation Body
87-61-6	Soil	Trichlorobenzene, 1,2,3-	8260B	ANAB
87-61-6	Water	Trichlorobenzene, 1,2,3-	8260B	ANAB
87-61-6	Soil	Trichlorobenzene, 1,2,3-	8260C	ANAB
87-61-6	Water	Trichlorobenzene, 1,2,3-	8260C	ANAB
120-82-1	Soil	Trichlorobenzene, 1,2,4-	8260B	ANAB
120-82-1	Water	Trichlorobenzene, 1,2,4-	8260B	ANAB
120-82-1	Soil	Trichlorobenzene, 1,2,4-	8260C	ANAB
120-82-1	Water	Trichlorobenzene, 1,2,4-	8260C	ANAB
71-55-6	Soil	Trichloroethane, 1,1,1-	8260B	ANAB
71-55-6	Water	Trichloroethane, 1,1,1-	8260B	ANAB
71-55-6	Soil	Trichloroethane, 1,1,1-	8260C	ANAB
71-55-6	Water	Trichloroethane, 1,1,1-	8260C	ANAB
79-00-5	Soil	Trichloroethane, 1,1,2-	8260B	ANAB
79-00-5	Water	Trichloroethane, 1,1,2-	8260B	ANAB
79-00-5	Soil	Trichloroethane, 1,1,2-	8260C	ANAB
79-00-5	Water	Trichloroethane, 1,1,2-	8260C	ANAB
79-00-5	Soil	Trichloroethane, 1,1,2-	8260C-SIM	ANAB
79-00-5	Water	Trichloroethane, 1,1,2-	8260C-SIM	ANAB
79-01-6	Soil	Trichloroethylene	8260B	ANAB
79-01-6	Water	Trichloroethylene	8260B	ANAB
79-01-6	Soil	Trichloroethylene	8260C	ANAB
79-01-6	Water	Trichloroethylene	8260C	ANAB
79-01-6	Soil	Trichloroethylene	8260C-SIM	ANAB
79-01-6	Water	Trichloroethylene	8260C-SIM	ANAB
75-69-4	Soil	Trichlorofluoromethane	8260B	ANAB
75-69-4	Water	Trichlorofluoromethane	8260B	ANAB
75-69-4	Soil	Trichlorofluoromethane	8260C	ANAB
75-69-4	Water	Trichlorofluoromethane	8260C	ANAB
95-95-4	Soil	Trichlorophenol, 2,4,5-	8270C	ANAB
95-95-4	Water	Trichlorophenol, 2,4,5-	8270C	ANAB
95-95-4	Soil	Trichlorophenol, 2,4,5-	8270D	ANAB
95-95-4	Water	Trichlorophenol, 2,4,5-	8270D	ANAB
88-06-2	Soil	Trichlorophenol, 2,4,6-	8270C	ANAB

Scope of Approval

CAS Number	Matrix	Hazardous Substance	Method	Accreditation Body
88-06-2	Water	Trichlorophenol, 2,4,6-	8270C	ANAB
88-06-2	Soil	Trichlorophenol, 2,4,6-	8270D	ANAB
88-06-2	Water	Trichlorophenol, 2,4,6-	8270D	ANAB
96-18-4	Soil	Trichloropropane, 1,2,3-	8260B	ANAB
96-18-4	Water	Trichloropropane, 1,2,3-	8260B	ANAB
96-18-4	Soil	Trichloropropane, 1,2,3-	8260C	ANAB
96-18-4	Water	Trichloropropane, 1,2,3-	8260C	ANAB
96-18-4	Soil	Trichloropropane, 1,2,3-	8260C SIM	ANAB
96-18-4	Water	Trichloropropane, 1,2,3-	8260C-SIM	ANAB
95-63-6	Soil	Trimethylbenzene, 1,2,4-	8260B	ANAB
95-63-6	Water	Trimethylbenzene, 1,2,4-	8260B	ANAB
95-63-6	Soil	Trimethylbenzene, 1,2,4-	8260C	ANAB
95-63-6	Water	Trimethylbenzene, 1,2,4-	8260C	ANAB
108-67-8	Soil	Trimethylbenzene, 1,3,5-	8260B	ANAB
108-67-8	Water	Trimethylbenzene, 1,3,5-	8260B	ANAB
108-67-8	Soil	Trimethylbenzene, 1,3,5-	8260C	ANAB
108-67-8	Water	Trimethylbenzene, 1,3,5-	8260C	ANAB
99-35-4	Water	Trinitrobenzene, 1,3,5- (1,3,5-TNB)	8270C	ORELAP
99-35-4	Soil	Trinitrobenzene, 1,3,5- (1,3,5-TNB)	8270D	ORELAP
99-35-4	Water	Trinitrobenzene, 1,3,5- (1,3,5-TNB)	8270D	ORELAP
99-35-4	Soil	Trinitrobenzene, 1,3,5- (1,3,5-TNB)	8270C	ORELAP
108-05-4	Soil	Vinyl Acetate	8260B	ANAB
108-05-4	Water	Vinyl Acetate	8260B	ANAB
108-05-4	Soil	Vinyl Acetate	8260C	ANAB
108-05-4	Water	Vinyl Acetate	8260C	ANAB
75-01-4	Soil	Vinyl Chloride	8260B	ANAB
75-01-4	Water	Vinyl Chloride	8260B	ANAB
75-01-4	Soil	Vinyl Chloride	8260C	ANAB
75-01-4	Water	Vinyl Chloride	8260C	ANAB
75-01-4	Soil	Vinyl Chloride	8260C-SIM	ANAB
75-01-4	Water	Vinyl Chloride	8260C-SIM	ANAB
N/A	Soil	Xylene, m+p-	8260B	ANAB
N/A	Water	Xylene, m+p-	8260B	ANAB

Scope of Approval

CAS Number	Matrix	Hazardous Substance	Method	Accreditation Body
N/A	Soil	Xylene, m+p-	8260C	ANAB
N/A	Water	Xylene, m+p-	8260C	ANAB
95-47-6	Soil	Xylene, o-	8260B	ANAB
95-47-6	Water	Xylene, o-	8260B	ANAB
95-47-6	Soil	Xylene, o-	8260C	ANAB
95-47-6	Water	Xylene, o-	8260C	ANAB
1330-20-7	Soil	Xylene, Total	8260B	ANAB
1330-20-7	Water	Xylene, Total	8260B	ANAB
1330-20-7	Soil	Xylene, Total	8260C	ANAB
1330-20-7	Water	Xylene, Total	8260C	ANAB
7440-66-6	Soil	Zinc, Total	6010B	ANAB
7440-66-6	Water	Zinc, Total	6010B	ANAB
7440-66-6	Soil	Zinc, Total	6010C	ANAB
7440-66-6	Water	Zinc, Total	6010C	ANAB
7440-66-6	Soil	Zinc, Total	6020A	ANAB
7440-66-6	Water	Zinc, Total	6020A	ANAB

THE STATE of ALASKA
GOVERNOR MICHAEL J. DUNLEAVY

Department of Environmental Conservation

DIVISION OF SPILL PREVENTION AND RESPONSE
Contaminated Sites Program
Laboratory Approval Program

555 Cordova Street
Anchorage, Alaska 99501
Main: 907.269.7526
cs.lab.cert@alaska.gov

June 20, 2022

Chris Williams
Eurofins - Sacramento
880 Riverside Parkway
West Sacramento, CA 95605

RE: Amendment #1 to Contaminated Sites Laboratory Approval **17-020**

On February 11, 2021, Eurofins - Sacramento received an approval letter from the Alaska Department of Environmental Conservation's Contaminated Sites Laboratory Approval Program (CS-LAP). On June 16, 2022, you requested an amendment to your approval. This letter adds the compounds in the attached Scope of Approval to your existing approval.

Please note that for the compounds added to your approval, the effective date is June 20, 2022. These compounds are **not** retroactively added to cover the period between February 11, 2021, and June 20, 2022.

Please attach this letter to your original approval letter and Scope of Approval issued February 11, 2021. The two combined letters and the Scope of Approval are the documentation of your approval through the CS-LAP.

If you have any questions, please contact me at (907) 269-7526, or by email at brian.englund@alaska.gov.

Respectfully,

Brian Englund

Brian Englund
CS-LAP Approval Officer

Scope of Approval

CAS Number	Matrix	Hazardous Substance	Method	Accreditation Body
763051-92-9	Soil	11-chloroeicosafluoro-3-oxaundecane-1-sulfonic acid (11Cl-PF3OUdS)	Draft 1633	ANAB
763051-92-9	Water	11-chloroeicosafluoro-3-oxaundecane-1-sulfonic acid (11Cl-PF3OUdS)	Draft 1633	ANAB
-	Soil	2H, 2H, 3H, 3H-Perfluorodecanoic acid (7:3 FTCA)	Draft 1633	ANAB
-	Water	2H, 2H, 3H, 3H-Perfluorodecanoic acid (7:3 FTCA)	Draft 1633	ANAB
-	Soil	2H, 2H, 3H, 3H-Perfluorooctanoic acid (5:3 FTCA)	Draft 1633	ANAB
-	Water	2H, 2H, 3H, 3H-Perfluorooctanoic acid (5:3 FTCA)	Draft 1633	ANAB
-	Soil	4,4,5,5,6,6-Heptafluorohexanoic acid (3:3 FTCA)	Draft 1633	ANAB
-	Water	4,4,5,5,6,6-Heptafluorohexanoic acid (3:3 FTCA)	Draft 1633	ANAB
919005-14-4	Soil	4,8-dioxa-3H-perfluorononanoic acid (ADONA)	Draft 1633	ANAB
919005-14-4	Water	4,8-dioxa-3H-perfluorononanoic acid (ADONA)	Draft 1633	ANAB
757124-72-4	Soil	4:2 Fluorotelomer sulfonic acid	Draft 1633	ANAB
757124-72-4	Water	4:2 Fluorotelomer sulfonic acid	Draft 1633	ANAB
27619-97-2	Soil	6:2 Fluorotelomer sulfonic acid (6:2 FTS)	Draft 1633	ANAB
27619-97-2	Water	6:2 Fluorotelomer sulfonic acid (6:2 FTS)	Draft 1633	ANAB
39108-34-4	Soil	8:2 Fluorotelomer sulfonic acid (8:2 FTS)	Draft 1633	ANAB
39108-34-4	Water	8:2 Fluorotelomer sulfonic acid (8:2 FTS)	Draft 1633	ANAB
756426-58-1	Soil	9-chlorohexadecafluoro-3-oxanone-1-sulfonic acid (9Cl-PF3ONS)	Draft 1633	ANAB
756426-58-1	Water	9-chlorohexadecafluoro-3-oxanone-1-sulfonic acid (9Cl-PF3ONS)	Draft 1633	ANAB
13252-13-6	Soil	Hexafluoropropylene oxide dimer acid (HFPO-DA)	Draft 1633	ANAB
13252-13-6	Water	Hexafluoropropylene oxide dimer acid (HFPO-DA)	Draft 1633	ANAB
4151-50-2	Soil	N-Ethyl perfluorooctane sulfonamide (EtFOSA)	Draft 1633	ANAB
4151-50-2	Water	N-Ethyl perfluorooctane sulfonamide (EtFOSA)	Draft 1633	ANAB
1691-99-2	Soil	N-Ethyl perfluorooctane sulfonamidoethanol (EtFOSE)	Draft 1633	ANAB
1691-99-2	Water	N-Ethyl perfluorooctane sulfonamidoethanol (EtFOSE)	Draft 1633	ANAB
2991-50-6	Soil	N-ethyl perfluorooctanesulfonamidoacetic acid (NEtFOSAA)	Draft 1633	ANAB
2991-50-6	Water	N-ethyl perfluorooctanesulfonamidoacetic acid (NEtFOSAA)	Draft 1633	ANAB
31506-32-8	Soil	N-Methyl perfluorooctane sulfonamide (MeFOSA)	Draft 1633	ANAB
31506-32-8	Water	N-Methyl perfluorooctane sulfonamide (MeFOSA)	Draft 1633	ANAB
24448-09-7	Soil	N-Methyl perfluorooctane sulfonamidoethanol (MeFOSE)	Draft 1633	ANAB
24448-09-7	Water	N-Methyl perfluorooctane sulfonamidoethanol (MeFOSE)	Draft 1633	ANAB
2355-31-9	Soil	N-methyl perfluorooctanesulfonamidoacetic acid (NMeFOSAA)	Draft 1633	ANAB
2355-31-9	Water	N-methyl perfluorooctanesulfonamidoacetic acid (NMeFOSAA)	Draft 1633	ANAB
151772-58-6	Soil	Nonafluoro-3,6-dioxaheptanoic acid (NFDHA)	Draft 1633	ANAB

Scope of Approval

CAS Number	Matrix	Hazardous Substance	Method	Accreditation Body
151772-58-6	Water	Nonafluoro-3,6-dioxaheptanoic acid (NFDHA)	Draft 1633	ANAB
113507-82-7	Soil	Perfluoro(2-ethoxyethane)sulfonic acid (PFEESA)	Draft 1633	ANAB
113507-82-7	Water	Perfluoro(2-ethoxyethane)sulfonic acid (PFEESA)	Draft 1633	ANAB
377-73-1	Soil	Perfluoro-3-methoxypropanoic acid (PFMPA)	Draft 1633	ANAB
377-73-1	Water	Perfluoro-3-methoxypropanoic acid (PFMPA)	Draft 1633	ANAB
863090-89-5	Soil	Perfluoro-4-methoxybutanoic acid (PFMBA)	Draft 1633	ANAB
863090-89-5	Water	Perfluoro-4-methoxybutanoic acid (PFMBA)	Draft 1633	ANAB
375-73-5	Soil	Perfluorobutanesulfonic acid (PFBS)	Draft 1633	ANAB
375-73-5	Water	Perfluorobutanesulfonic acid (PFBS)	Draft 1633	ANAB
375-22-4	Soil	Perfluorobutanoic acid (PFBA)	Draft 1633	ANAB
375-22-4	Water	Perfluorobutanoic acid (PFBA)	Draft 1633	ANAB
335-77-3	Soil	Perfluorodecane sulfonic acid (PFDS)	Draft 1633	ANAB
335-77-3	Water	Perfluorodecane sulfonic acid (PFDS)	Draft 1633	ANAB
335-76-2	Soil	Perfluorodecanoic acid (PFDA)	Draft 1633	ANAB
335-76-2	Water	Perfluorodecanoic acid (PFDA)	Draft 1633	ANAB
79780-39-5	Soil	Perfluorododecane sulfonic acid (PFDoS)	Draft 1633	ANAB
79780-39-5	Water	Perfluorododecane sulfonic acid (PFDoS)	Draft 1633	ANAB
307-55-1	Soil	Perfluorododecanoic acid (PFDoA)	Draft 1633	ANAB
307-55-1	Water	Perfluorododecanoic acid (PFDoA)	Draft 1633	ANAB
375-92-8	Soil	Perfluoroheptane sulfonic acid (PFHpS)	Draft 1633	ANAB
375-92-8	Water	Perfluoroheptane sulfonic acid (PFHpS)	Draft 1633	ANAB
375-85-9	Soil	Perfluoroheptanoic acid (PFHpA)	Draft 1633	ANAB
375-85-9	Water	Perfluoroheptanoic acid (PFHpA)	Draft 1633	ANAB
355-46-4	Soil	Perfluorohexanesulfonic acid (PFHxS)	Draft 1633	ANAB
355-46-4	Water	Perfluorohexanesulfonic acid (PFHxS)	Draft 1633	ANAB
307-24-4	Soil	Perfluorohexanoic acid (PFHxA)	Draft 1633	ANAB
307-24-4	Water	Perfluorohexanoic acid (PFHxA)	Draft 1633	ANAB
68259-12-1	Soil	Perfluorononanesulfonic acid (PFNS)	Draft 1633	ANAB
68259-12-1	Water	Perfluorononanesulfonic acid (PFNS)	Draft 1633	ANAB
375-95-1	Soil	Perfluorononanoic acid (PFNA)	Draft 1633	ANAB
375-95-1	Water	Perfluorononanoic acid (PFNA)	Draft 1633	ANAB
754-91-6	Soil	Perfluorooctanesulfonamide (PFOSA)	Draft 1633	ANAB
754-91-6	Water	Perfluorooctanesulfonamide (PFOSA)	Draft 1633	ANAB

Scope of Approval

CAS Number	Matrix	Hazardous Substance	Method	Accreditation Body
1763-23-1	Soil	Perfluorooctanesulfonic acid (PFOS)	Draft 1633	ANAB
1763-23-1	Water	Perfluorooctanesulfonic acid (PFOS)	Draft 1633	ANAB
335-67-1	Soil	Perfluorooctanoic acid (PFOA)	Draft 1633	ANAB
335-67-1	Water	Perfluorooctanoic acid (PFOA)	Draft 1633	ANAB
2706-91-4	Soil	Perfluoropentanesulfonic acid (PFPeS)	Draft 1633	ANAB
2706-91-4	Water	Perfluoropentanesulfonic acid (PFPeS)	Draft 1633	ANAB
2706-90-3	Soil	Perfluoropentanoic acid (PFPeA)	Draft 1633	ANAB
2706-90-3	Water	Perfluoropentanoic acid (PFPeA)	Draft 1633	ANAB
376-06-7	Soil	Perfluorotetradecanoic acid (PFTA)	Draft 1633	ANAB
376-06-7	Water	Perfluorotetradecanoic acid (PFTA)	Draft 1633	ANAB
72629-94-8	Soil	Perfluorotridecanoic acid (PFTrDA)	Draft 1633	ANAB
72629-94-8	Water	Perfluorotridecanoic acid (PFTrDA)	Draft 1633	ANAB
2058-94-8	Soil	Perfluoroundecanoic acid (PFUnA)	Draft 1633	ANAB
2058-94-8	Water	Perfluoroundecanoic acid (PFUnA)	Draft 1633	ANAB

CERTIFICATE OF ACCREDITATION

The ANSI National Accreditation Board

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)

In the field of

TESTING

This certificate is valid only when accompanied by a current scope of accreditation document.
The current scope of accreditation can be verified at www.anab.org.

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)

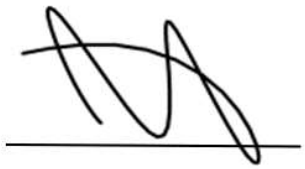
Biological Tissue		
Technology	**Method**	**Analyte**
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	Perfluorononanesulfonic acid (PFNS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15 WS-LC-0025	4,8-Dioxa-3H-perfluorononanoic acid (ADONA)
LC/MS/MS	PFAS by LCMSMS Compliant 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	*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)
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: Analysis of Per- and Polyfluoroalkyl Substances (PFAS) in Water, Solid, Biosolids and Tissue

[Method 1633]

Approvals (Signature/Date):

12/02/2022	11/30/2022
Robert Hrabak Date	Joe Schairer Date
Technical Manager	Health & Safety Manager / Coordinator
11/30/2022	12/02/2022
Lisa Stafford Date	Chris Williams Date
Quality Assurance Manager	Laboratory Manager

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1. SCOPE AND APPLICATION

1.1. This procedure describes the analysis of water, soil, solids, biosolids, 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	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	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 (FOSAs)		
Perfluoro-1-octanesulfonamide	PFOSA, (FOSA)	754-91-6
N-ethylperfluoro-1-octanesulfonamide	NEtFOSA (Et-FOSA)	4151-50-2
N-methylperfluoro-1-octanesulfonamide	NMeFOSA (Me-FOSA)	31506-32-8
Perfluorinated sulfonamide ethanols (FOSEs)		
2-(N-ethylperfluoro-1-octanesulfonamido) ethanol	NEtFOSE (Et-FOSE)	1691-99-2
2-(N-methylperfluoro-1-octanesulfonamido) ethanol	NMeFOSE (Me-FOSE)	24448-09-7
Perfluorinated sulfonamidoacetic acids (FOSAAs)		
N-ethylperfluoro-1-octanesulfonamidoacetic acid	NEtFOSAA (EtFOSAA)	2991-50-6
N-methylperfluoro-1-octanesulfonamidoacetic acid	NMeFOSAA (MeFOSAA)	2355-31-9
Fluorotelomer sulfonic acids (FTS)		
1H,1H,2H,2H-perfluorohexane sulfonic acid *(4:2)*	4:2 FTS	757124-72-4

Table 1.1 PFAS Supported		
Compound Name	**Abbreviations**	**CAS #**
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
Fluorotelomer carboxylic acids (FTCAs)		
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
Per-and Polyfluoroether carboxylic acids		
Perfluoro(2-propoxypropanoic) acid or Hexafluoropropylene oxide dimer acid	HFPO-DA, GenX	13252-13-6
4,8-dioxa-3H-perfluorononanoic acid	ADONA(1) (DONA)	919005-14-4
Perfluoro-3-methoxypropanoic acid (PFMPA)	PFMPA, (PFECA F)	377-73-1
Perfluoro-4-methoxybutanoic acid (PFMBA)	PFMBA,(PFECA A)	863090-89-5
Nonafluoro-3,6-dioxaheptanoic acid (NFDHA)	NFDHA (PFECA B)	151772-58-6
Ether sulfonic acids		
9-Chlorohexadecafluoro-3-oxanonane-1-sulfonic acid	9Cl-PF3ONS	756426-58-1
11-Chloroeicosafluoro-3-oxaundecane-1-sulfonic acid	11Cl-PF3OUdS	763051-92-9
Perfluoro(2-ethoxyethane) sulfonic acid	PFEESA (PES)	113507-82-7

***Note**: Abbreviations in parenthesis are the abbreviations used by the laboratory's LIMS where they differ from the abbreviation listed in Method 1633.*

(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 1633, 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)		
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
Difluoro(perfluoromethoxy)acetic acid	PFMOAA	674-13-5
Perfluoro-4-isopropoxybutanoic acid	PFPE-1, (PFECA G)	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	PS Acid	29311-67-9
Perfluoro-2-{[perfluoro-3-(perfluoroethoxy)-2-propanyl]oxy}ethanesulfonic acid	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]-	R-PDSCA	2416366-21-5
2,2,3,3,4,5,5,5-octafluoro-4-(1,1,2,2-tetrafluoro-2-sulfoethoxy) pentanoic acid	R-PSDA	2416366-18-0
Perfluoro-1-butanesulfonamide	FBSA	30334-69-1
Perfluoro-1-hexanesulfonamide	FHxSA	41997-13-1
Bis(trifluoromethane)sulfonamide	TFSI	82113-65-3

Table 1.2 Additional Compounds		
Compound Name	**Abbreviation**	**CAS #**
6:2 Fluorotelomer phosphate diester	6:2 diPAP	57677-95-9
6:2\8:2 Fluorotelomer phosphate diester	6:2\8:2 diPAP	943913-15-3
8:2 Fluorotelomer phosphate diester	8:2 diPAP	678-41-1
2-fluoro-2-[1,1,2,3,3,3-hexafluoro-2-(1,1,2,2-tetrafluoro-2-sulfoethoxy)propoxy] acetic acid	HPSDA, H-PSDA, Hydrolyzed PSDA	2416366-19-1
1H,1H,2H,2H-perfluorododecane sulfonic acid (10:2)	10:2 FTS	120226-60-0

(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. Note that all compounds are reported in their acid form. Reporting limits and Method Detection Limits for individual compounds are stored in the laboratory's LIMS.

Table 1.3 Reporting Limits and Working Range			
Matrix	**Nominal Sample Size**	**Reporting Limit**	**Working Range**
Water	125/mL	1.6 ng/L – 40 ng/L	1.6 ng/L - 400 ng/L
Leachate	100 mL	8 ng/L – 200 ng/L	8 ng/L – 1200 ng/L
Solid	5 g	0.2 ng/g – 5.0 ng/g	0.2 ng/g - 20 ng/g
Biosolids	0.5 g	2 ng/g – 50 ng/g	2 ng/g – 200 ng/g
Tissue	2 g	0.5 ng/g – 12.5 ng/g	0.4 ng/g – 200 ng/g

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 ammonium hydroxide (NH_4OH)/methanol solution.

2.2. Solid/biosolids samples are extracted with a NH_4OH /methanol solution using agitation for 1 hour. The mixture is centrifuged and the solvent filtered.

2.3. Tissue samples are extracted with a potassium hydroxide (KOH)/methanol and acetonitrile solutions using agitation for 16 hours and sonication for 30 minutes. The mixture is centrifuged and the solvent filtered.

2.4. The final extracts are analyzed by LC/MS/MS. PFAS are separated from other components on a C18 column with a solvent gradient program using 2- mM ammonium acetate/water/acetonitrile and acetonitrile. The mass spectrometer detector is operated in the electrospray (ESI) negative ion mode for the analysis of PFAS.

2.5. 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 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.

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

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. TDCA: Taurodeoxycholic acid

3.13. TCDA: Taurochenodeoxycholic acid

3.14. TUDCA: Tauroursodeoxycholic acid

3.15. IDA: Isotope dilution analyte (equivalent to EIS in reference method)

3.16. IS: Internal Standard (equivalent to NIS in reference method)

3.17. LCS: Laboratory control sample (equivalent to OPR in reference method)

3.18. 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 (i.e. no contribution greater than ½ the quantitation (reporting) limit. 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. 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 Environmental Health and Safety Manual (NDSC-US-EHS-QP46060), the Sacramento Addendum to the EH&S Manual (WS-PEHS-002) 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. The use of a filtering syringe with the SPE cartridge, if and when needed, presents an extreme risk of ergonomic injury due to the force needed to push the sample through the cartridge, and the set-up and body geometry of the individual using the syringe/SPE cartridge. Use step boxes to position yourself above the syringe and manifold so that your body weight can be carefully applied to pushing the syringe plunger down, rather than just using your arm and shoulder muscles. Ensure that this task is rotated amongst staff members so that no one has to do it repeatedly for weeks or months. Ensure that routine breaks are taken, and that muscles and joints involved with this task are routinely stretched to offset this hazard.

5.1.3. 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.

5.1.4. Laboratory procedures such as manual use of Vortex mixers or similar equipment, hand shaking samples beyond several inversions, 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. This specifically includes identification and use of mechanical options that reduce the amount of manual handling required to perform extraction procedures such as Vortex mixing and shaking.

5.1.5. Eye protection that satisfies ANSI Z87.1 (as per the NDSC 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.

5.1.6. Perfluorocarboxylic acids are acids and are not compatible with strong bases.

5.1.7. 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.

5.2. 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
Acetonitrile (2-3-0)	Flammable Poison	20 ppm-TWA	Early symptoms may include nose and throat irritation, flushing of the face, and chest tightness. Prolonged exposure to high levels of vapors may cause formation of cyanide anions in the body.

Material[1]	Hazards	Exposure Limit[2]	Signs and Symptoms of Exposure
Ammonium Hydroxide (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.
Formic Acid (3-2-1)	Flammable Corrosive Toxic Irritant	5 ppm TWA 10 ppm STEL	Extremely destructive on contact with skin, mucous membranes, eyes, upper respiratory tract. Inhalation may result in spasms, inflammation and edema. Symptoms include burning sensation, coughing, wheezing, shortness of breath, headache, nausea, vomiting, and depression.
Methanol (2-3-0)	Flammable Poison Irritant	200 ppm PEL 250 ppm STEL	Harmful if swallowed, or absorbed through the skin. Causes eye, skin and respiratory tract irritation, and may cause central nervous system depression. 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)	Symptoms of inhalation may include coughing, sneezing, damage to the nasal or respiratory tract. High concentrations can cause lung damage. Contact with skin can cause irritation or severe burns and scarring with greater exposures. Causes irritation of eyes with tearing, redness, and swelling.
(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. Processes for cleaning extraction manifolds and associated components are described in WS-OP-0011, “Glassware Cleaning”.

6.1. 15 mL polypropylene test tubes with polypropylene screw caps.

6.2. 50 mL graduated plastic centrifuge tubes.

6.3. 125 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 11.3.6 Step 4.

6.4. 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.

6.5. Extract concentrator or nitrogen manifold with water bath heating to 65°C.

6.6. Syringe filter, PALL/Acrodisc 0.2 um Nylon membrane, 25 mm, or equivalent. Do not use PTFE type filters.

6.7. 300 µL autosampler vials, polypropylene, with polypropylene screw caps, Waters PN 1860004112, or equivalent.

6.8. SPE columns - Phenomenex PFAS WAX/GCB, 250mg/50mg/6cc or equivalent. This cartridge incorporates a graphitized carbon.

6.9. Silanized glass wool, Sigma-Aldrich PN 20411. Rinse with methanol 2 times and store in clean glass jar prior to use. Pack to half the high of WAX SPE cartridge barrel.

6.10. Vacuum manifold for Solid Phase Extraction (SPE).

6.11. 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.

6.12. pH indicator paper, JT Baker Baker-pHIX pH 2.0-9.0, or equivalent.

6.13. Centrifuge (Thermo Scientific Sorvall Legend X1, or equivalent), capable of reaching at least 4500 rpm.

6.14. Vortex Mixer (Scientific Industries model SI-0236 or equivalent)

6.15. Shaker table (Eberbach model 6010, or equivalent) for soil extractions

6.16. Desiccator, part # B002VBW9XW or equivalent

6.17. Liquid Chromatography/Tandem Mass Spectrometer (LC/MS/MS) –The instrument described below, or equivalent, is 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.

6.17.1. SCIEX LC/MS/MS

This system consists of a Shimadzu HPLC interfaced with a SCIEX 5500 Triple Quad MS, or equivalent. The instrument control and data acquisition software is SCIEX Analyst, version 1.6.3 or equivalent.

6.17.1.1. Shimadzu CTO-20AC HPLC equipped with 3 LC-20AD pumps and one DGU-20 degassing unit or equivalent.

6.17.1.2. Phenomenex Gemini C_{18} 3 µm, 3.0 mm x 100 mm, Part No. 00D-4439-Y0, or equivalent.

6.17.1.3. PFAS Isolator column, Phenomenex Luna C_{18} 5 µm, 50 mm x 4.6 mm, part no. 00B-4252-E0 or equivalent. This is plumbed between the UPLC pumps and autosampler valve to minimize PFAS background from the UPLC solvent lines and filters.

6.18. Preventive and routine maintenance is described in the table below

Table 6.18
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.

Table 6.18 HPLC/MS/MS Preventative Maintenance	
Semi-Annually	**Annually**
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. Acetonitrile, HPLC Grade

7.1.2. Ammonium acetate (solid salt) ACS grade.

7.1.3. Ammonium acetate (20 mM in water): Prepared by weighing 1.54 g of ammonium acetate and dissolving in 1 L of water. This solution has volatile components, thus it should be replaced every 7 days or sooner.

7.1.4. Ammonium hydroxide (NH_4OH), 30% in water, ACS reagent grade

7.1.5. Ammonium hydroxide (NH_4OH), 3% in water: Prepared by diluting 10 mL of ammonium hydroxide (30%) with 90 mL of reagent water for a total volume of 100 mL. Replace after 3 months.

7.1.6. Ammonium hydroxide (NH_4OH), 0.3% in methanol (v/v): Prepared by diluting 10 mL of ammonium hydroxide (30%) into 990 mL of methanol for a total of 1 L.

7.1.7. Ammonium hydroxide (NH_4OH), 1% in methanol (v/v): Prepared by diluting 33 mL of ammonium hydroxide into 967 mL of methanol for a total of 1 L.

7.1.8. Formic Acid, greater than 96% purity or equivalent, ACS reagent grade

7.1.9. Formic Acid, 0.1 M, in water: Prepared by dissolving 4.6 g of formic acid into 1 L of reagent water. Replace after 2 years.

7.1.10. Formic Acid, 0.3 M, in water: Prepared by dissolving 13.8 g of formic acid into 1 L of reagent water. Replace after 2 years.

7.1.11. Formic Acid, 5% in water(v/v): Prepared by diluting 5 mL of formic acid with 95 mL of reagent water for a total volume of 100 mL. Replace after 2 years.

7.1.12. Formic Acid, 50% in water(v/v): Prepared by diluting 50 mL of formic acid with 50 mL of reagent water for a total volume of 100 mL. Replace after 2 years.

7.1.13. 1:1 0.1 M formic acid:methanol (v/v); Prepared by mixing equal volumes of methanol and 0.1 M formic acid. Replace after 2 years.

7.1.14. Graphitized carbon (Envi-CarbTM or equivalent, for tissues)

7.1.15. Methanol (MeOH) ACS grade

7.1.16. Potassium Hydroxide (KOH) (solid, reagent grade).

7.1.17. Potassium hydroxide, 0.4% in methanol (w/v): Prepared by weighing 16 g of potassium hydroxide and dissolving in 4 L of methanol.

7.1.18. Ottawa Sand (blank matrix for solid samples)

7.1.19. Store bought chicken breast or tilapia (blank matrix for tissue samples)

7.1.20. Water, Nanopure or Millipore, must be free of interference and target analytes.

7.1.21. Nitrogen, Ultra High Purity, used for the ESI interface, collision cell, and concentration of extracts.

7.1.22. Air, Ultra-Pure, used for vacuum and source gas.

7.1.23. 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.

7.2.2. As of this writing, only PFOS, PFOA, PFHxS, NEtFOSAA and NMeFOSAA 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. 1633 /LCS (LCS/Matrix PFC Spike Solution), 4 ng/mL (nominal) in 250 ml of a mixed stock solution in methanol at a nominal concentration listed below. 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
1633 IM/LCS Solution Recipe
The solutions below are combined and diluted to 250 mL in methanol

Analyte	Stock Conc. (µg/mL)	Aliquot (mL)	1633 IM/LCS Conc. (µg/L)	Analyte	Stock Conc. (µg/mL)	Aliquot (mL)	1633 IM/LCS Conc. (µg/L)
PFBA	50	0.02	4	6:2 FTS	47.4	0.02	3.8
PFPeA	50	0.02	4	8:2 FTS	47.9	0.02	3.8
PFHxA	50	0.02	4	FOSA	50	0.02	4
PFHpA	50	0.02	4	Me-FOSA	50	0.02	4
PFOA	50	0.02	4	Et-FOSA	50	0.02	4
PFNA	50	0.02	4	Me-FOSAA	50	0.02	4
PFDA	50	0.02	4	Et-FOSAA	50	0.02	4

Table 7.3
1633 IM/LCS Solution Recipe
The solutions below are combined and diluted to 250 mL in methanol

Analyte	Stock Conc. (µg/mL)	Aliquot (mL)	1633 IM/LCS Conc. (µg/L)	Analyte	Stock Conc. (µg/mL)	Aliquot (mL)	1633 IM/LCS Conc. (µg/L)
PFUdA	50	0.02	4	Me-FOSE	50	0.02	4
PFDoA	50	0.02	4	Et-FOSE	50	0.02	4
PFTrDA	50	0.02	4	HFPO-DA	50	0.02	4
PFTeDA	50	0.02	4	4,8-dioxa-3H-PFNA (DONA)	47.1	0.02	3.8
PFBS	44.2	0.02	3.5	PFMPA (PFECA F)	50	0.02	4
PFPeS	46.9	0.02	3.8	PFMPA (PFECA A)	50	0.02	4
PFHxS	45.5	0.02	3.6	NFDHA (PFECA B)	50	0.02	4
PFHpS	47.6	0.02	3.8	9Cl-PF3ONS	46.6	0.02	3.7
PFOS	46.6	0.02	3.7	11Cl-PF3OUdS	47.1	0.02	3.8
PFNS	48	0.02	3.8	PFEESA (PES)	44.5	0.02	3.6
PFDS	48.2	0.02	3.9	3:3 FTCA	50	0.02	4
PFDoS	48.4	0.02	3.9	5:3 FTCA	50	0.02	4
4:2 FTS	46.7	0.02	3.7	7:3 FTCA	50	0.02	4
PFPrA	48.5	0.02	3.9	Hydro-EVE Acid	50	0.02	4
MTP	50	0.02	4	Hydrolyzed PSDA	50	0.02	4
PFMOAA	50	0.02	4	R-PSDA	50	0.02	4
PMPA	50	0.02	4	PS Acid	50	0.02	4
PFO2HxA	50	0.02	4	TAF	50	0.02	4
PFPrS	46	0.02	3.7	8:2 FTUCA	50	0.02	4
PEPA	50	0.02	4	PFECHS	46.2	0.02	3.7
NVHOS	50	0.02	4	Hydro-PS-Acid	50	0.02	4
FBSA	50	0.02	4	8:2 FTCA	50	0.02	4
PFO3OA	50	0.02	4	10:2 FTUCA	50	0.02	4
6:2 FTCA	50	0.02	4	10:2 FTCA	50	0.02	4
PFECA_G (PFPE-1)	50	0.02	4	10:2 FTS	48.3	0.02	3.9
R-PSDCA	50	0.02	4	6:2-DiPAP	48.6	0.02	3.9
FHxSA	50	0.02	4	8:2-DiPAP	48.9	0.02	3.9
R-EVE	50	0.02	4	6:2/8:2-DiPAP	48.8	0.02	3.9
EVE-Acid	50	0.02	4	PFODA	50	0.02	4
6:2 FTUCA	50	0.02	4	PFHxDA	50	0.02	4
PFO4DA	50	0.02	4	TFSI	50	0.02	4

7.4. 1633 Isotope Dilution Analyte Solution (Extracted Internal Standards), 25-50 ng/mL

The 1633-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 0.025-0.050 ug/mL (25-50 ng/mL) is prepared from the individual solutions described in Section 7.2.5. using the recipe below:

Table 7.4
1633-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/L)	IDA	Stock Conc. (µg/mL)	Aliquot (mL)	IDA Mix Conc. (µg/L)
13C4-PFBA	50	0.100	25	13C8-PFOS	47.8	0.100	23.9
13C5-PFPeA	50	0.100	25	13C2-4:2FTS	46.7	0.100	23.4
13C5-PFHxA	50	0.100	25	13C2-6:2FTS	47.5	0.100	23.8
13C4-PFHpA	50	0.100	25	13C2-8:2FTS	47.9	0.100	24
13C8-PFOA	50	0.100	25	13C8-FOSA	50	0.100	25
13C9-PFNA	50	0.100	25	d3-MeFOSA	50	0.100	25
13C6-PFDA	50	0.100	25	d5-EtFOSA	50	0.100	25
13C7-PFUdA	50	0.200	50	d3-MeFOSAA	50	0.100	25
13C2-PFDoA	50	0.200	50	d5-EtFOSAA	50	0.100	25
13C2-PFTeDA	50	0.200	50	d7-Me-FOSE	50	0.100	25
13C3-PFBS	46.5	0.100	23.3	d9-Et-FOSE	50	0.100	25
13C3-PFHxS	50	0.100	25	13C3-HFPO-DA	50	0.200	50
13C-6:2 FTUCA	50	0.100	25	13C-10:2 FTCA	50	0.200	50
13C-6:2 FTCA	50	0.100	50	M2-10:2 FTS	50	0.100	25
13C-8:2 FTUCA	50	0.100	25	M4-6:2-DiPAP	50	0.100	25
13C_8:2 FTCA	50	0.200	50	13C2_PFHxDA	50	0.200	50
13C-10:2 FTUCA	50	0.100	25	M4-8:2-DiPAP	50	0.100	28

7.5. 1633 Internal Standard Solution, 62.5 ng/mL

The 1633 IS solution is added to all extracts prior to analysis and used as an intermediate solution for preparation of the instrument calibration standards. 400 mL of the solution at a nominal concentration of 62.5 ng/mL is prepared from the individual solutions described in Section 7.2.5 using the recipe below.

Table 7.5
1633-IS Recipe
The solutions below are combined and diluted to 400mL with Methanol.

IDA	Stock Conc. (µg/mL)	Aliquot (mL)	IDA Mix Conc. (ug/L)	IDA	Stock Conc. (µg/mL)	Aliquot (mL)	IDA Mix Conc. (ug/L)
13C3-PFBA	50	0.500	62.5	13C2-PFDA	50	0.500	62.5
13C2-PFHxA	50	0.500	62.5	18O2-PFHxS	47.3	0.500	59.125
13C4-PFOA	50	0.500	62.5	13C4-PFOS	47.8	0.500	59.875

Table 7.5
1633-IS Recipe
The solutions below are combined and diluted to 400mL with Methanol.

IDA	Stock Conc. (µg/mL)	Aliquot (mL)	IDA Mix Conc. (ug/L)	IDA	Stock Conc. (µg/mL)	Aliquot (mL)	IDA Mix Conc. (ug/L)
13C5-PFNA	50	0.500	62.5				

7.6. Calibration Standards

Calibration solutions are prepared from the standards described in Sections 7.3, 7.4, and 7.5, above. For each level, a 200 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 90% methanol to 10% water, v/v.

Table 7.6
1633 Calibration Solution Recipe

PFAS Standards	Volume (mL) to add in 2000 mL FV							
	CS-1	CS-2	CS-3	CS-4	CS-5	CS-6	CS-7	CS-8
1633 Native (20µg/m)	0.2	0.4	0.8	2.5	10	25	50	100
1633 IDA Mix (25/50/L)	10	10	10	10	10	10	10	10
1633 IS Mix (62.5 µg/L)	4	4	4	4	4	4	4	4

7.6.1. Initial Calibration (ICAL) Levels (ng/mL)

Table 7.6.1
Initial Calibration Solution Concentrations (ng/mL)

Compound	CS-1	CS-2	CS-3	CS-4	CS-5	CS-6	CS-7	CS-8
PFBA	0.020	0.040	0.080	0.250	1.00	2.50	5.00	10.0
PFPeA	0.020	0.040	0.080	0.250	1.00	2.50	5.00	10.0
PFHxA	0.020	0.040	0.080	0.250	1.00	2.50	5.00	10.0
PFHpA	0.020	0.040	0.080	0.250	1.00	2.50	5.00	10.0
PFOA	0.020	0.040	0.080	0.250	1.00	2.50	5.00	10.0
PFNA	0.020	0.040	0.080	0.250	1.00	2.50	5.00	10.0
PFDA	0.020	0.040	0.080	0.250	1.00	2.50	5.00	10.0
PFUdA	0.020	0.040	0.080	0.250	1.00	2.50	5.00	10.0
PFDoA	0.020	0.040	0.080	0.250	1.00	2.50	5.00	10.0
PFTrDA	0.020	0.040	0.080	0.250	1.00	2.50	5.00	10.0
PFTeDA	0.020	0.040	0.080	0.250	1.00	2.50	5.00	10.0
PFBS	0.018	0.035	0.071	0.221	0.884	2.210	4.420	8.840
PFPeS	0.019	0.038	0.075	0.235	0.938	2.345	4.69	9.38
PFHxS*	0.018	0.036	0.073	0.228	0.91	2.275	4.55	9.10
PFHpS	0.019	0.038	0.076	0.238	0.952	2.38	4.76	9.52
PFOS*	0.019	0.037	0.075	0.233	0.932	2.33	4.66	9.32

Table 7.6.1
Initial Calibration Solution Concentrations (ng/mL)

Compound	CS-1	CS-2	CS-3	CS-4	CS-5	CS-6	CS-7	CS-8
PFNS	0.019	0.038	0.077	0.240	0.96	2.40	4.80	9.60
PFDS	0.019	0.039	0.077	0.241	0.964	2.41	4.82	9.64
PFDoS	0.019	0.0388	0.077	0.242	0.968	2.42	4.84	9.68
4:2 FTS	0.019	0.037	0.075	0.234	0.934	2.34	4.67	9.34
6:2 FTS	0.019	0.038	0.076	0.237	0.948	2.37	4.74	9.48
8:2 FTS	0.019	0.038	0.077	0.240	0.958	2.40	4.79	9.58
FOSA	0.020	0.040	0.080	0.250	1.00	2.50	5.00	10.0
Me-FOSA	0.020	0.040	0.080	0.250	1.00	2.50	5.00	10.0
Et-FOSA	0.020	0.040	0.080	0.250	1.00	2.50	5.00	10.0
MeFOSAA*	0.020	0.040	0.080	0.250	1.00	2.50	5.00	10.0
EtFOSAA*	0.020	0.040	0.080	0.250	1.00	2.50	5.00	10.0
Me-FOSE	0.020	0.040	0.080	0.250	1.00	2.50	5.00	10.0
Et-FOSE	0.020	0.040	0.080	0.250	1.00	2.50	5.00	10.0
HFPO-DA	0.020	0.040	0.080	0.250	1.00	2.50	5.00	10.0
DONA	0.019	0.038	0.075	0.236	0.942	2.36	4.71	9.42
PFMPA (PFECA F)	0.020	0.040	0.080	0.250	1.00	2.50	5.00	10.0
PFMBA (PFECA A)	0.020	0.040	0.080	0.250	1.00	2.50	5.00	10.0
NFDHA (PFECA B)	0.020	0.040	0.080	0.250	1.00	2.50	5.00	10.0
9Cl-PF3ONS	0.019	0.037	0.075	0.233	0.932	2.33	4.66	9.32
11Cl-PF3OUdS	0.019	0.038	0.075	0.236	0.942	2.36	4.71	9.42
PFEESA (PES)	0.018	0.035	0.071	0.223	0.890	2.23	4.45	8.90
3:3 FTCA	0.020	0.040	0.080	0.250	1.00	2.50	5.00	10.0
5:3 FTCA	0.020	0.040	0.080	0.250	1.00	2.50	5.00	10.0
7:3 FTCA	0.020	0.040	0.080	0.250	1.00	2.50	5.00	10.0
PFPrA	0.020	0.040	0.080	0.250	1.00	2.50	5.00	10.0
MTP	0.020	0.040	0.080	0.250	1.00	2.50	5.00	10.0
TFSI	0.020	0.040	0.080	0.250	1.00	2.50	5.00	10.0
PFMOAA	0.020	0.040	0.080	0.250	1.00	2.50	5.00	10.0
PMPA	0.020	0.040	0.080	0.250	1.00	2.50	5.00	10.0
PFO2HxA	0.020	0.040	0.080	0.250	1.00	2.50	5.00	10.0
PFPrS	0.018	0.037	0.074	0.230	0.920	2.30	4.60	9.20
PEPA	0.020	0.040	0.080	0.250	1.00	2.50	5.00	10.0
NVHOS	0.020	0.040	0.080	0.250	1.00	2.50	5.00	10.0
FBSA	0.020	0.040	0.080	0.250	1.00	2.50	5.00	10.0
PFO3OA	0.020	0.040	0.080	0.250	1.00	2.50	5.00	10.0
6:2 FTCA	0.020	0.040	0.080	0.250	1.00	2.50	5.00	10.0
PFECA_G (PFPE-1)	0.020	0.040	0.080	0.250	1.00	2.50	5.00	10.0
R-PSDCA	0.020	0.040	0.080	0.250	1.00	2.50	5.00	10.0
FHxSA	0.020	0.040	0.080	0.250	1.00	2.50	5.00	10.0
R-EVE	0.020	0.040	0.080	0.250	1.00	2.50	5.00	10.0

Table 7.6.1
Initial Calibration Solution Concentrations (ng/mL)

Compound	CS-1	CS-2	CS-3	CS-4	CS-5	CS-6	CS-7	CS-8
EVE-Acid	0.020	0.040	0.080	0.250	1.00	2.50	5.00	10.0
6:2 FTUCA	0.020	0.040	0.080	0.250	1.00	2.50	5.00	10.0
PF04DA	0.020	0.040	0.080	0.250	1.00	2.50	5.00	10.0
Hydro-EVE Acid	0.020	0.040	0.080	0.250	1.00	2.50	5.00	10.0
Hydrolyzed PSDA	0.020	0.040	0.080	0.250	1.00	2.50	5.00	10.0
R-PSDA	0.020	0.040	0.080	0.250	1.00	2.50	5.00	10.0
PS Acid	0.020	0.040	0.080	0.250	1.00	2.50	5.00	10.0
TAF	0.020	0.040	0.080	0.250	1.00	2.50	5.00	10.0
8:2 FTUCA	0.020	0.040	0.080	0.250	1.00	2.50	5.00	10.0
PFECHS	0.018	0.037	0.074	0.231	0.924	2.31	4.62	9.24
Hydro-PS-Acid	0.020	0.040	0.080	0.250	1.00	2.50	5.00	10.0
8:2 FTCA	0.020	0.040	0.080	0.250	1.00	2.50	5.00	10.0
10:2 FTUCA	0.020	0.040	0.080	0.250	1.00	2.50	5.00	10.0
10:2 FTCA	0.020	0.040	0.080	0.250	1.00	2.50	5.00	10.0
10:2 FTS	0.019	0.039	0.077	0.242	0.966	2.41	4.83	9.66
6:2-DiPAP	0.019	0.039	0.078	0.243	0.972	2.43	4.86	9.72
8:2-DiPAP	0.020	0.039	0.078	0.245	0.978	2.45	4.89	9.78
6:2/8:2-DiPAP	0.020	0.039	0.078	0.244	0.976	2.44	4.88	9.76
PFODA	0.020	0.040	0.080	0.250	1.00	2.50	5.00	10.0
PFHxDA	0.020	0.040	0.080	0.250	1.00	2.50	5.00	10.0
Labeled Isotope Dilution Analytes (IDA)								
13C4-PFBA	1.25	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	1.25
13C5-PFHxA	1.25	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	1.25
13C8-PFOA	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25
13C9-PFNA	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25
13C6-PFDA	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25
13C7-PFUdA	1.25	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	1.25
13C2-PFTeDA	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25
13C3-PFBS	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16
13C3-PFHxS	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25
13C8-PFOS	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20
13C2-4:2 FTS	1.17	1.17	1.17	1.17	1.17	1.17	1.17	1.17
13C2-6:2FTS	1.19	1.19	1.19	1.19	1.19	1.19	1.19	1.19
13C2-8:2FTS	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20
13C8-FOSA	1.25	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	1.25
d5-EtFOSA	1.25	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	1.25
d5-EtFOSAA	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25

Table 7.6.1
Initial Calibration Solution Concentrations (ng/mL)

Compound	CS-1	CS-2	CS-3	CS-4	CS-5	CS-6	CS-7	CS-8
d7-Me-FOSE	1.25	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	1.25
13C3-HFPO-DA	1.25	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	1.25
13C-6:2 FTCA	1.25	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	1.25
13C-8:2 FTCA	1.25	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	1.25
13C-10:2 FTCA	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25
M2-10:2FTS	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25
M4-6:2-DiPAP	1.25	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	1.25
M4-8:2-DiPAP	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25
Internal Standard (IS)								
13C3-PFBA	1.25	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	1.25
13C4-PFOA	1.25	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	1.25
13C2-PFDA	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25
18O2-PFHxS	1.18	1.18	1.18	1.18	1.18	1.18	1.18	1.18
13C4-PFOS	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20

** Both branched and linear isomers are used.*

***Note**: Sample extracts are in 90:10% MeOH/H_2O.*

7.6.2. A technical (qualitative) grade standard which contains both linear and branched isomers for PFOA, PFNA, FOSA, Me/Et-FOSE and Me/Et-FOSA is used as a retention time (RT) marker. This is used to integrate the total response for both linear and branched isomers of these analytes in environmental samples while relying on the initial calibration with the linear isomer quantitative standard. This technical (qualitative) grade standard is analyzed with every initial calibration and at the beginning of a daily sequence.

7.6.2.1. Additionally, standards of the bile acids (TDCA, {TUDCA and TCDA, only if eluent is not acetonitrile}) at 1.0 ug/mL are to be analyzed, after the qualitative standard for the initial calibration, on days when tissue samples are analyzed. Be certain to attach those three chromatograms to the document listed in Section 7.6.2.2.

7.6.2.2. Attach this document to the ICV from the associated ICAL by scanning the document and associating it to the file as a **single** document type of High Res MS Tune in TALS and to the CCVL on non-CAL days. Use the following naming convention: "_TSTD_Instrument_Date." Example: _TSTD_A10_15Mar2019.

7.6.2.3. The daily checks are attached to the initial CCV of the sequence.

7.7. Initial Calibration Verification Standard (ICV)

7.7.1. 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 7.7.1
PFC-MXB composition

Analyte	Stock Conc. (µg/mL)	Analyte	Stock Conc. (µg/mL)
PFHxA	2	PFBS	2
PFHpA	2	PFHxS	2
PFOA	2.1	PFOS	2
PFNA	2.1	EtFOSAA	2
PFDA	2	MeFOSAA	2
PFUdA	2.1	HFPO-DA	2
PFDoA	2.1	9Cl-PF3ONS	2
PFTrDA	2	11Cl-PF3OUdS	2
PFTeDA	2	4,8-dioxa-3H- PFNA (DONA)	2

7.7.2. ICV-IM1: 10 mL of a combined stock for the analytes listed below is created, using the recipe below, and methanol as the final solvent:

Table 7.7.2
ICV-IM1 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
PFPeS	46.9	0.1	0.469	Me-FOSA	50	0.1	0.5
PFHpS	47.6	0.1	0.476	Et-FOSE	50	0.1	0.5
PFNS	48	0.1	0.480	Me-FOSE	50	0.1	0.5
PFDS	48.2	0.1	0.482	4:2 FTS	46.7	0.1	0.467
PFDoS	48.4	0.1	0.484	6:2 FTS	47.4	0.1	0.474
8:2 FTS	47.9	0.1	0.479	PFODA	50	0.1	0.5
10:2 FTS	48.2	0.1	0.482	PFHxDA	50	0.1	0.5

7.7.3. ICV-IM2: 250 mL of a combined stock for the analytes listed below is created, using the recipe below, and methanol as the final solvent.

Table 7.7.3
ICV-IM2 Recipe

Analyte	Stock Conc. (µg/mL)	Aliquot (mL)	ICV-IM2 Conc. (µg/mL)	Analyte	Stock Conc. (µg/mL)	Aliquot (mL)	ICV-IM Conc. (µg/mL)
6:2 diPAP	48.6	0.1	0.0195	8:2 diPAP	48.9	0.1	0.0195
6:2/8:2 diPAP	48.7	0.1	0.0195	FBSA	50	0.1	0.02
				FHxSA	50	0.1	0.02

7.7.4. 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 7.7.5
ICV-IM3 Recipe

Analyte	Stock Conc. (µg/mL)	Aliquot (mL)	ICV-IM3 Conc. (µg/mL)	Analyte	Stock Conc. (µg/mL)	Aliquot (mL)	ICV-IM Conc. (µg/mL)
10:2 FTCA	50	0.1	0.5	10:2 FTUCA	50	0.1	0.5
8:2 FTCA	50	0.1	0.5	8:2 FTUCA	50	0.1	0.5
6:2 FTCA	50	0.1	0.5	6:2 FTUCA	50	0.1	0.5
TFSI	48.9	0.1	0.489	PFPrS	45.8	0.1	0.458
PFPrA	48.5	0.1	0.485	PFECHS	46.1	0.1	0.461
3:3 FTCA	50	0.1	0.5	PFEESA (PES)	44.6	0.1	0.446
5:3 FTCA	50	0.1	0.5	PFMPA (PFECA F)	50	0.1	0.5
7:3 FTCA	50	0.1	0.5	PFMBA (PFECA A)	50	0.1	0.5
				NFDHA (PFECA B)	50	0.1	0.5

7.7.5. ICV-IM4: 500 mL of a combined stock for the analytes listed below is created, using the recipe below, and methanol as the final solvent.

Table 7.7.5
ICV-IM4 Recipe

Analyte	Stock Conc. (µg/mL)	Aliquot (mL)	ICV-IM4 Conc. (µg/mL)	Analyte	Stock Conc. (µg/mL)	Aliquot (mL)	ICV-IM4 Conc. (µg/mL)
EVE Acid	50	0.05	0.1	PFO2HxA	50	0.05	0.1
Hydro-EVE Acid	50	0.05	0.1	PFO3OA	50	0.05	0.1
Hydrolyzed PSDA	50	0.05	0.1	PFO4DA	50	0.05	0.1
Hydro-PS Acid	50	0.05	0.1	PMPA	50	0.05	0.1

Table 7.7.5 ICV-IM4 Recipe							
Analyte	**Stock Conc. (µg/mL)**	**Aliquot (mL)**	**ICV-IM4 Conc. (µg/mL)**	**Analyte**	**Stock Conc. (µg/mL)**	**Aliquot (mL)**	**ICV-IM4 Conc. (µg/mL)**
MTP	50	0.05	0.1	PS Acid	50	0.05	0.1
NVHOS	50	0.05	0.1	R-EVE	50	0.05	0.1
PEPA	50	0.05	0.1	R-PSDA	50	0.05	0.1
PFECA G	50	0.05	0.1	R-PSDCA	50	0.05	0.1
PFMOAA	50	0.05	0.1	TAF	50	0.05	0.1

7.7.6. 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 200 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 7.7.6 1633 ICV Recipe	
PFAS Standards	**Volume (mL) to add in 200 mL FV**
Commercial PFAS Mix	0.25
1633 ICV_IM1	1.0
1633 ICV_IM2	25
1633 ICV_IM3	1.0
1633 ICV_IM4	5.0
1633 IDA Mix	10
1633 IS Mix	4.0

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	125 mL HDPE Bottle	125	0-6°C	28 days if 0-6°C or 90 days if stored at ≤ -20°C[2]
Soil/Sediment	4 oz. HDPE wide-mouth container	100 g	0-6°C	90 days

Table 8 Sample Collection, Preservation, and Storage Requirements				
Tissue	4 oz. HDPE wide-mouth container	50 g	≤ -20 °C	90 days

[1] *Extraction holding time is calculated from date of collection. Analytical holding time is determined from date of extraction.*

[2] *By default, aqueous samples for Draft Method 1633 are stored at 0-6 Centigrade and held for up to 28 days prior to extraction. During initial development of Draft Method 1633, potential issues were observed with NMeFOSE, NEtFOSE, NMeFOSAA, and NEtFOSAA, after 7 days of storage at 0-6 C. These issues are more likely to elevate the observed concentrations of other PFAS compounds via the transformation of these precursors if they are present in the sample.*

8.1. Extracts are stored at 0 - 6°C and must be analyzed within 28 days of extraction.

8.2. 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.

8.3. Biphasic samples

8.3.1. Samples denoted as aqueous (groundwaters, surface waters, and wastewaters) with less than 50 mg of solids content are prepared and handled as a liquid sample (Section 11.2). To determine solids content, compare the sample to a reference container with 50 mg solid content. If the sample contains more than 50 mg solids, contact the client for authorization to extract the sample at a smaller aliquot or as a solid. Detailed descriptions of any deviations from the procedure must be documented in the LIMS NCM program.

8.3.2. Samples considered solids (biosolids, sediments, and soils) are prepared and handled as solid samples following appropriate homogenization as per Section 11.5. Correction for moisture content is provided through the LIMS when required by the client.

8.3.3. 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 11.5 for the solid phase). The extracts are analyzed, and results reported for each phase separately.

9. QUALITY CONTROL

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 low level laboratory control sample (LLCS), a laboratory control sample (LCS) and a method blank. Laboratory generated QC samples (Blank, LLCS, LCS,) 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, a matrix spike/matrix spike duplicate (MS/MSD) may be included in the batch. 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 wetted with reagent water. For tissue samples the method blank is an aliquot of stored purchased chicken breast or tilapia. 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, greater than 1/3 the regulatory compliance 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. The position of the method blank in the SPE manifold during SPE extraction is

rotated across batches.

9.4. A laboratory control sample (LCS), defined as OPR (on-going precision and recovery) in Method 1633, 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.

9.4.1. The control limits for the LCS are stored in TALS. Once sufficient data has been gathered, limits based on historical recoveries are generated and implemented.

9.4.2. If insufficient sample is available to process a MS/MSD, then a second LCS (LCSD) should be processed to provide precision data. The LCS pair is then evaluated according to the MS/MSD RPD criteria. Use of a LCS pair is place of a MS/MSD must be documented as a Non Conformance Memo (NCM) in TALS.

9.5. Low level LCS (LLCS), defined as LLOPR (low-level on-going precision and recovery) in Method 1633, must be extracted with every process batch of similar matrix, not to exceed twenty (20) samples. The LLCS is an aliquot of laboratory matrix (e.g. water for aqueous samples and Ottawa sand for solids) spiked with analytes of known identity and at a concentration of twice the RL. The LLCS 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 LLCS is deemed unacceptable. See WS-PQA-0003 for specific acceptance criteria.

9.5.1. The control limits for the LLCS are stored in TALS. Once sufficient data has been gathered, limits based on historical recoveries are generated and implemented.

9.6. Matrix spikes are not required for this method because any deleterious effect of the matrix is evident in the recoveries of the IDA. A matrix spike/matrix spike duplicate (MS/MSD or MS/SD) can be processed per client request. 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. Recovery limits for MS/MSD are the same as those used for the LCS.

9.7. Instrument blanks (RB or CCB) are required at the beginning of an analytical sequence, after high level samples (>UCL) and every CCV. The blank should contain IDA and IS to quantitate results. The blank should not contain any analyte > RL. See WS-PQA-003 for specific acceptance criteria.

9.8. 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.

9.9. Isotope Dilution Analytes (IDA). 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 IDA recoveries being outside of the acceptance limits as long as the signal-to-noise ratio is greater than 10:1.

9.9.1. 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

9.9.2. 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 data with appropriate qualifiers and narrative comments.

9.9.3. 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:

Condition:	Corrective Action:
Field samples are positive for the associated native target analyte and IDA recovery is >10% (>5% for Me/Et-FOSE)	Report the data with appropriate qualifiers and narrative comments
Field samples are ND for associated native target analytes and IDA recovery is >10% (>%5 for Me/Et-	Evaluate the S/N of the associated Native analytes in the most recent RL (CCVL) standard or L1 if an ICAL

FOSE)	is ran that day.	
	S/N X the IDA recovery is >10	Report the data with appropriate qualifiers and narrative comments
	S/N X the IDA recovery is <10	Report an elevated RL if project DQO allows. Qualify and narrate, otherwise RX or RI at an appropriate dilution
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.*		

9.9.4. 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).

9.9.4.1. Re-extraction may be necessary under other circumstances when data quality has been determined to be adversely affected

9.10. Ion Ratio

9.10.1. Compare the quantifier/qualifier SRM transition ratio in the sample to the SRM transition ratio in the standard.

Equation 1

$$Ion\ Ratio = \frac{Area\ Quantitation\ Ion\ (1° Transition)}{Area\ Qualitative\ Ion\ (2° Transition)}$$

9.10.2. The quantifier/qualifier SRM ion ratio should be within ± 50% of the quantifier/qualifier SRM ion ratios calculated from the mid-level ICAL point.

9.10.3. 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.

9.10.4. If the ion ratio is <0.5X the lower control limit or >2X the upper control limit, then do not report the analyte. It should be either ND at the RL or elevate the RL as needed (G flag).

9.10.4.1. As an example: If the target ion ratio is 4.00, the Chrom determined limits are then 2.00-6.00. If the ratio is <1.00 (2.00 x 0.5) or >12 (6.00 x 2) follow the specification above (9.10.4)

9.11. Internal Standards

Internal standards (IS) are spiked into every field sample, QC sample, standard, and instrument blank. They are used for quantitation of the IDA.

9.11.1. The area of the IS in field and QC samples should be within -50% to +100% (50-200%) of the average area of the calibration standards.

9.11.2. 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.

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 NDSC-QA-SOP42091 "Calibration Curves and Selection of Calibration Points".

10.2. Routine instrument operating conditions are listed in the table in Section 11.8.

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.

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 11.8.

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 tune criterion.

10.3.3.1. 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 SOP NDSC-QA-SOP42091, it is not acceptable to remove points from a calibration curve. Refer to Section 10.8.1 for the required minimum number of levels for this method.

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. Initial Calibration

Refer to Section 12.4.3 for details relating to setting retention times and evaluating retention times.

10.8.1. 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.

- A minimum of six analytical standards is used when using average response factor and/or linear calibration fits, five of which must be ≥ RL.
- A minimum of seven analytical standards is used when a quadratic fit is used to generate the curve, six of which must be ≥ RL.

10.8.2. 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. Detailed descriptions and formulas for each fitting type can be found in SOP NDSC-QA-SOP42091, "Calibration Curves and Selection of Calibration Points".

10.8.2.1. For average response factor (RFa), the relative standard deviation (RSD) for all compounds must be ≤ 20% for the curve to be valid.

10.8.2.2. For linear and quadratic fits, the intercept of the line must be less than ½ the reporting limit, and the relative standard error (RSE) must be ≤ 20%.

10.8.3. The Chrom data system is programmed to complement the calibration evaluation guidelines in SOP NDSC-QA-SOP42091 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 SOP NDSC-QA-SOP42091.

- Average Response Factor
- Linear, 1/concentration^2 weighting
- Linear, 1/concentration weighting, forced through zero
- Quadratic, 1/concentration^2 weighting

10.8.4. 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

10.8.5. 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.

10.8.6. Evaluation of Calibration Curves

The following requirements must be met for any calibration to be used:

- The signal to noise ratio for each component must be greater than or equal to 3:1 in the lowest calibration standard for that component.
- 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.

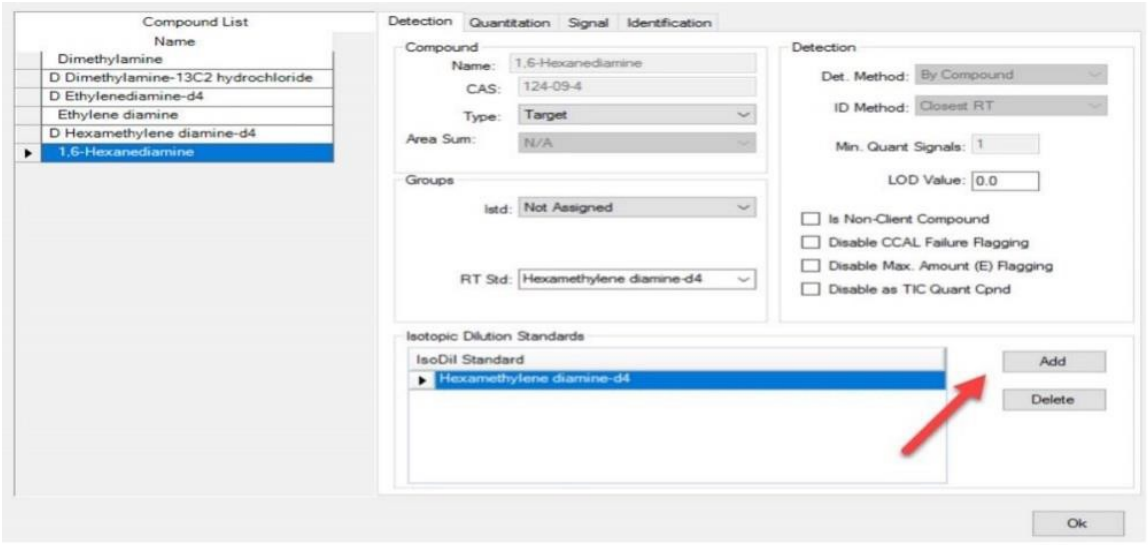
If these criteria are not met, instrument conditions and standards will be checked, and the ICAL successfully repeated before continuing.

10.8.7. 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.

Note: for this method PFTrDA is quantitated against the average areas of the IDA 13C2-PFTeDA and 13C2-PFDoA. In order to set this quantitation up correctly in Chrom be certain to update the analyte PFTrDA per the example below (Figure 0).

Figure 0



10.8.8. Bile Salts Interference Check

The laboratory must analyze a bile salts standard (TDCA, {TCDA and TUDCA only if the eluent is not acetonitrile}) after the initial calibration, prior to the analysis of tissue samples, to check for interferences caused by bile salts. If an interference is present, the chromatographic conditions must be modified to eliminate the interference of TDCA (e.g. changing the retention time of TDCA such that it falls outside the retention time window for PFOS with baseline resolution), and the initial calibration is repeated. If tissue samples are not being analyzed this check can be skipped.

10.9. Initial Calibration Blank (ICB)

10.9.1. Immediately following the ICAL, a calibration blank is analyzed that consists of an injection of final extract solvent containing both IDA and IS.

10.9.2. The result for the calibration blank must be less than the reporting limit.

10.9.3. 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.

10.10. Initial Calibration Verification (ICV)

10.10.1. 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.

10.10.2. The recovery for the ICV must be equal to or within 70-130% for all natives and IDA.

10.10.3. See Section 9.8 for corrective actions in the event that the ICV does not meet the criteria above.

10.11. 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 at the mid-level range of the curve. The curve and ICV do not need to be run every day. To start an analytical sequence on days when an ICAL is not performed, a CCVL (low standard at the RL) is analyzed and if it meet acceptance criteria a run can be started.

10.11.1. The recovery for the CCV & CCVL standards must be equal to or within 70-130% for all natives and IDA.

10.11.2. If this is not achieved, the instrument has drifted outside the calibration limits. The instrument must be recalibrated.

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. Samples >50 mg solids should be processed as a solid sample.. Compare sample to comparison/reference bottle. If the sample should be processed as a solid or biphasic or reduced volume contact the client for guidance prior to such action. Invert samples to homogenize prior to adding any spiking solutions.

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.

11.2.2. 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.

11.2.2.1. If the sample is identified as a leachate please prep at 100 mL. The sample should be collected in an appropriately sized container, i.e. 100-125 mL. If not, document such and that a 100 mL aliquot was used for the analysis.

11.2.3. Prepare additional aliquots of a field sample for the MS/MSD, if requested.

11.2.4. Prepare sufficient 125-mL aliquots of HPLC-Grade water for MB, LLCS, (and LCSD if the batch does not have a sample duplicate or MS/MSD.

11.2.5. Vortex the LCS/Matrix PFC Spike and IDA PFC solutions prior to use.

11.2.6. Add 0.25 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.

11.2.7. Spike the LCS and MS/MSD (if requested) with 1.0 mL of the LCS/Matrix PFC Spike solution (Section 7.3), for a fixed concentration of 0.8 ng/mL in the final sample vial.

11.2.8. Spike the LLCS with the 100 uL of the LCS/Matrix PFS Spike solution (Section 7.3), for a fixed concentration of 0.080 ng/mL in the final sample vial.

11.2.9. Swirl or vortex all samples after adding spike solutions.

11.2.10. Check that the pH is 6.5 ± 0.5 using narrow range pH paper (Section 6.12). If necessary, adjust pH with 50% formic acid and 3% ammonium hydroxide.

11.3. Solid Phase Extraction (SPE) of Aqueous Samples

The automated PromoChrom can be used as long as the program follows these conditions and passes the background check.

11.3.1. Condition the SPE cartridges (Section 6.8, Phenomenex Strata PFAS WAX/GCB, 250mg/50mg/6cc 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 15.0 mL of 0.3% NH_4OH/methanol.

11.3.3. Wash with 5.0 mL of 0.1% 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. Pour the samples into the reservoirs attached to the SPE columns and with vacuum, pull the entire sample volume (125 mL) through the cartridge at a rate of approximately 2 to 5 drops per second.

11.3.6. 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.

11.3.7. After the entire sample has been loaded onto the column, rinse the sample bottle with two 5 mL aliquots of reagent water and pour into the column reservoir.

11.3.8. After the final loading of the sample but before completely passed through the column, rinse the SPE column with 5 mL 30:70 methanol:water twice.

11.3.9. After the sample and water rinse have completely passed through the cartridge, allow the column to dry with vacuum for 15 seconds.

11.3.10. Discard the rinses.

11.4. SPE Elution & Final Volume of Aqueous Samples – using 15 mL polypropylene test tubes as receiving tubes in the SPE manifold.

11.4.1. Add the collection tubes to the manifold. Rinse sample bottles with 5 mL of 0.3% NH_4OH/methanol and transfer to the column reservoir onto the cartridge. Elute the analytes from the cartridge by pulling the 0.3% NH_4OH /methanol through using low vacuum such that the solvent exits the cartridge in a dropwise fashion.

11.4.2. Air dry and weigh the bottles (record as the tare weight in TALS) to get the sample volume extracted.

11.4.3. Vortex the IS solution prior to use.

11.4.4. Add 100 uL of IS (Section 7.5) at 62.5 ng/mL concentration into centrifuge tube.

11.4.5. Add 500 uL of DI reagent water.

11.4.6. Adjust the volume to 5 mL with the eluting solvent. Cap and vortex.

11.4.7. Transfer a portion of the extract to a 0.3 mL polypropylene micro vial and submit for analysis. Archive the rest of the extract in a refrigerator for re-injection and dilution.

11.5. Solid and Biosolids Sample Preparation and Extraction

11.5.1. 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.

11.5.2. Weigh a representative dry weight adjusted 5 g aliquot of sample (0.5g for biosolids) into a 50 mL centrifuge tube. Weigh additional sample amounts for the matrix spike and matrix spike duplicate analyses if they are requested.

11.5.2.1. Do not batch solid sample and biosolids samples together due to the different masses.

11.5.3. For the method blank, LLCS and LCS matrix, use 5 g each of Ottawa sand wetted with 2.5g of DI water or 0.5 g of Ottawa sand wetted with 0.25g of DI water for biosolids.

11.5.4. Vortex the LCS/Matrix Spike and 1633 IDA solutions prior to use.

11.5.5. Add 0.25 mL of the 1633 IDA 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.

11.5.6. Spike the LCS and MS/MSD (if requested) with 3.0 mL of the LCS/Matrix Spike solution (Section 7.3), for a fixed concentration of –2.4 ng/mL in the final sample vial.

11.5.7. Spike the LLCS with 300 uL of the LCS/Matrix Spike solution (Section 7.3), for a fixed concentration of 0.24 ng/mL in the final sample vial.

11.5.8. Cap the tubes, vortex samples and allow the spike to settle into the sample matrix for at least 30 minutes.

11.5.9. Add 10 mL of 0.4% KOH/methanol to each sample. Cap and vortex.

11.5.10. Shake each sample on an orbital shaker at room temperature for 30 minutes.

11.5.11. Centrifuge each sample at 3500 rpm for 5 minutes.

11.5.12. Collect and decant the solvent into a new container.

11.5.13. Add 4 mL of 0.4% KOH/methanol solution to the residue and vortex.

11.5.14. Centrifuge each sample at 3500 rpm for 5 minutes.

11.5.15. Collect/decant the solvent into the same centrifuge tube from Section 11.5.12.

11.5.16. Bring the volume up to 125 mL with reagent water for each sample. Check that the pH is 6.5 ± 0.5 using narrow range pH paper (Section 6.12). If necessary, adjust pH with 50% formic acid and 3% ammonium hydroxide.

11.5.17. Proceed to Section 11.6.

11.6. Solid Phase Extraction (SPE) of Solid, Biosolids and Tissue Samples

The automated PromoChrom system can be used as long as the program follows these conditions and passes the background check.

11.6.1. Condition the SPE cartridges (Section 6.8, Phenomenex Strata PFAS WAX/GCB, 200mg/50mg/6mL 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.

11.6.2. Wash with 15.0 mL of 0.3% NH_4OH/methanol.

11.6.3. Wash with 5.0 mL of 0.1 N 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.

11.6.4. 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.

11.6.5. Add samples to the columns and with vacuum, pull the entire 50 mL aliquot of the sample through the cartridge at a rate of approximately 2 to 5 drops per second.

11.6.6. After the entire sample has been loaded onto the column, rinse the centrifuge tube with two 5 mL aliquots of reagent water and pour into the column reservoir.

11.6.7. After the final loading of the sample but before completely passed through the column, rinse the SPE column with 5 mL of 30:70 MeOH/water twice.

11.6.8. After the sample and water rinse have completely passed through the cartridge, allow the column to dry with vacuum for 15 seconds. Discard the rinses.

11.6.9. Place 15 mL centrifuge tubes in the manifold.

11.6.10. Rinse extract centrifuge tubes with 5 mL of 0.3% NH_4OH/methanol and transfer to the column reservoir onto the cartridge. Elute the analytes from the cartridge by pulling the 0.3% NH_4OH/methanol through using low vacuum such that the solvent exits the cartridge in a dropwise fashion.

11.6.11. Vortex the 1633 IS solution prior to use.

11.6.12. Add 100 uL of 1633 IS (Section 7.5) at 62.5 ng/mL concentration.

11.6.13. Add 0.5 mL of DI reagent water.

11.6.14. Adjust the final volume to 5mL with the eluting solvent. Cap and vortex.

11.6.15. Transfer a portion of the extract to a 0.3 mL polypropylene micro vial and submit for analysis. Archive the rest of the extract in a refrigerator for re-injection and dilution.

11.7. Tissue Sample Preparation and Extraction

Prior to subsampling tissue matrices, ensure that they have been appropriately homogenized in accordance with SOP WS-WI-0018, Tissue Handling and Extraction.

11.7.1. Weigh a representative 2 g aliquot of sample into a 50 mL centrifuge tube. Weigh additional sample amounts for the matrix spike and matrix spike duplicate analyses if they are requested.

11.7.2. For the method blank, LLCS and LCS matrix, use 2 g each of tissue reference material (chicken breast or fish).

11.7.3. Vortex the LCS/Matrix Spike and 1633 IDA solutions prior to use.

11.7.4. Add 0.250 mL of the 1633 IDA 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.

11.7.5. Spike the LCS and MS/MSD (if requested) with 3.0 mL of the LCS/Matrix Spike solution (Section 7.3), for a fixed concentration of 2.4 ng/mL in the final sample vial.

11.7.6. Spike the LLCS with 300 uL of the LCS/Matrix Spike solution (Section 7.3) for a fixed concentration of 0.240 ng/mL in the final sample vial.

11.7.7. Cap the tubes, vortex samples and allow the spike to settle into the sample matrix for at least 30 minutes.

11.7.8. Add 10 mL of 0.05M KOH/methanol to each sample. Cap and vortex.

11.7.9. Shake each sample on an orbital shaker at room temperature for at least 16 hours.

11.7.10. Centrifuge each sample at 2800 rpm for 10 minutes.

11.7.11. Collect and decant the solvent into a new container.

11.7.12. Add 10 mL of acetonitrile (ACN) to the residue. Cap and vortex.

11.7.13. Sonicate each sample for 30 minutes.

11.7.14. Centrifuge each sample at 2800 rpm for 10 minutes.

11.7.15. Collect/decant the solvent into the new centrifuge tube from Section 11.7.11.

11.7.16. Add 5 mL of 0.05M KOH/methanol to the residue. Cap and vortex.

11.7.17. Centrifuge each sample at 2800 rpm for 10 minutes.

11.7.18. Collect/decant the solvent into the new centrifuge tube from Section 11.7.11.

11.7.19. Add 10 mg of carbon (7.1.14) to each sample and batch QC extract.

11.7.20. Hand-shake occasionally for no more than 5 minutes. It is important to minimize the time the sample extract is in contact with the carbon.

11.7.21. Immediately vortex for 30 seconds and centrifuge at 2800 rpm for 10 minutes.

11.7.22. Immediately decant into a new centrifuge tube.

11.7.23. Bring the volume up to 250 mL with reagent water for each sample. Check that the pH is 6.5 ± 0.5 using narrow range pH paper (Section 6.12). If necessary, adjust pH with 50% formic acid and 3% ammonium hydroxide.

11.7.24. Proceed to Section 11.6 SPE for Solid, Biosolids, and Tissue Samples.

11.8. Instrument Conditions and Elution Orders

Suggested operating conditions & analyte reference data are listed in Tables 11.8-1 through 11.8-5 for the SCIEX LCMS systems:

Table 11.8 - 1
Recommended Instrument Operating Conditions

HPLC Conditions (Shimadzu HPLC)				
Column (Column temp = 45°C)	Phenomenex Gemini 3 µm C18 110Å, 50 X 2 mm			
Mobile Phase Composition	A = 2 mM Acetate in 95:5 H2O:ACN B = Acetonitrile			
Gradient Program	**Time**	**%A**	**%B**	**Flow Rate - mL/min**
	0	98	2	0.50
	0.2	98	2	0.50
	4.00	65	35	0.50
	7.00	45	55	0.60
	9.00	25	75	0.60
	10.00	5	95	0.60
	11.45	5	95	0.60
	11.50	98	2	0.50
	13.50	98	2	0.50
	Maximum pressure limit = 8000 psi			
Injection Size	20 µL (fixed amount throughout the sequence).			
Run Time	~13.50 minutes			
Mass Spectrometer Interface Settings (SCIEX 5500)				
MS Interface Mode	ESI Negative Ion. Minimum of 10 scans/peak.			
Ion Spray Voltage (kV)	4.5			
Entrance Potential (V)	5			
Declustering Potential (V)	25			
Desolvation Temp	600ºC			
Curtain Gas	35 psi			
Collision Gas	8 psi			

Table 11.8 - 2
Masses/Transitions Utilized

ID	Comments	Q1	Q3	RT
11Cl-PF3OUdS	Native Analyte	630.9	450.9	8.31
11Cl-PF3OUdS_2	Native Analyte	632.9	452.9	8.31
13C2_PFDA	Internal Standard	515.1	470.1	6.95

Table 11.8 - 2
Masses/Transitions Utilized

ID	Comments	Q1	Q3	RT
13C2_PFDoA	Isotope Dilution Analyte	615.1	570	7.86
13C2_PFHxA	Internal Standard	315.1	270	4.5
13C2_PFHXA_2	Internal Standard	315.1	119.4	4.5
13C2_PFTeDA	Isotope Dilution Analyte	715.2	670	8.68
13C3_HFPO-DA	Isotope Dilution Analyte	286.9	168.9	4.78
13C3_HFPO-DA_2	Isotope Dilution Analyte	286.9	184.9	4.78
13C3_PFBA	Internal Standard	216	172	1.87
13C3_PFBS	Isotope Dilution Analyte	302.1	79.9	4.36
13C3_PFBS_2	Isotope Dilution Analyte	302.1	98.9	4.36
13C3_PFHxS	Isotope Dilution Analyte	402.1	79.9	5.96
13C3_PFHxS_2	Isotope Dilution Analyte	402.1	98.8	5.96
13C4_PFBA	Isotope Dilution Analyte	216.8	171.9	1.87
13C4_PFHpA	Isotope Dilution Analyte	367.1	322	5.25
13C4_PFOA	Internal Standard	417.1	172	5.89
13C4_PFOS	Internal Standard	502.8	79.9	7.06
13C4_PFOS_2	Internal Standard	502.8	98.9	7.06
13C5_PFHxA	Isotope Dilution Analyte	318	273	4.5
13C5_PFHxA_2	Isotope Dilution Analyte	318	120.3	4.5
13C5_PFNA	Internal Standard	468	423	6.44
13C5_PFPeA	Isotope Dilution Analyte	268.3	223	3.51
13C6_PFDA	Isotope Dilution Analyte	519.1	474.1	6.95
13C7_PFUdA	Isotope Dilution Analyte	570	525.1	7.41
13C8_PFOA	Isotope Dilution Analyte	421.1	376	5.89
13C8_PFOS	Isotope Dilution Analyte	507.1	79.9	7.06
13C8_PFOS_2	Isotope Dilution Analyte	507.1	98.9	7.06
13C8_PFOSA	Isotope Dilution Analyte	506.1	77.8	7.91
13C9_PFNA	Isotope Dilution Analyte	472.1	427	6.44
18O2_PFHxS	Internal Standard	403	83.9	5.96
3:3 FTCA	Native Analyte	241	177	2.96
3:3 FTCA_2	Native Analyte	241	117	2.96
4.2 FTS	Native Analyte	327.1	307	4.22
4:2 FTS2	Native Analyte	327.1	80	4.22
5:3 FTCA	Native Analyte	341	237.1	4.85
5:3 FTCA_2	Native Analyte	341	217	4.85
6:2 FTS	Native Analyte	427.1	407	5.67
6:2 FTS_2	Native Analyte	427.1	80.9	5.67
7:3 FTCA	Native Analyte	441	316.9	6.14
7:3 FTCA_2	Native Analyte	441	336.9	6.14

Table 11.8 - 2
Masses/Transitions Utilized

ID	Comments	Q1	Q3	RT
8:2 FTS	Native Analyte	527.1	507	6.74
8:2 FTS_2	Native Analyte	527.1	80.8	6.74
9Cl-PF3ONS	Native Analyte	530.8	351	7.4
9Cl-PF3ONS_2	Native Analyte	532.8	353	7.4
d3MeFOSA	Isotope Dilution Analyte	515	219	9.45
d3-MeFOSAA	Isotope Dilution Analyte	573.2	419	6.98
d5EtFOSA	Isotope Dilution Analyte	531.1	219	9.77
d5-EtFOSAA	Isotope Dilution Analyte	589.2	419	7.17
d7N-MeFOSE	Isotope Dilution Analyte	623.2	58.9	9.32
d9N-EtFOSE	Isotope Dilution Analyte	639.2	58.9	9.64
DONA	Native Analyte	376.9	250.9	5.5
DONA_2	Native Analyte	376.9	84.8	5.5
EtFOSA	Native Analyte	526	219	9.79
EtFOSA_2	Native Analyte	526	169	9.79
HFPO-DA	Native Analyte	284.9	168.9	4.78
HFPO-DA_2	Native Analyte	284.9	184.9	4.78
M2-4:2FTS	Isotope Dilution Analyte	329.1	80.9	4.22
M2-4:2FTS_2	Isotope Dilution Analyte	329.1	309	4.22
M2-6:2FTS	Isotope Dilution Analyte	429.1	80.9	5.67
M2-6:2FTS_2	Isotope Dilution Analyte	429.1	409	5.67
M2-8:2FTS	Isotope Dilution Analyte	529.1	80.9	6.74
M2-8:2FTS_2	Isotope Dilution Analyte	529.1	509	6.74
MeFOSA	Native Analyte	511.9	219	9.45
MeFOSA_2	Native Analyte	511.9	169	9.45
N-EtFOSAA	Native Analyte	584.2	419.1	7.17
N-EtFOSAA_2	Native Analyte	584.2	526	7.17
N-EtFOSE	Native Analyte	630	58.9	9.66
NFDHA (PFECA B)	Native Analyte	295	201	4.36
NFDHA_2 (PFECA B_2)	Native Analyte	295	84.9	4.36
N-MeFOSAA	Native Analyte	570.1	419	6.98
N-MeFOSAA_2	Native Analyte	570.1	483	6.98
N-MeFOSE	Native Analyte	616.1	58.9	9.32
PFBA	Native Analyte	212.8	168.9	1.87
PFBS	Native Analyte	298.7	79.9	4.36
PFBS_2	Native Analyte	298.7	98.8	4.36
PFDA	Native Analyte	512.9	469	6.95
PFDA_2	Native Analyte	512.9	219	6.95
PFDoA	Native Analyte	613.1	569	7.86

Table 11.8 - 2
Masses/Transitions Utilized

ID	Comments	Q1	Q3	RT
PFDoA_2	Native Analyte	613.1	319	7.86
PFDoS	Native Analyte	699.1	79.9	8.83
PFDoS_2	Native Analyte	699.1	98.8	8.83
PFDS	Native Analyte	599	79.9	8
PFDS_2	Native Analyte	599	98.8	8
PFEESA (PES)	Native Analyte	314.8	134.9	4.8
PFEESA_2 (PES_2)	Native Analyte	314.8	82.9	4.8
PFHpA	Native Analyte	363.1	319	5.25
PFHpA_2	Native Analyte	363.1	169	5.25
PFHpS	Native Analyte	449	79.9	6.54
PFHpS_2	Native Analyte	449	98.8	6.54
PFHxA	Native Analyte	313	269	4.5
PFHxA_2	Native Analyte	313	118.9	4.5
PFHxS	Native Analyte	398.7	79.9	5.96
PFHxS_2	Native Analyte	398.7	98.9	5.96
PFMBA (PFECA A)	Native Analyte	279	85.1	3.85
PFMPA (PFECA F)	Native Analyte	229	84.9	2.65
PFNA	Native Analyte	463	419	6.44
PFNA_2	Native Analyte	463	219	6.44
PFNS	Native Analyte	548.8	79.9	7.55
PFNS_2	Native Analyte	548.8	98.8	7.55
PFOA	Native Analyte	413	369	5.89
PFOA_2	Native Analyte	413	169	5.89
PFOS	Native Analyte	498.9	79.9	7.06
PFOS_2	Native Analyte	498.9	98.8	7.06
PFOSA	Native Analyte	498.1	77.9	7.93
PFOSA_2	Native Analyte	498.1	478	7.93
PFPeA	Native Analyte	263	219	3.51
PFPeA_2	Native Analyte	263	68.9	3.51
PFPeS	Native Analyte	349.1	79.9	5.27
PFPeS_2	Native Analyte	349.1	98.9	5.27
PFTeDA	Native Analyte	713.1	669	8.68
PFTeDA_2	Native Analyte	713.1	168.9	8.68
PFTrDA	Native Analyte	663	619	8.29
PFTrDA_2	Native Analyte	663	168.9	8.29
PFUdA	Native Analyte	563.1	519	7.41
PFUdA_2	Native Analyte	563.1	269.1	7.41
TCDA_1	Native Analyte	498.29	106.98	0

Table 11.8 - 2
Masses/Transitions Utilized

ID	Comments	Q1	Q3	RT
TCDA_2	Native Analyte	498.29	123.9	0
TCDA_3	Native Analyte	499.29	106.98	0
TCDA_4	Native Analyte	499.29	123.9	0
TCDCA	Native Analyte	464.21	126	0
TUDCA	Native Analyte	464.2	126	0
PFPrA (PPF Acid)	Native Analyte	163	119	1.72
13C3_PFPrA (PPF Acid)	Isotope Dilution Analyte	166	121	1.72
MTP	Native Analyte	175	97	1.36
PFMOAA	Native Analyte	179	84.9	1.95
PMPA	Native Analyte	229	185	2.23
PFO2HxA	Native Analyte	245	85	2.46
PFPrS	Native Analyte	249.1	80	2.23
PEPA	Native Analyte	278.9	234.9	2.66
TFSI	Native Analyte	280.1	147.1	2.42
TFSI_2	Native Analyte	280.1	77.9	2.42
NVHOS	Native Analyte	297	135	2.26
FBSA	Native Analyte	297.9	78	2.85
PFO3OA	Native Analyte	311.1	85.2	3.11
6:2 FTUCA	Native Analyte	356.858	292.9	3.73
6:2 FTUCA_2	Native Analyte	356.858	243	3.73
13C-6:2 FTUCA	Isotope Dilution Analyte	358.858	293.9	3.73
PFO4DA	Native Analyte	376.9	85	3.81
6:2 FTCA	Native Analyte	377.1	313.1	3.76
6:2 FTCA_2	Native Analyte	377.1	63	3.76
13C-6:2 FTCA	Isotope Dilution Analyte	378.883	293.9	3.76
PFECA_G (PFPE-1)	Native Analyte	378.9	184.9	3.7
R-PSDCA	Native Analyte	397	217	3.53
FHxSA	Native Analyte	397.9	78	4.07
R-EVE	Native Analyte	405	217	2.03
EVE-Acid	Native Analyte	407	262.9	3.96
Hydro-EVE Acid	Native Analyte	427	282.9	3.59
Hydrolyzed PSDA	Native Analyte	439.1	342.9	2.03
R-PSDA	Native Analyte	441	241	2.03
PS Acid	Native Analyte	442.804	146.8	3.96
PFO5DoA (TAF)	Native Analyte	442.9	85	4.55
8:2 FTUCA	Native Analyte	456.856	392.9	4.86
8:2 FTUCA_2	Native Analyte	456.856	343	4.86

Table 11.8 - 2
Masses/Transitions Utilized

ID	Comments	Q1	Q3	RT
13C-8:2 FTUCA	Isotope Dilution Analyte	458.856	393.9	4.86
PFECHS_2	Native Analyte	460.8	98.9	4.07
PFECHS	Native Analyte	460.8	380.9	4.07
Hydro-PS-Acid	Native Analyte	463	263	3.59
8:2 FTCA	Native Analyte	477	393.1	4.89
8:2 FTCA_2	Native Analyte	477	63.2	4.89
13C-8:2 FTCA	Native Analyte	478.846	393.9	4.89
10:2 FTUCA	Native Analyte	556.86	492.9	5.85
13C-10:2 FTUCA	Isotope Dilution Analyte	558.86	493.9	5.85
10:2 FTCA	Native Analyte	576.795	493	5.88
10:2 FTCA_2	Native Analyte	576.795	63.1	5.88
13C-10:2 FTCA	Isotope Dilution Analyte	578.795	493.9	5.88
10:2 FTS	Native Analyte	627	607	7.66
10:2 FTS_2	Native Analyte	627	79.96	7.66
M2-10:2FTS	Isotope Dilution Analyte	633	612	7.66
6:2-DiPAP_1	Native Analyte	788.792	78.9	6.28
6:2-DiPAP_2	Native Analyte	788.792	96.9	6.28
M4-6:2-DiPAP_1	Isotope Dilution Analyte	792.817	78.9	6.28
M4-6:2-DiPAP_2	Isotope Dilution Analyte	792.817	96.9	6.28
PFHxDA	Native Analyte	813	769	9.38
PFHxDA_2	Native Analyte	813	169	9.38
13C2_PFHxDA	Isotope Dilution Analyte	815	770	9.38
6:2/8:2-DiPAP_1	Native Analyte	888.7	78.9	6.28
6:2/8:2-DiPAP_2	Native Analyte	888.7	96.9	6.28
PFODA	Native Analyte	913	869	9.95
PFODA_2	Native Analyte	913	169	9.95
8:2-DiPAP_1	Native Analyte	988.743	78.9	7.29
8:2-DiPAP_2	Native Analyte	988.743	96.9	7.29
M4-8:2-DiPAP_1	Isotope Dilution Analyte	992.774	78.9	7.29
M4-8:2-DiPAP_2	Isotope Dilution Analyte	992.774	96.9	7.29

Table 11.8 – 3
Recommended Instrument Operating Conditions

Mass Spectrometer Scan Settings (SCIEX 5500)							
RT	ID	MRM (win)	Dwell Weight	DP (volts)	EP (volts)	CE (volts)	CXP (volts)
0	TCDA_1	70	1	-65	-5	-58	-12

Table 11.8 – 3
Recommended Instrument Operating Conditions

Mass Spectrometer Scan Settings (SCIEX 5500)

RT	ID	MRM (win)	Dwell Weight	DP (volts)	EP (volts)	CE (volts)	CXP (volts)
0	TCDA_2	70	1	-65	-5	-58	-12
0	TCDA_3	90	1	-65	-5	-58	-12
0	TCDA_4	90	1	-65	-5	-58	-12
0	TCDCA	120	1	-65	-5	-58	-12
0	TUDCA	120	1	-65	-5	-58	-12
1.87	13C3_PFBA	90	1	-25	-5	-12	-31
1.87	13C4_PFBA	90	1	-25	-5	-12	-31
1.87	PFBA	90	1	-25	-5	-12	-31
2.65	PFMPA (PFECA F)	70	1	-23	-10	-10	-16
2.96	3:3 FTCA	70	1	-46	-10	-11	-13
2.96	3:3 FTCA_2	70	1	-33	-10	-44	-15
3.51	13C5_PFPeA	80	1	-55	-7	-12	-13
3.51	PFPeA	80	1	-55	-7	-12	-13
3.51	PFPeA_2	80	1	-55	-7	-62	-15
3.85	PFMBA (PFECA A)	70	1	-5	-10	-16	-9
4.22	4.2 FTS	70	1	-60	-7	-32	-10
4.22	4:2 FTS2	70	1	-50	-10	-50	-12
4.22	M2-4:2FTS	70	1	-50	-7	-80	-10
4.22	M2-4:2FTS_2	70	1	-50	-7	-32	-10
4.36	13C3_PFBS	70	1	-55	-6	-58	-37
4.36	13C3_PFBS_2	70	1	-55	-6	-58	-37
4.36	NFDHA (PFECA B)	70	1	-35	-10	-14	-17
4.36	NFDHA_2 (PFECA B_2)	70	1	-35	-10	-34	-5
4.36	PFBS	70	1	-55	-6	-58	-37
4.36	PFBS_2	70	1	-55	-5	-40	-12
4.5	13C2_PFHxA	50	1	-55	-5	-14	-13
4.5	13C2_PFHXA_2	50	1	-55	-5	-26	-7
4.5	13C5_PFHxA	50	1	-60	-5	-12	-15
4.5	13C5_PFHxA_2	50	1	-60	-5	-30	-9
4.5	PFHxA	50	1	-55	-5	-14	-13
4.5	PFHxA_2	50	1	-55	-5	-26	-7
4.78	13C3_HFPO-DA	70	1	-15	-10	-5	-17
4.78	13C3_HFPO-DA_2	70	1	-75	-10	-18	-15
4.78	HFPO-DA	70	1	-15	-10	-5	-17
4.78	HFPO-DA_2	70	1	-75	-10	-18	-15
4.8	PFEESA (PES)	70	1	-98	-12	-28	-12
4.8	PFEESA_2 (PES_2)	70	1	-98	-12	-28	-12

Table 11.8 – 3 Recommended Instrument Operating Conditions							
Mass Spectrometer Scan Settings (SCIEX 5500)							
RT	**ID**	**MRM (win)**	**Dwell Weight**	**DP (volts)**	**EP (volts)**	**CE (volts)**	**CXP (volts)**
4.85	5:3 FTCA	70	1	-10	-10	-18	-13
4.85	5:3 FTCA_2	70	1	-10	-10	-38	-11
5.25	13C4_PFHpA	70	1	-25	-6	-12	-41
5.25	PFHpA	70	1	-25	-6	-12	-41
5.25	PFHpA_2	70	1	-25	-6	-20	-10
5.27	PFPeS	70	1	-57	-9	-66	-40
5.27	PFPeS_2	70	1	-57	-9	-45	-12
5.5	DONA	70	1	-55	-10	-16	-17
5.5	DONA_2	70	1	-55	-10	-35	-17
5.67	6:2 FTS	70	1	-50	-7	-32	-10
5.67	6:2 FTS_2	70	1	-80	-10	-72	-12
5.67	M2-6:2FTS	70	1	-50	-7	-90	-10
5.67	M2-6:2FTS_2	70	1	-50	-7	-32	-10
5.89	13C4_PFOA	70	1	-110	-6	-24	-20
5.89	13C8_PFOA	70	1	-110	-6	-18	-20
5.89	PFOA	70	1	-110	-6	-18	-20
5.89	PFOA_2	70	1	-110	-6	-24	-20
5.96	13C3_PFHxS	65	1	-145	-12	-88	-11
5.96	13C3_PFHxS_2	65	1	-145	-12	-80	-13
5.96	18O2_PFHxS	65	1	-145	-12	-88	-11
5.96	PFHxS	65	1	-145	-12	-88	-11
5.96	PFHxS_2	65	1	-145	-12	-80	-13
6.14	7:3 FTCA	70	1	-27	-12	-18	-10
6.14	7:3 FTCA_2	70	1	-22	-12	-31	-35
6.44	13C5_PFNA	70	1	-25	-6	-14	-48
6.44	13C9_PFNA	70	1	-25	-6	-14	-48
6.44	PFNA	70	1	-25	-6	-14	-47
6.44	PFNA_2	70	1	-25	-6	-24	-47
6.54	PFHpS	70	1	-65	-11	-88	-46
6.54	PFHpS_2	70	1	-65	-11	-50	-12
6.74	8:2 FTS	70	1	-50	-7	-40	-15
6.74	8:2 FTS_2	70	1	-60	-10	-82	-9
6.74	M2-8:2FTS	70	1	-50	-7	-90	-15
6.74	M2-8:2FTS_2	70	1	-50	-7	-40	-15
6.95	13C2_PFDA	70	1	-25	-6	-16	-51
6.95	13C6_PFDA	70	1	-25	-6	-16	-51
6.95	PFDA	70	1	-25	-6	-16	-51

Table 11.8 – 3 Recommended Instrument Operating Conditions							
Mass Spectrometer Scan Settings (SCIEX 5500)							
RT	**ID**	**MRM (win)**	**Dwell Weight**	**DP (volts)**	**EP (volts)**	**CE (volts)**	**CXP (volts)**
6.95	PFDA_2	70	1	-25	-6	-26	-12
6.98	d3-MeFOSAA	90	1	-40	-7	-36	-15
6.98	N-MeFOSAA	90	1	-40	-7	-36	-15
6.98	N-MeFOSAA_2	90	1	-75	-10	-22	-12
7.06	13C4_PFOS	90	1	-140	-9	-130	-13
7.06	13C4_PFOS_2	90	1	-140	-9	-98	-5
7.06	13C8_PFOS	90	1	-205	-9	-112	-11
7.06	13C8_PFOS_2	90	1	-205	-9	-112	-11
7.06	PFOS	90	1	-140	-9	-130	-13
7.06	PFOS_2	90	1	-140	-9	-98	-5
7.17	d5-EtFOSAA	90	1	-50	-7	-36	-15
7.17	N-EtFOSAA	90	1	-50	-7	-36	-15
7.17	N-EtFOSAA_2	90	1	-90	-10	-28	-12
7.4	9Cl-PF3ONS	70	1	-120	-10	-30	-17
7.4	9Cl-PF3ONS_2	70	1	-120	-10	-30	-15
7.41	13C7_PFUdA	70	1	-25	-7	-18	-54
7.41	PFUdA	70	1	-25	-7	-18	-54
7.41	PFUdA_2	70	1	-25	-7	-28	-12
7.55	PFNS	70	1	-75	-10	-113	-52
7.55	PFNS_2	70	1	-75	-8	-71	-12
7.86	13C2_PFDoA	70	1	-25	-5	-18	-54
7.86	PFDoA	70	1	-25	-5	-18	-54
7.86	PFDoA_2	70	1	-25	-5	-30	-12
7.91	13C8_PFOSA	75	1	-90	-8	-92	-11
7.93	PFOSA	75	1	-90	-8	-92	-11
7.93	PFOSA_2	75	1	-60	-10	-40	-8
8	PFDS	70	1	-30	-11	-130	-11
8	PFDS_2	70	1	-30	-11	-110	-17
8.29	PFTrDA	90	1	-25	-7	-20	-54
8.29	PFTrDA_2	90	1	-25	-7	-36	-12
8.31	11Cl-PF3OUdS	70	1	-160	-10	-40	-17
8.31	11Cl-PF3OUdS_2	70	1	-160	-10	-40	-15
8.68	13C2_PFTeDA	120	1	-25	-7	-22	-54
8.68	PFTeDA	120	1	-25	-7	-22	-10
8.68	PFTeDA_2	120	1	-25	-7	-36	-30
8.83	PFDoS	90	1	-10	-11	-76	-11
8.83	PFDoS_2	90	1	-10	-11	-130	-5
9.32	d7N-MeFOSE	70	1	-20	-5	-70	-10

Table 11.8 – 3
Recommended Instrument Operating Conditions

Mass Spectrometer Scan Settings (SCIEX 5500)

RT	ID	MRM (win)	Dwell Weight	DP (volts)	EP (volts)	CE (volts)	CXP (volts)
9.32	N-MeFOSE	70	1	-20	-5	-70	-10
9.45	d3MeFOSA	70	1	-75	-7	-37	-15
9.45	MeFOSA	70	1	-75	-7	-37	-15
9.45	MeFOSA_2	70	1	-50	-2	-40	-6
9.64	d9N-EtFOSE	70	1	-20	-5	-70	-10
9.66	N-EtFOSE	70	1	-20	-5	-70	-10
9.77	d5EtFOSA	70	1	-75	-7	-37	-15
9.79	EtFOSA	70	1	-75	-7	-37	-15
9.79	EtFOSA_2	70	1	-50	-8	-40	-6
1.72	PFPrA (PPF Acid)	120	1	-5	-10	-16	-13
1.72	13C3_PFPrA (PPF Acid)	120	1	-5	-10	-16	-13
1.36	MTP	120	1	-45	-10	-22	-9
1.95	PFMOAA	120	1	-25	-10	-18	-7
2.23	PMPA	60	1	-15	-10	-12	-5
2.46	PFO2HxA	60	1	-25	-10	-24	-5
2.23	PFPrS	60	1	-57	-9	-66	-40
2.66	PEPA	90	1	-20	-10	-10	-5
2.42	TFSI	90	1	-130	-7	-36	-9
2.42	TFSI_2	90	1	-130	-7	-106	-11
2.26	NVHOS	60	1	-210	-10	-34	-7
2.85	FBSA	90	1	-105	-10	-106	-9
3.11	PFO3OA	60	1	-31	-10	-32	-40
3.73	6:2 FTUCA	60	1	-45	-10	-20	-11
3.73	6:2 FTUCA_2	60	1	-45	-10	-48	-9
3.73	13C-6:2 FTUCA	60	1	-5	-10	-18	-11
3.81	PFO4DA	60	1	-10	-10	-34	-5
3.76	6:2 FTCA	60	1	-16	-13	-9	-22
3.76	6:2 FTCA_2	60	1	-15	-12	-27	-8
3.76	13C-6:2 FTCA	60	1	-5	-10	-20	-11
3.7	PFECA_G	90	1	-162	-10	-16	-5
3.53	R-PSDCA	60	1	-210	-10	-34	-7
4.07	FHxSA	90	1	-35	-10	-68	-7
2.03	R-EVE	60	1	-65	-10	-24	-35
3.96	EVE-Acid	60	1	-45	-10	-12	-5
3.59	Hydro-EVE Acid	90	1	-25	-10	-18	-21
2.03	Hydrolyzed PSDA	60	1	-56	-8	-40	-12
2.03	R-PSDA	60	1	-66	-10	-34	-9
3.96	PS Acid	60	1	-50	-10	-36	-19
4.55	PFO5DoA (TAF)	60	1	-95	-10	-38	-5
4.86	8:2 FTUCA	60	1	-25	-10	-20	-15
4.86	8:2 FTUCA_2	60	1	-25	-10	-54	-13
4.86	13C-8:2 FTUCA	60	1	-25	-10	-20	-15
4.07	PFECHS_2	60	1	-65	-9	-72	-10

Table 11.8 – 3
Recommended Instrument Operating Conditions

Mass Spectrometer Scan Settings (SCIEX 5500)

RT	ID	MRM (win)	Dwell Weight	DP (volts)	EP (volts)	CE (volts)	CXP (volts)
4.07	PFECHS	60	1	-65	-9	-39	-13
3.59	Hydro-PS-Acid	60	1	-56	-10	-36	-10
4.89	8:2 FTCA	60	1	-35	-9	-22	-17
4.89	8:2 FTCA_2	60	1	-9	-9	-34	-5
4.89	13C-8:2 FTCA	60	1	-35	-9	-22	-17
5.85	10:2 FTUCA	60	1	-60	-10	-22	-17
5.85	13C-10:2 FTUCA	60	1	-60	-10	-22	-17
5.88	10:2 FTCA	60	1	-5	-10	-24	-15
5.88	10:2 FTCA_2	60	1	-5	-10	-46	-7
5.88	13C-10:2 FTCA	60	1	-5	-10	-24	-15
7.66	10:2 FTS	70	1	-110	-7	-38	-5
7.66	10:2 FTS_2	70	1	-60	-10	-92	-12
7.66	M2-10:2FTS	70	1	-110	-7	-38	-5
6.28	6:2-DiPAP_1	120	1	-25	-10	-134	-9
6.28	6:2-DiPAP_2	120	1	-25	-10	-82	-9
6.28	M4-6:2-DiPAP_1	120	1	-30	-10	-134	-15
6.28	M4-6:2-DiPAP_2	120	1	-30	-10	-72	-11
9.38	PFHxDA	120	1	-25	-7	-24	-54
9.38	PFHxDA_2	120	1	-25	-7	-38	-12
9.38	13C2_PFHxDA	120	1	-25	-7	-24	-54
6.28	6:2/8:2-DiPAP_1	120	1	-20	-10	-126	-15
6.28	6:2/8:2-DiPAP_2	120	1	-20	-10	-110	-11
9.95	PFODA	120	1	-25	-7	-26	-54
9.95	PFODA_2	120	1	-25	-7	-40	-12
7.29	8:2-DiPAP_1	120	1	-70	-10	-138	-11
7.29	8:2-DiPAP_2	120	1	-70	-10	-96	-11
7.29	M4-8:2-DiPAP_1	120	1	-5	-10	-136	-15
7.29	M4-8:2-DiPAP_2	120	1	-5	-10	-116	-11

Table 11.8 – 4
Retention Times & Quantitation

Native Compounds	Typical Native RT (minutes)	IDA analog	Typical IDA RT (minutes)	Quantitation Method
PFBA	2.54	13C4_PFBA	2.54	Isotope Dilution
3:3 FTCA	2.9	13C5_PFPeA	2.97	Isotope Dilution
PFPeA	2.97	13C5_PFPeA	2.97	Isotope Dilution
PFBS	2.98	13C3-PFBS	2.98	Isotope Dilution
PFECA A (PFMBA)	3	13C5_PFPeA	2.97	Isotope Dilution
PES (PFEESA)	3.09	13C5_PFHxA	3.35	Isotope Dilution
PFECA B (NFDHA)	3.21	13C5_PFHxA	3.35	Isotope Dilution

Table 11.8 – 4
Retention Times & Quantitation

Native Compounds	Typical Native RT (minutes)	IDA analog	Typical IDA RT (minutes)	Quantitation Method
4:2 FTS	3.28	13C2-4:2FTS	3.28	Isotope Dilution
PFHxA	3.35	13C5_PFHxA	3.35	Isotope Dilution
PFPeS	3.45	13C3_PFHxS	2.98	Isotope Dilution
HFPO-DA	3.46	13C3_HFPO-DA	3.46	Isotope Dilution
5:3 FTCA	3.7	13C5_PFHxA	3.77	Isotope Dilution
PFECA_F (PFMPA)	3.08	13C5_PFPeA	3.77	Isotope Dilution
PFHpA	3.74	13C4_PFHpA	3.74	Isotope Dilution
PFHxS	3.74	13C3_PFHxS	3.74	Isotope Dilution
DONA	3.79	13C3_HFPO-DA	4.5	Isotope Dilution
6:2 FTS	4.12	13C2-6:2FTS	4.12	Isotope Dilution
PFOA	4.14	13C8_PFOA	4.14	Isotope Dilution
PFHpS	4.14	13C8_PFOS	4.5	Isotope Dilution
7:3 FTCA	4.5	13C5_PFHxA	4.55	Isotope Dilution
PFOS	4.5	13C8_PFOS	4.5	Isotope Dilution
PFNA	4.52	13C9_PFNA	4.52	Isotope Dilution
9Cl-PF3ONS	4.69	13C3_HFPO-DA	4.5	Isotope Dilution
PFOSA	4.82	13C8_PFOSA	4.82	Isotope Dilution
PFNS	4.83	13C8_PFOS	4.5	Isotope Dilution
PFDA	4.86	13C6_PFDA	4.86	Isotope Dilution
8:2 FTS	4.86	13C2-8:2FTS	4.86	Isotope Dilution
N-MeFOSAA	5.03	d3-MeFOSAA	5.03	Isotope Dilution
PFDS	5.16	13C8_PFOS	4.5	Isotope Dilution
PFUdA (PFUnA)	5.19	13C7_PFUdA	5.19	Isotope Dilution
N-EtFOSAA	5.19	d5-EtFOSAA	5.19	Isotope Dilution
N-MeFOSE	5.25	d7N-MeFOSE	5.25	Isotope Dilution
MeFOSA	5.26	d3MeFOSA	5.26	Isotope Dilution
11Cl-PF3OUdS	5.31	13C3_HFPO-DA	4.5	Isotope Dilution
N-EtFOSE	5.4	d9N-EtFOSE	5.4	Isotope Dilution
EtFOSA	5.44	d5EtFOSA	5.44	Isotope Dilution
PFDoA	5.47	13C2_PFDoA	5.47	Isotope Dilution
PFDoS	5.72	13C8_PFOS	4.5	Isotope Dilution
PFTrDA	5.75	13C2_PFDoA	5.47	Isotope Dilution
PFTeDA	5.99	13C2_PFTeDA	5.99	Isotope Dilution
PFPrA (PPF Acid)	1.72	13C4_PFBA	2.54	Isotope Dilution
MTP	1.36	13C4_PFBA	2.54	Isotope Dilution
PFMOAA	1.95	13C4_PFBA	2.54	Isotope Dilution
PMPA	2.23	13C4_PFBA	2.54	Isotope Dilution
PFO2HxA	2.46	13C5_PFPeA	2.97	Isotope Dilution

Table 11.8 – 4
Retention Times & Quantitation

Native Compounds	Typical Native RT (minutes)	IDA analog	Typical IDA RT (minutes)	Quantitation Method
PFPrS	2.23	13C3_PFBS	2.98	Isotope Dilution
PEPA	2.66	13C5_PFPeA	2.97	Isotope Dilution
TFSI	2.42	13C4_PFBA	2.54	Isotope Dilution
NVHOS	2.26	13C4_PFBA	2.54	Isotope Dilution
FBSA	2.85	13C3_PFBS	2.98	Isotope Dilution
PFO3OA	3.11	13C5_PFHxA	3.35	Isotope Dilution
6:2 FTUCA	3.73	13C-6:2 FTUCA	3.73	Isotope Dilution
PFO4DA	3.81	13C4_PFHpA	3.74	Isotope Dilution
6:2 FTCA	3.76	13C-6:2 FTCA	3.76	Isotope Dilution
PFECA_G (PFPE-1)	3.7	13C8_PFOA	4.14	Isotope Dilution
R-PSDCA	3.53	13C4_PFHpA	3.74	Isotope Dilution
FHxSA	4.07	13C3_PFBS	2.98	Isotope Dilution
R-EVE	2.03	13C4_PFBA	2.54	Isotope Dilution
EVE-Acid	3.96	13C4_PFBA	2.54	Isotope Dilution
Hydro-EVE Acid	3.59	13C4_PFHpA	3.74	Isotope Dilution
Hydrolyzed PSDA	2.03	13C4_PFBA	2.54	Isotope Dilution
R-PSDA	2.03	13C4_PFBA	2.54	Isotope Dilution
(PS Acid	3.96	13C8_PFOA	4.14	Isotope Dilution
PFO5DoA (TAF)	4.55	13C8_PFOA	4.14	Isotope Dilution
8:2 FTUCA	4.86	13C-8:2 FTUCA	4.86	Isotope Dilution
PFECHS	4.07	13C8_PFOA	4.14	Isotope Dilution
Hydro-PS-Acid	3.59	13C4_PFHpA	3.74	Isotope Dilution
8:2 FTCA	4.89	13C-8:2 FTCA	4.89	Isotope Dilution
10:2 FTUCA	5.85	13C-10:2 FTUCA	5.85	Isotope Dilution
10:2 FTCA	5.88	13C-10:2 FTCA	5.88	Isotope Dilution
10:2 FTS	7.66	M2-10:2FTS	7.66	Isotope Dilution
6:2-DiPAP	6.28	M4-6:2-DiPAP	6.28	Isotope Dilution
PFHxDA	9.38	13C2_PFHxDA	9.38	Isotope Dilution
6:2/8:2-DiPAP	6.28	M4-6:2-DiPAP	6.28	Isotope Dilution
PFODA	9.95	13C2_PFHxDA	9.38	Isotope Dilution
8:2-DiPAP	7.29	M4-8:2-DiPAP	7.29	Isotope Dilution

Table 11.8 – 5
Retention Times & Quantitation

IDA	Typical IDA RT (minutes)	IS analog	Typical RT (minutes)	Quantitation Method
13C4_PFBA	2.08	13C3_PFBA	2.54	Internal Standard
13C5_PFPeA	3.71	13C2_PFHxA	4.62	Internal Standard
13C5_PFHxA	4.62	13C2_PFHxA	4.62	Internal Standard
13C4_PFHpA	5.34	13C2_PFHxA	4.62	Internal Standard
13C8_PFOA	5.94	13C4_PFOA	5.94	Internal Standard
13C9_PFNA	6.43	13C5_PFNA	4.52	Internal Standard
13C6_PFDA	6.88	13C2_PFDA	6.88	Internal Standard
13C7_PFUnA	7.32	13C2_PFDA	6.88	Internal Standard
13C2_PFDoA	7.72	13C2_PFDA	6.88	Internal Standard
13C2_PFTeDA	8.42	13C2_PFDA	6.88	Internal Standard
13C3-PFBS	4.50	18O2_PFHxS	6.00	Internal Standard
13C3_PFHxS	6.00	18O2_PFHxS	6.00	Internal Standard
13C8_PFOS	6.98	13C4_PFOS	6.98	Internal Standard
13C2_4:2FTS	4.41	18O2_PFHxS	6.00	Internal Standard
13C2_6:2FTS	5.75	18O2_PFHxS	6.00	Internal Standard
13C2_8:2FTS	6.72	18O2_PFHxS	6.00	Internal Standard
13C8_PFOSA	8.01	13C4_PFOS	6.98	Internal Standard
d3MeFOSA	9.49	13C4_PFOS	6.98	Internal Standard
d5EtFOSA	9.81	13C4_PFOS	6.98	Internal Standard
d3-MeFOSAA	6.93	13C4_PFOS	6.98	Internal Standard
d5-EtFOSAA	7.10	13C4_PFOS	6.98	Internal Standard
d7N-MeFOSE	9.37	13C4_PFOS	6.98	Internal Standard
d9N-EtFOSE	9.68	13C4_PFOS	6.98	Internal Standard
13C3_HFPO-DA	4.90	13C2-PFHxA	4.62	Internal Standard
13C-6:2 FTUCA	3.73	13C2_PFHxA	4.62	Internal Standard
13C-6:2 FTCA	3.76	13C2_PFHxA	4.62	Internal Standard
13C-8:2 FTUCA	4.86	13C5_PFNA	4.52	Internal Standard
13C-8:2 FTCA	4.89	13C2_PFDA	6.88	Internal Standard
13C-10:2 FTUCA	5.85	13C2_PFDA	6.88	Internal Standard
13C-10:2 FTCA	5.88	13C2_PFDA	6.88	Internal Standard
M2-10:2FTS	7.66	13C4_PFOS	6.98	Internal Standard
M4-6:2-DiPAP	6.28	13C2_PFDA	6.88	Internal Standard
13C2_PFHxDA	9.38	13C2_PFDA	6.88	Internal Standard
M4-8:2-DiPAP	7.29	13C2_PFDA	6.88	Internal Standard

11.9. Instrument Analysis

11.9.1. Tune and calibrate the instrument as described in Section 10.

11.9.2. A typical run sequence is as follows:

- Rinse Blank (RB, not linked to anything)
- CCVL (referred to as an ISC in Method 1633)
- Qualitative verification standard

- Rinse Blank (RB, not linked to anything)
- Method blank
- LLCS
- LCS
- Bile salt interference check (TDCA, TCDCA, TUDCA)
- 10 samples: link to midpoint of ICAL
- CCV: link to midpoint of ICAL
- CCB
- 10 more samples: link to midpoint of ICAL
- CCV: link to midpoint of ICAL
- CCB
- Etc.

11.9.3. Vortex all sample aliquots and standards prior to placing on the autosampler.

11.9.4. 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.

11.9.5. If carryover is suspected, those samples are to be re-analyzed from a fresh extract aliquot (i.e. go the archive of the extract).

11.9.6. 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 11.9.8. If not clean, proceed as directed below.

11.9.7. 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 11.9.6.

11.9.8. 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 no more than 100X without diluting out the IDA, in most cases, and thus preserving quantitation via isotope dilution. .

12.2.1. If the IDA response in the dilution is < 10:1 signal to noise or RT is off then the sample is to be re-extracted at a smaller aliquot.

12.2.2. If a dilution greater than 100X is needed, then the sample should be re-extracted at a smaller aliquot.

12.2.3. If a dilution is required, report the 1X data, including IDA, as primary data, and analyte of interest and associated IDA only from the dilution as secondary data.

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 ± 0.4 minutes of 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.*

12.4.2. 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) standard as well, and adjusts the RT window for an analyte if it is 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 $$Concentration\ (ng/mL) = \frac{-b \pm \sqrt{b^2-4ac-y}}{2a}$$

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 $$Concentration\ (ng/g) = \frac{C_{ex}V_t}{W_sD}$$

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)

13.3.1. The method initial demonstration of capability is performed by processing 4 LCS samples and a method blank. Compare the average recovery and RSD to the IPR limits in Table 5 of the reference method.

13.3.2. Each analyst performing this procedure must successfully analyze four LCS QC samples using current laboratory LCS control limits in the LIMS. 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 NDSC 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 dry 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 or by consolidation into 55-gallon open top plastic drum, which is shipped after no more than 90 days.

16. REFERENCES

16.1. Draft Method 1633 – Analysis of Per- and Polyfluroalkyl Substances (PFAS) in Aqueous, Solid, Biosolids and Tissue Samples by LC-MS/MS, August 2021.

16.2. 2nd Draft Method 1633 – Analysis of Per- and Polyfluroalkyl Substances (PFAS) in Aqueous, Solid, Biosolids and Tissue Samples by LC-MS/MS, June 2022.

17. METHOD MODIFICATIONS

Modifications from Method 1633 are detailed below:

17.1. Percent solids in aqueous samples is determined by visual comparison to a reference sample that contains 50 mg of solid material (carbon). If samples are more turbid the extracted volume is reduced or the sample is processed as a solid based upon consultation with the client.

17.2. An SPE cartridge with 250 mg of WAX and 50 mg of carbon is used for water extraction and solid matrices clean up. As a result solvents and elution procedures are different.

17.3. The TDCA separation window is changed from 60 seconds to less than 15 seconds and baseline resolution.

17.4. The CCVL (ISC) will be used to start the analytical sequence on non-ICAL days and is to meet both S/N (3:1) and CCV acceptance criteria.

17.5. The corrective action to be taken in the event of clogging occurring in the SPE columns that is described in Section 11.3.6 is in lieu of using a second SPE cartridge as described in the reference method.

17.6. Immediately following the loading of aqueous samples onto the SPE columns, sample bottles are rinsed with reagent water, and the reagent water added to the column reservoir. This step is addition to the basic methanol rinse as part of the SPE elution step.

17.7. Default volume for water is reduced from 500 mL to 125 mL.

17.8. The soils extraction solvent is 0.4%KOH/Methanol instead of 0.3% NH_4OH/methanol.

17.9. If the analyte's mass transition ion ratio is outside of the control limits, the extract is not re-analyzed. The data is flagged as per section 9.10.4.

17.10. If the IDA recovery is outside of the control limits data is evaluated per Section 9.9. Re-extraction is only performed as outlined in this section.

18. ATTACHMENTS

There are no attachments associated with this SOP.

19. REVISION HISTORY

19.1. WS-LC-0042, Revision 0, Effective 12/05/2022

19.1.1. This is the initial version of this SOP.

Appendix E

Waste Management Plan

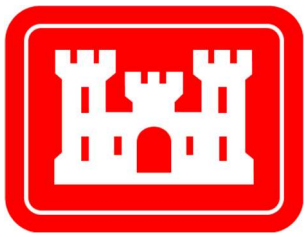
Final

Waste Management Plan

Per- and Polyfluoroalkyl Substances (PFAS) Plume Monitoring
Eielson AFB, Alaska

Contract No. W911KB-20-D-0012
Delivery Order W911KB23F0161

July 2024



Prepared for:
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APPROVAL PAGE

North Wind-EA Joint Venture (JV) has prepared this planning document for the U.S. Army Corps of Engineers in accordance with the terms and conditions of Contract No. W911KB-20-D-0012.

Kristy Carlstrom
Project Manager
North Wind-EA JV

Date

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ATTACHMENT

Attachment 1 Eielson AFB IDW Tracking Form

ACRONYMS AND ABBREVIATIONS

µg/L	micrograms per liter
AAC	Alaska Administrative Code
ADEC	Alaska Department of Environmental Conservation
AFB	Air Force Base
AFCEC	Air Force Civil Engineer Center
APDES	Alaska Pollutant Discharge Elimination System
APP	Accident Prevention Plan
AST	aboveground storage tank
CFR	Code of Federal Regulations
DoD	U.S. Department of Defense
DOT	U.S. Department of Transportation
EPA	U.S. Environmental Protection Agency
HAZWOPER	Hazardous Waste Operations and Emergency Response
HWF	Hazardous Waste Facility
ID	identification
IDW	investigation derived waste
IX	ion exchange
JV	Joint Venture
NOI	Notice of Intent
PFOA	perfluorooctanoic acid
PFOS	perfluorooctane sulfonate
PFAS	per- and polyfluoroalkyl substances
POC	point of contact
PPE	personal protective equipment
PWTS	PFAS Wastewater Treatment System
SSHP	Site Safety and Health Plan

SVOC	semi-volatile organic compound
TBD	to be determined
UFP-QAPP	Uniform Federal Policy-Quality Assurance Project Plan
USACE	U.S. Army Corps of Engineers
VOC	volatile organic compound
WMP	Waste Management Plan

1. INTRODUCTION

North Wind-EA Joint Venture (JV) prepared this Waste Management Plan (WMP) to guide in the proper handling and disposal of investigation-derived waste (IDW) generated from the sampling of monitoring wells at Eielson Air Force Base (AFB), Alaska, under Contract Number W911KB-20-D-0012. IDW will consist of purged groundwater, decontamination water (including dedicated equipment used for monitoring well sampling), and personal protective equipment (PPE). The project location and background are included in the Uniform Federal Policy-Quality Assurance Project Plan (UFP-QAPP) (North Wind, 2023).

This WMP, which is to be used in conjunction with the UFP-QAPP, is included as Appendix D of the UFP-QAPP. The WMP is intended to guide in the proper handling and disposal of wastes generated during field sampling. The determination of final IDW disposal methods will be in general accordance with the regulations listed in Section 1.1.

1.1 Regulatory Requirements

This WMP describes the procedures and practices that North Wind-EA JV and its subcontractors will implement to manage wastes generated at the project site, and to ensure compliance with the applicable federal and state regulations outlined below, as applicable:

- 18 Alaska Administrative Code (AAC):
  - Chapter 75, "Oil and Other Hazardous Substances Pollution Control."
- 29 Code of Federal Regulations (CFR):
  - Part 1910, "Occupational Safety and Health Standards."

1.2 Personnel Qualifications

Project personnel and their responsibilities are provided in UFP-QAPP Worksheets #4/7/8. The Field Lead and Site Safety and Health Officer will have current 40-hour Hazardous Waste Operations and Emergency Response (HAZWOPER) and 8-hr HAZWOPER Supervisor certification. HAZWOPER certifications are provided in the Accident Prevention Plan/Site Safety and Health Plan (APP/SSHP).

In addition, per the requirements of Eielson AFB, project personnel will be required to attend an annual hazardous waste training on-site that is held by the Eielson AFB Hazardous Waste Program Manager.

2. ANTICIPATED WASTE STREAMS

The estimated waste streams, quantities, associated containers, and documentation to be used during this project are listed in Table 1. Contaminated PPE and sampling supplies generated during waste removal and handling activities will be added to the appropriate waste stream for disposal.

Table 1. Estimated Waste Types, Quantities, and Containerization

Waste Type	Estimated Quantity	Containerization
Purge water from monitoring well sampling and equipment decontamination water potentially containing non-hazardous PFAS, metals, and SVOCs.	440-gallons	DOT approved 55-gallon drums
Potentially contaminated sampling debris (including PPE, tubing*, and other debris associated with sampling).	TBD	Heavy duty plastic bags
Project generated solid wastes (i.e., trash).	TBD	Heavy duty plastic bags

Notes:
*Tubing is left in-place between sampling events.
DOT = U.S. Department of Transportation
PFAS = Per- and polyfluoroalkyl substances
PPE = personnel protective equipment
SVOC = semi-volatile organic
TBD = to be determined

3. WASTE MANAGEMENT

Per U.S. Department of Defense (DoD) guidance (DoD 2023), there are four identified commercially available options for either destroying or disposing of PFAS-containing materials:

- Carbon reactivation units with environmental permits (for used granular activated carbon only).
- Hazardous waste landfills with environmental permits.
- Solid waste landfills with environmental permits that have composite liners, and gas and leachate collection and treatment systems.
- Hazardous waste incinerators with environmental permits.

IDW purge water generated from the monitoring wells will be treated at the PFAS Wastewater Treatment System (PWTS) located at the Hazardous Waste Facility (HWF) at Eielson AFB. The use of the PWTS, is subject to an annual contractual limit of approximately 30,000 gallons (not solely for this project). However, the estimated quantities of IDW purge water generated from the sampling events is minimal (approximately 440 gallons). The treatment of IDW purge water will be coordinated with the Air Force Civil Engineer Center (AFCEC) prior to treatment.

The PWTS system design incorporates the use of Sorbix ion exchange (IX) resin, which has been used successfully for the treatment of perfluorooctanoic acid (PFOA) and perfluorooctane sulfonate (PFOS) and is capable of treating PFAS to below 0.07 micrograms per liter (µg/L). The PWTS system includes an IX module and various ancillary equipment and materials including storage tanks, a secondary containment area, temporary piping, and discharge control devices. The influent storage tank is a 2,500-gallon polyethylene tank for batch treatment. A 14,000-gallon aboveground storage tank (AST), labeled PFOS/PFOA Tank #1, is used to store larger volumes of PFAS impacted water awaiting treatment. The effluent storage tank is a 10,000-gallon single-wall, steel AST.

PFAS impacted water will be treated in batches between roughly 2,500 and 10,000 gallons, based on the influent and effluent storage limitations. PFAS impacted wastewater is processed from the polyethylene tank, through the IX module, and into the 10,000-gallon effluent tank. Water is then discharged from the 10,000-gallon effluent tank to the drainage swale located directly south of the HWF once sampling data

indicate that the effluent limits in the Alaska Pollutant Discharge Elimination System (APDES) permit have been achieved. Treated wastewater not meeting the APDES limits will be reprocessed through the IX module. Operators of the PWTS system will obtain authorization from the Alaska Department of Environmental Conservation (ADEC) to discharge water by submitting a Notice of Intent (NOI) to discharge and a Best Management Plan to the Division of Water (Ahtna 2019).

General refuse will be disposed of at the Fairbanks North Star Borough Landfill. General refuse quantities will not be tracked.

3.1 Accumulation

IDW purge water generated from each monitoring well will be individually containerized in 55-gallon DOT approved containers. IDW will be collected in 5-gallon buckets from each monitoring well within Eielson AFB and will be containerized at the point where it was generated and then transported to Containment Cell #2 at the LF003 storage site and transferred into a 55-gallon drum pending treatment at the PWTS. IDW from monitoring wells that are not located on Eielson AFB will also be containerized in 5-gallon buckets and transported to Containment Cell #2 at LF003 and then transferred into a 55-gallon drum, pending treatment at the PWTS.

The DOT-approved 55-gallon drum(s) containing IDW will be temporarily stored at LF003 until sufficient quantities are collected from each groundwater sampling event for treatment. For each container stored at the LF003 storage site, a record will be maintained on the Eielson AFB IDW Tracker Form. The form will be updated after each groundwater sampling event and then submitted to the Eielson AFB point of contact (POC). The IDW form includes a running list of the following:

- Generated waste,
- Date the waste was generated,
- Source location,
- Current location,
- Media,
- Container type,
- Container identification (ID) number, and
- Approximate volume.

The Eielson AFB IDW tracker form is provided in Attachment 1.

3.2 Containerization

IDW liquids will be consolidated in DOT-approved 55-gallon liquid-tight containers, will be in good condition, and will be marked in accordance with 40 CFR 262. General refuse will be stored in heavy duty plastic bags and will not be labeled.

3.3 Marking and Labeling

All IDW containers will be marked with a unique container ID number and have the following information:

- Generator Information,

- Contents,
- Associated Site ID where the waste was generated from,
- Accumulation Start Date,
- Contract – W911KB20D0012,
- Eielson AFB POC, and
- North Wind-EA JV POC.

4. TRANSPORTATION AND DISPOSAL

All IDW will be transported from Eielson AFB, Alaska to US Ecology Vikings Facility, Anchorage, Alaska. Prior to transport off base, North Wind-EA JV will coordinate with the Eielson AFB POC. Wastes removed from the site and generated during monitoring well sampling activities will be disposed of as listed in Table 2.

Table 2. Waste Types and Disposal

Waste Type	Final Treatment/Disposal	Treatment Facility/Location
Equipment decontamination water and groundwater purge water potentially containing PFAS, metals, VOCs, and SVOCs. Assumed to be non-hazardous.	PWTS	HWF at Eielson AFB
Potentially contaminated sampling debris (including PPE, tubing*, and other debris associated with sampling)	Disposal in a municipal landfill	Fairbanks Solid Waste Facility
Project generated solid wastes (trash, debris, etc.)	Disposal in a municipal landfill	Fairbanks Solid Waste Facility

Notes:
***** Tubing is left in-place between sampling events

AFB – Air Force Base
HWF – Hazardous Waste Facility
PPE = personal protective equipment
PWTS – PFAS Wastewater Treatment Systems
SVOC – semi-volatile organic compound
VOC – volatile organic compound

5. REFERENCES

18 AAC 75. "Oil and Other Hazardous Substances Pollution Control," as amended through October 18, 2023, *Alaska Administrative Code*, Alaska Department of Environmental Conservation.

29 CFR 1910, *Code of Federal Regulations*, "Occupational Safety and Health Standards."

Ahtna Engineering Services, LLC, 2019. *Final Operations and Maintenance Manual, PFAS Wastewater Treatment System, Eielson Air Force Base, Alaska*. April.

DoD, 2023. *DoD PFAS Disposal, Cleanup, and Environmental Justice*. July.

North Wind, 2023. *Moose Creek Long-Term Water Supply Interim Remedy Continuation of Water Provisioning, Community Involvement, Treatment System Installation / Monitoring / Operations / Maintenance, Sampling and Groundwater Plume Evaluation for Eielson AFB, Alaska, Uniform Federal Policy – Quality Assurance Project Plan (UFP-QAPP)*, North Wind-EA JV, December.

ATTACHMENT 1
Eielson AFB IDW Tracking Form

Eielson AFB IDW Tracking Form						
Date of Generation	**Source Location**	**Current Location**	**CoCs**	**Volume or Weight**	**Waste Drum Number**	**Date Removed**
TOTAL						

Appendix F

Regulatory Comments

From:	Gleason, Erin (she/her/hers)
To:	SMITH, KRISTINA A CIV USAF PACAF 354 CES/CZOP; BOESE, MICHAEL L CIV USAF AFMC PACAF/AFCEC CZOP; MANGINI, WILLIAM D CIV USAF PACAF 354 CES/CZOP; DRENNING, NICOLE K CIV USAF PACAF 354 CES/CZOP; PRICE, JOSEPH E CIV USAF AFCEC 354 CES/CZOP
Cc:	Axl LeVan (axl.levan@alaska.gov); Bernhardt, Sarah P (DEC); Matthew Fleetwood (matthew.fleetwood@alaska.gov)
Subject:	[Non-DoD Source] Draft Final PFAS Plume Monitoring UFP-QAPP (dated May 2024) - EPA approval
Date:	Wednesday, July 3, 2024 8:49:09 AM
Attachments:	2024.7.3 PFAS Groundwater Plume_EPA_RTC.docx

Good Morning,

EPA has reviewed the Draft Final PFAS Plume Monitoring UFP-QAPP (dated May 2024) and corresponding RTC. All EPA comments have been resolved and this QAPP is approved. Please see attached comment table for your records.

Thank you,

Erin Gleason (she, her)
Remedial Project Manager
SEMD, U.S. EPA Region 10
Alaska Operations Office
Main: 907-271-1209

Document: Draft PFAS Plume Monitoring, Eielson AFB, UFP QAPP (dated February 2024)
Date Received: February 26, 2024
Reviewer(s): Erin Gleason, Don Clabaugh

Comment #	Page	Section	EPA Comment (May 8th, 2024)	USAF Response (May 23rd, 2024)	EPA Response (July 7th, 2024)
1	127	App B Section 3.1 Paragraph 2	Describe how the data set for the replacement wells will be compiled. Will data from the replaced wells be the initial part of the data set and data from the replacement wells be combined for the trend analysis?	Only data from the new wells will be included in the analysis. The following sentence has been added to Paragraph 2: "*No data from the wells removed from the monitoring well network will be included in the data set analyzed*."	Agreed
2		App B Table 1	Add depth to water table so that depth of top of screen can be compared, or a column that indications whether the water table is within the screened zone. Consider a data set consisting of only wells screened across the water table for comparison with MAROS results from data set with shallowest well.	Concur. The depth to water table (in feet btoc) has been added to Table 1. As very few shallow wells are not screened across the water table (less than five in either the Eielson or Moose Creek shallow well groupings), such a data set is unlikely to yield a substantially different MAROS analysis.	Agreed
3		App B Table 1	Add footnote for '*' on MWE-2. Will MW-2 be used in the well data grouping?	Yes, MW-2 is part of the Eielson Shallow grouping for the MAROS analysis. The "*" for several wells in Table 1 is	Agreed

				defined in the footnotes of this table as “Final Environmental Restoration Atlas (USAF, 2023).” Also, please note monitoring well NPB-022 was inadvertently left off Worksheet #18. This well was meant to replace 20PS-MW18 as there are numerous wells in the vicinity that are being sampled. Table 18-1 of Worksheet #18 and Figure 4 of the Draft UFP-QAPP and Figure 1 of the Waste Management Plan have been revised.	
4		App B Figure 1	Consider adding figures with just wells in each data set so that spatial coverage for each MAROS evaluations can be considered. Also, consider adding a figure with wells that screen across the water table.	Concur. An additional figure, Figure 2, has been added to display the Eielson shallow grouping wells and the Moose Creek shallow grouping wells with different colors of icons. As the intermediate and deep wells are not part of a plume analysis (only individual well trends), the spatial distribution is not applicable, and therefore, a separate figure indicating the spatial	Agreed

				distribution of these wells is not provided. Also, please note that Figure 1 has been revised to reflect which wells were added and removed for the proposed monitoring well network.	
5		App B Table 2	Describe plume thickness estimate of 50 ft. Consider comparing MAROS results for 50 ft with results with 10 ft for wells screened across the water table and/or 25 ft for shallow wells and 25 ft for deeper wells.	The plume thickness value is based on the maximum well depth being evaluated (50 feet). As most of the wells are 25 feet deep or less, the MAROS evaluation for both well groupings will be run twice: one with a plume thickness input of 25 feet, and one with a thickness of 50 feet. The effect of the plume thickness input on the plume analysis, if any, will be discussed in the report. This information has been added to Section 3.2.	Agreed
6		App B Table 2	Check effective porosity estimate of 15 % against current groundwater modeling and solute transport model calibration.	The pre-draft of the updated model uses an effective porosity of 5%. Based on discussion with the groundwater model contractor, an effective porosity between 5-15% would be reasonable for the	Agreed

				MAROS evaluation. The porosity input value has been revised to 10%.	
7			Please note that Method 1633 was finalized in January 2024. Revise throughout document.	Very few laboratories are certified to use the recent finalized Method 1633. Therefore, Draft Method 1633 will continue to be used by Eurofins. Please note Eurofins revised their SOP in October 2023 (WS-LC-0042). This update has been added to Worksheets #19/30, #23, #24, #25, #28 and the revised SOP is included in Appendix D.	Agreed
8	14, 25	Worksheet #3, worksheet #9	The titles of USAF, ADEC, and EPA in worksheet #3 are not accurate. Please coordinate with respective agencies for their accurate tites. Erin Gleason's title is "Remedial Project Manager".	Concur. The titles of USAF, ADEC, and EPA have been revised in Worksheets #3 and 5. Per ADEC, Axl LeVan is Remedial Project Manager and Sarah Bernhardt has been added as the Alternate Remedial Project Manager. The titles of USAF have been confirmed to be correct. Additionally, William Mangini has been added as an USAF Remedial PM. Also, please note Kimberley Kearney and Steven Vaughn have both retired. Worksheets #3, 4, and 5	Agreed

				have been revised by replacing Kimberley Kearney with Renee LaFata as Program Manager and Steven Vaughn has been removed as Interim PM.	
9	18	Worksheet #6	Amendments to the QAPP must be approved by EPA and ADEC either in the form of a field change form or a QAPP addendum. Please revise the third to last row in the table of worksheet #6.	A row has been added to the table indicating that amendments to the QAPP must be approved by EPA and ADEC either in the form of a field change form or a QAPP addendum.	Agreed
10	36, 46	Worksheet #11, Worksheet 14.3	The data being collected under this QAPP is delineating extent of PFAS contamination in the groundwater surrounding Eielson AFB. This information is in support of the Remedial Investigation. As such, EPA's view is that this work is a CERCLA project.	Air Force agrees that this work is performed under CERCLA. However, the purpose of this sampling effort is for long-term monitoring and not plume delineation. The work performed under this UFP-QAPP will be reported as a secondary document that will be used to support the Remedial Investigation.	Noted
11	37	Worksheet #11	Please compare the PFAS data to the most current EPA regional screening level (RSL). EPA RSL may be updated May and October of each year.	Concur. Worksheet #11 has been revised to compare the PFAS data to the current RSL. Please note that laboratory detection limits do not meet the current RSLs for PFOA and PFOS.	Agreed
12	47	Section 14.4.3	The transport of pollutants and contaminants off-site for	All PFAS IDW generated from the groundwater sampling	Agreed

			treatment, must be done at an permitted treatment facility per 121 d(3) of the NCP. Please provide additional information about US Ecology being permitted to treat CERCLA wastes or make arrangements for treatment onsite.	events will be treated on-site by the PFAS Wastewater Treatment System (PWTS) located at the Hazardous Waste Facility. WS #14 and Appendix E have been revised accordingly.	
13	49	Worksheet #15	Please use the most recent EPA RSL as your project action levels.	Concur. WS #15 has been updated to indicate that the RSLs current at the time of the pre-draft submittal will be used as screening levels. Note that laboratory detection limits do not meet the current RSLs for PFOA and PFOS. The project action levels (PALs) are based on the most recent DoD drinking water guidance.	Agreed
14	105	References	Include CERCLA in your references	Concur. Section 10.1 of WS#10 has been revised by adding references to CERCLA.	Agreed
15	108	Figure 2	Figure 2 is oddly pixilated. Please review and revise.	Concur. Figure 1 (which also appeared to be oddly pixilated) and Figure 2 have been updated.	Agreed
16	109	Figure 3	Recommend removing the reference to LHA and just say 7, 35, and 70 ppt. or USAF "action level".	Concur. “LHA” has been revised to “PAL.”	Agreed

THE STATE of ALASKA
GOVERNOR MIKE DUNLEAVY

Department of Environmental Conservation

DIVISION OF SPILL PREVENTION AND RESPONSE
Contaminated Sites Program

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July 8, 2024

File No: 107.38.006, 107.38.150

Kristina Smith
Installation Restoration Program
AFCEC CZOP
2310 Central Avenue, Suite 213
Eielson AFB, AK 99702

Re: DEC Approval of the *Final Per – and Polyfluoroalkyl Substances (PFAS) Plume Monitoring Uniform Federal Policy – Quality Assurance Project Plan, Eielson Air Force Base, Alaska,* July 2024

Dear Ms. Smith:

The Alaska Department of Environmental Conservation (DEC) has completed a review of the above referenced document and response to comments (RTCs). This UFP-QAPP provides guidance and applicable information for executing field activities, data analysis, and reporting while monitoring the Eielson PFAS plume.

Based on review DECs remaining RTCs (comments 5 & 19) were addressed in the matrix. Therefore, DEC approves the document. Please update worksheet 6 with the language from comment 5 in the final document with approval letter attached. If you have any questions, please do not hesitate to contact the DEC project manager at (907) 451-2156, or by email at axl.levan@alaska.gov.

Sincerely,

Digitally signed by Axl
Date: 2024.07.08 15:20:52 -08'00'

Axl LeVan
Remedial Project Manager

cc via email: Joe Price, AFCEC
Mike Boese, AFCEC
Nicole Drenning, AFCEC
Will Mangini, AFCEC
Erin Gleason, EPA
Sarah Bernhardt, DEC
Matthew Fleetwood, DEC

DEC Comments for the
Draft Per – and Polyfluoroalkyl Substances (PFAS) Plume Monitoring Uniform Federal Policy – Quality Assurance Project Plan, Eielson Air Force Base, Alaska, February 2024
March 8, 2024

Reviewer: Alaska Department of Environmental Conservation

Comment No.	Page	Section	Comment / Recommendation	Response
1.	General		DEC would appreciate a side-by-side figure or additions to the figures showing the changes in wells being sampled compared to previous work plans and reports.	Concur. Figure 4 of the QAPP and Figure 1 of App. B have been revised accordingly. Also, please note monitoring well NPB-022 was inadvertently left off Worksheet #18. This well was meant to replace 20PS-MW18 as there are numerous wells in the vicinity that are being sampled. Table 18-1 of Worksheet #18 and Figure 4 of the Draft UFP-QAPP and Figure 1 of the Draft Waste Management Plan have been revised. **DEC Accepts Response 5/30/2024**

Comment No.	Page	Section	Comment / Recommendation	Response
2.	General		Is sufficient data expected to be available after either of these events for the MAROS evaluation?	Individual well statistics at the new wells will be unavailable until four sample events have been collected. However, there will be sufficient data to perform trend analyses at all other wells, and to perform the MAROS plume analysis. Please refer to Section 3.1, paragraph 3 of the MAROS work plan. **DEC Accepts Response 5/30/2024**
3.	6	WS #3	Please add Sarah Bernhardt for ADEC staff. Both EPA and DEC staff should be included as Remedial Project Managers in the context of Eielson restoration work. Sarah Bernhardt is the Alternate RPM for DEC.	Concur. Worksheet #3 has been revised by adding Sarah Bernhardt as an Alternate RPM. Additionally, William Mangini has been added as an USAF Remedial PM. Also, please note Kimberley Kearney and Steven Vaughn have both retired. Worksheets

Comment No.	Page	Section	Comment / Recommendation	Response
				#3, 4, and 5 have been revised by replacing Kimberley Kearney with Renee LaFata as Program Manager and Steven Vaughn has been removed as Interim PM. **DEC Accepts Response 5/30/2024**
4.	9	WS #5	Axl Level should be LeVan. Please add Sarah as an Alternate RPM to the figure.	Concur. The spelling has been corrected and Sarah Bernhardt has been added as an Alternate RPM. **DEC Accepts Response 5/30/2024**
5.	11	WS #6	As a note for field change forms 48-hour approval would not be possible if submitted on Friday. No change to the language required, but DEC wanted to flag this in advance of the field season.	Comment acknowledged. **Note an approval of amendments section was added that indicates the North Wind PM will provide FCF. This would generally go through the Air Force PM and DEC recommends**

Comment No.	Page	Section	Comment / Recommendation	Response
				clarifying this in the WS. Concur. Worksheet #6 has been revised to state "The North Wind PM will email the field change form to the USACE PM and USAF PM, the USAF PM will then review and sign the field change form and then forward the form to EPA and ADEC for review and approval." DEC Accepts Response 7/8/2024 with note: The change was not made to the document. DEC will review field change forms sent from USAF PM as indicated in the above response to comment during field work. The above text should be

Comment No.	Page	Section	Comment / Recommendation	Response
				used in the final version of the document with DEC approval letter attached.
6.	19	WS #9	"This will be revised upon EPA announcing new maximum contaminant level that is anticipated in November 2023 (not official)." Is a change to PALs still anticipated and would it be implemented if it occurred during the field season or in advance of reporting?	Worksheet #9 pertains to the scoping meeting held on Oct. 25, 2023. The last bullet of Section 9.4 has been revised to clarify this. The most recent drinking water PFAS guidance from DoD will be used as the PAL(s). Thus, if the DoD updates the drinking water guidance to align with the MCLs, they will be used as the PALs in the report. WS #15 has been revised to include this information. **DEC Accepts Response 5/30/2024**
7.	22	WS #10	First paragraph at the page. The PFAS SI report was finalized July 2022. Please update background information.	Concur. Background has been updated to reflect that the SI has been completed.

Comment No.	Page	Section	Comment / Recommendation	Response
				DEC Accepts Response 5/30/2024
8.	28	WS #11	Step 1. DEC recommends emphasizing the lateral movement as the main sampling as well as the vertical delineation currently emphasized. The focus appears to be on the shallower wells with regards to MAROS review.	Step 1 has been revised to emphasize the lateral spread of PFAS as a primary concern. **DEC Accepts Response 5/30/2024**
9.	34	WS #13	Will any SI Report data be used? The document was finalized.	Yes, the PFOA, PFOS, aggregate PFOA/PFOS, and PFBS data from the 2022 Site Investigation was used in the 2022 report. The Worksheet has been revised to indicate that the database used from the 2022 report includes data from 2019 to 2022. Note that the 2022 SI only includes data from 2019 and 2020. **DEC Accepts Response 5/30/2024**

Comment No.	Page	Section	Comment / Recommendation	Response
10.	46	WS #17	This worksheet would be a good place to describe the changes in selected well locations and the reasoning. This could also be highlighted on the WS #18 table. DEC notes that the wells are named in Section 3.1, Appendix B.	Concur. Worksheet #17 has been revised to discuss the monitoring wells that have been removed and added to the bi-annual sampling for 2024. Worksheet #18 has been revised by bolding/highlighting the new monitoring wells. **DEC Accepts Response 5/30/2024**
11.	55	WS #19 and 30	"90 days from collection to analysis if stored at =-20°C" Based on the footnote is this type of storage expected to be used? Or will samples be run as soon as possible?	Under normal circumstances, the laboratory does not anticipate needing to freeze the samples to extend holding times in accordance with Method 1633. However, this footnote is provided in the case that unanticipated sample delays occur at the laboratory, such as increased sample backlog, instruments out of service, etc.,

Comment No.	Page	Section	Comment / Recommendation	Response
				that result in samples being stored at -20°C. If the storage of samples at -20°C becomes necessary at any point during the project, it will be noted in the individual data validation report(s) for the associated data package(s). **DEC Accepts Response 5/30/2024**
12.	57	WS #21	DEC appreciates the use of comments to clarify changes to SOPs based on PFAS in addition to the inclusion of a specific PFAS SOP.	Comment acknowledged.
13.	85	WS #36	For "Field Duplicates" if multiple Field Duplicates are flagged, DEC recommends considering flagging of additional samples beyond the parent and duplicate to capture potential larger data concerns.	Concur. Professional judgment will be used by the validators when reviewing both laboratory and field duplicates to determine if a larger data concern is present, and if necessary, apply appropriate flags beyond the parent and duplicate(s). If poor precision is observed in both field and

Comment No.	Page	Section	Comment / Recommendation	Response
				laboratory duplicates, the laboratory may be the source of the data concerns. Alternatively, if the poor precision seems limited to the field duplicates, the source of data concerns may rest in the sampling technique, sample matrix, etc. Findings of duplicate data concerns will be discussed within the data validation report(s) and annual report, where applicable. **DEC Accepts Response 5/30/2024**
14.	Figures		Can figures be improved for readability in the draft-final/final version.	Concur. The figures will be high resolution for the draft final and final versions of the reports. **DEC Accepts Response 5/30/2024**
15.	Figure 4		I think it would be helpful to highlight on this figure which wells were added or removed from the sampling effort this year.	Concur. Figure 4 of the QAPP and Figure

Comment No.	Page	Section	Comment / Recommendation	Response
				1 of App. B have been revised accordingly. **DEC Accepts Response 5/30/2024**
Groundwater Plume Evaluation Work Plan				
16.	Figure 1		Figure 1 in this section and Figure 4 in the first QAPP appear to not match (especially in the downgradient wells). Please ensure that both are matching and accurate to the plume boundaries and site maps.	Concur. Discrepancies between Figure 1 of the Work Plan and Figure 4 of the QAPP have been rectified. **DEC Accepts Response 5/30/2024**
17.	Table 2		For Plume Length and Width: Does this estimate of the length and width affect the model when the MAROS evaluation is split into two sections? Would a Source area location of the largest contributing sources make sense or is the most upgradient source the best selection? How was Plume Thickness selected? Is this based on the shallow area being evaluated or is this an averaging of the depth across the plume?	The length is input based on the dimensions of each section. The table has been revised to indicate the length of each section. The thickness is based on the shallow area being evaluated (up to 50 feet bgs). Note that the Work Plan has been revised to include a comparative analysis between a plume thickness input of 25 feet and an input

Comment No.	Page	Section	Comment / Recommendation	Response
				of 50 feet (Section 3.2). **DEC Accepts Response 5/30/2024**
18.	Appendix C		Some but not all the SOPs have a Project-Specific Variance Form. If these were intended to be included, please include for all SOPs. The additions to Worksheet #21 are sufficient for DEC, but the forms may be helpful in the field.	Project-Specific Variance forms have been removed from SOPs as applicable. **DEC Accepts Response 5/30/2024**
Draft Waste Management Plan				
19.	7	4	It may be worth reiterating in this section that regulatory approval (signed ADEC Transport and Disposal form) will occur before any off-base transport.	IDW will not be transported offsite as initially planned. Waste will be treated at the PFAS Wastewater Treatment System located at the Hazardous Waste Facility at Eielson AFB. The WMP and Section 14.4 of the QAPP have been updated accordingly. **DEC Accepts Response 5/30/2024 with note: The second paragraph of 3.1 should be removed or section 3.4 regarding transport approval**

Comment No.	Page	Section	Comment / Recommendation	Response
				should be added back. Currently the accumulation section implies that IDW could leave base for treatment but all references to the transport approval forms have been removed. Concur. The 2nd paragraph of Section 3.1 has been deleted. DEC Accepts Response 7/8/2024
End of comments				