PROGRAMMATIC
UNIFORM FEDERAL POLICY
QUALITY ASSURANCE PROJECT PLAN

REMEDIAL INVESTIGATIONS FOR PER- AND POLYFLUOROALKYL SUBSTANCES (PFAS) AT MULTIPLE AIR NATIONAL GUARD INSTALLATIONS

JOE FOSS FIELD, SOUTH DAKOTA
TRUAX FIELD, WISCONSIN
VOLK FIELD, WISCONSIN

DRAFT FINAL

Prepared for:

ANG Readiness Center
NGB/A4VR

December 2021

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Draft Final
Programmatic
Uniform Federal Policy
Quality Assurance Project Plan

Remedial Investigations for Per- and Polyfluoroalkyl Substances (PFAS) at Multiple Air National Guard Installations

Joe Foss Field, South Dakota
Truax Field, Wisconsin
Volk Field, Wisconsin

Prepared for:

ANG Readiness Center, NGB/A4VR
3501 Fetchet Avenue
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Under Contract to:

U.S. Army Corps of Engineers, Omaha District
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December 2021
Contract No. W9128F-18-D-0026/ Delivery Order: W9128F20F0325
EA Project No. 6332106

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LIST OF ACRONYMS AND ABBREVIATIONS

°C	Degrees Celsius
%RSD	Percent relative standard deviation
µg/kg	Microgram(s) per kilogram
µg/L	Microgram(s) per liter
4:2 FTS	4:2 Fluorotelomer sulfonate
6:2 FTS	6:2 Fluorotelomer sulfonate
8.2 FTS	8:2 Fluorotelomer sulfonate
AAOF	Army Aviation Operating Facility
AASF	Army Aviation Support Facility
AEC	Anion exchange capacity
AFFF	Aqueous film forming foam
amu	Atomic mass unit(s)
ANG	Air National Guard
APP	Accident Prevention Plan
ASD	Assistant Secretary of Defense
ASTM	ASTM International
B.A.	Bachelor of Arts
bgs	Below ground surface
B.S.	Bachelor of Science
C	Carbon
CA	Corrective Action
CAS	Chemical Abstracts Service
CCB	Continuing calibration blank
CCV	Continuing calibration verification
CEC	Cation exchange capacity
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CIH	Certified Industrial Hygienist
CMQ/OE	Certified Manager of Quality/Organizational Excellence
CPOC	Chemical(s) of potential concern
CQCS	Contractor Quality Control Supervisor
CSM	Conceptual site model
CSP	Certified Safety Professional
DL	Detection Limit
DoD	Department of Defense
DoE	Department of Energy
DPT	Direct push technology
DQCR	Daily Quality Control Report
DQI	Data quality indicators

LIST OF ACRONYMS AND ABBREVIATIONS (continued)

DQO	Data Quality Objective
DUA	Data usability assessment
EA	EA Engineering, Science, and Technology, Inc., PBC
EC	Electrical conductivity
ECSM	Ecological conceptual site model
ELAP	Environmental Laboratory Accreditation Program
EM	Environmental Manager
ERPIMS	Environmental Resources Program Information Management System
FTA	Fire Training Area
GC	Gas chromatography
GC/MS	Gas chromatography/mass spectrometry
GPS	Global Positioning System
HA	Health Advisory
HDPE	High-density polyethylene
HHRA	Human health risk assessment
HPLC	High-performance liquid chromatography
HPT	Hydraulic profiling tool
HRSC	High resolution site characterization
HTRW	Hazardous, toxic, and radioactive waste
ICAL	Initial calibration
ICB	Initial calibration blank
ICP	Inductively coupled plasma
ICV	Initial calibration verification
IDW	Investigation-derived waste
IDQTF	Intergovernmental Data Quality Task Force
ISO	International Organization for Standardization
LCS	Laboratory control sample
LCSD	Laboratory control sample duplicate.
LC/MS/MS	Liquid Chromatography Tandem Mass Spectrometry
LOD	Limit of detection
LOQ	Limit of quantification
MDL	Method detection limit
mg	Milligram(s)
mg/kg	Milligram(s) per kilogram
mL	Milliliter(s)
mm	Millimeter(s)

LIST OF ACRONYMS AND ABBREVIATIONS (continued)

MPC	Measurement performance criteria
M.S.	Master of Science
MS	Matrix spike
MSD	Matrix spike duplicate
MW	Monitoring well
NA	Not applicable
ND	Non-detect
NEtFOSAA	N-ethyl perfluorooctane sulfonamidoacetic acid
NMeFOSAA	N-methyl perfluorooctane sulfonamidoacetic acid
ng/L	Nanogram(s) per liter
NGB/A4VR	National Guard Bureau/Environmental Restoration Branch
No.	Number
OSHA	Occupational Safety and Health Administration
PA	Preliminary Assessment
PDT	Project delivery team
PE	Professional Engineer
PFAS	Per- and polyfluoroalkyl substances
PFBA	Perfluorobutanoic acid
PFBS	Perfluorobutane sulfonate
PFC	Perfluorinated compound
PFDA	Perfluorodecanoic acid
PFDoA	Perfluorododecanoic acid
PFDS	Perfluorodecane sulfonate
PFHpA	Perfluoroheptanoic acid
PFHpS	Perfluoroheptane sulfonate
PFHxA	Perfluorohexanoic acid
PFHxS	Perfluorohexane sulfonate
PFNA	Perfluorononanoic acid
PFNS	Perfluorononane sulfonate
PFOA	Perfluorooctanoic acid
PFOS	Perfluorooctane sulfonate
PFOSA	Perfluorooctanesulfonamide
PFPA	Perfluoropentanoic acid
PFPS	Perfluoropentane sulfonate
PFTeDA	Perfluorotetradecanoic acid
PFTriDA	Perfluorotridecanoic acid
PFUnA	Perfluoroundecanoic acid
PG	Professional Geologist
PhD	Doctor of Philosophy
PM	Project Manager

LIST OF ACRONYMS AND ABBREVIATIONS (continued)

PMP	Project Management Professional
POC	Point of Contact
QA	Quality assurance
QAPP	Quality Assurance Project Plan
QC	Quality control
QSM	Quality Systems Manual
RCRA	Resource Conservation and Recovery Act
RI	Remedial investigation
RPD	Relative percent difference
RPM	Restoration Program Manager
RSL	Regional Screening Level
RTC	Regional Training Center
SD	South Dakota
SI	Site Inspection
SL	Screening Level
SLERA	Screening level ecological risk assessment
SOP	Standard operating procedure
SSHP	Site Safety and Health Plan
su	Standard unit(s)
SVOC	Semivolatile organic compound
TBD	To be determined
TCLP	Toxicity Characteristic Leaching Procedure
TO	Task Order
TOC	Total organic carbon
TPP	Technical project planning
TSA	Technical system audit
UCL	Upper confidence limit
UFP-QAPP	Uniform Federal Policy-Quality Assurance Project Plan
USACE	U.S. Army Corps of Engineers
USEPA	U.S. Environmental Protection Agency
VOC	Volatile organic compound
WI	Wisconsin
WP	Work Plan
ZHE	Zero headspace extractor

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INTRODUCTION

This *Draft Programmatic Uniform Federal Policy-Quality Assurance Project Plan (UFP-QAPP), Remedial Investigations at Multiple Air National Guard Installations* has been prepared to support remedial investigation (RI) activities for per- and polyfluoroalkyl substances (PFAS) at multiple Air National Guard (ANG) facilities, including Joe Foss Field, South Dakota (SD), Truax Field, Wisconsin (WI), and Volk Field, WI.

EA Engineering, Science, and Technology, Inc., PBC (EA) has prepared this Programmatic UFP-QAPP under contract with the U.S. Army Corps of Engineers (USACE) Omaha District, W9128F-18-D-0026; Task Order (TO) Number (No.) W9128F20F0325 for the Air National Guard (ANG) and the National Guard Bureau/Environmental Restoration Branch (NGB/A4VR). Services covered under this Programmatic UFP-QAPP are defined in the Performance Work Statement (PWS) dated 17 August 2020 and includes investigations to evaluate the nature and extent of PFAS from the validated aqueous film forming foam (AFFF) release locations and other potential non-AFFF and secondary PFAS releases at Joe Foss Field, Truax Field, and Volk Field.

The RI includes site characterization activities to delineate the nature and extent of PFAS resulting from past aqueous film-forming foam (AFFF) releases and other potential non-AFFF (e.g., chrome plating facilities, car washes) and secondary PFAS releases (e.g., landfills, oil/water separators). Activities also include updating the CSM and completing a risk assessment. For the purposes of this RI, delineation is defined as the lateral and vertical extent of PFAS in all impacted media. At the conclusion of RI activities, the data should be sufficient to:

- Develop a comprehensive understanding of the vertical and lateral extent of PFAS in soil, groundwater, sediment, and surface water;
- Determine the source strength of residual PFAS in soil within the unsaturated source zones;
- Identify potential exposure pathways to humans (and incorporate into the CSM); and
- Complete a human health risk assessment.

The Programmatic UFP-QAPP has been prepared in accordance with the *Uniform Federal Policy for Quality Assurance Project Plans* (Intergovernmental Data Quality Task Force [IDQTF] 2005a, 2005b, and 2005c), using optimized UFP-QAPP Worksheets in accordance with IDQTF guidance (IDQTF 2012). The UFP-QAPP format fulfills the requirements of the U.S. Environmental Protection Agency's (USEPA) guidance documents QA/R-5 (EPA 2001) and QA/G-4 (USEPA 2006). This document provides the programmatic strategy for conducting RIs, defines the sampling objectives and methods that will be used (including associated standard operating procedures [SOPs] (Appendix A), and includes the project organization, Data Quality Objective (DQO) process, the generic schedule, the programmatic approach to conceptual site model (CSM) development, project quality objectives, and techniques that may be applied to sites and decision criteria. Laboratory SOPs are included in Appendix B. This programmatic Work Plan includes a Quality Control Plan that describes procedures to ensure quality control during the defined scope of work (Appendix C), Accident Prevention Plan that discusses the general hazards associated with this work (Appendix D), Waste Management Plan that provides the framework for handing of wastes generated during the RIs (Appendix E), and general field forms to be used during the RIs (Appendix F).

Installation-specific addenda to this Programmatic UFP-QAPP, including an installation-specific Health and Safety Plan, will be prepared to provide installation-specific details including background information, CSMs, sampling locations and analytical requirements, installation-specific hazards, hospital routes, points of contact, and other pertinent details to conduct an RI at each site. **Table 1** illustrates the specific Programmatic UFP-QAPP worksheets that will be modified as part of the installation specific addenda.

Table 1: Comparison of Programmatic UFP-QAPP to Installation-Specific Addenda

Worksheet	Applicable Document
Worksheets #1 and #2 – Title and Approval Page and QAPP Identifying Information	Programmatic/Site-Specific
Worksheets #3 and #5 – Project Organization and QAPP Distribution	Programmatic/Site-Specific
Worksheets #4, #7, #8 – Personnel Qualifications and Sign-off Sheet	Programmatic/Site-Specific
Worksheet #6 – Communication Pathways	Programmatic/Site-Specific
Worksheet #9 – Project Planning Session Summary	Programmatic/Site-Specific
Worksheet #10 – Conceptual Site Model	Site-Specific
Worksheet #11 – Project/ Data Quality Objectives	Programmatic/Site-Specific
Worksheet #12 – Measurement Performance Criteria	Programmatic
Worksheet #13 – Secondary Data Uses and Limitations	Site-Specific
Worksheets #14 and #16 – Project Tasks and Schedule	Programmatic/Site-Specific
Worksheet #15 – Screening Limits and Laboratory- Specific Detection/ Quantitation Limits	Programmatic
Worksheet #17 – Sampling Design and Rationale	Site-Specific
Worksheet #18 – Sampling Locations and Methods	Site-Specific
Worksheets #19 and #30 – Sample Containers, Preservation and Hold Times	Programmatic
Worksheet #20 – Field Quality Control Summary	Programmatic/Site-Specific
Worksheet #21 – Field Standard Operating Procedures	Programmatic
Worksheet #22 – Field Equipment Calibration, Maintenance, Testing and Inspection	Programmatic
Worksheet #23 – Analytical Standard Operating Procedures	Programmatic
Worksheet #24 – Analytical Instrument Calibration	Programmatic
Worksheet #25 – Analytical Instrument and Equipment Maintenance, Testing and Inspection	Programmatic
Worksheets #26 and #27 – Sample Handling, Custody and Disposal	Programmatic
Worksheet #28 – Analytical Quality Control and Corrective Actions	Programmatic
Worksheet #29 – Project Documents and Records	Programmatic
Worksheets #31, #32 and #33 – Assessments and Corrective Action	Programmatic
Worksheet #34 – Data Verification and Validation Inputs	Programmatic
Worksheet #35 – Data Verification Procedures	Programmatic
Worksheet #36 – Data Validation Procedures	Programmatic
Worksheet #37 – Data Usability Assessment	Programmatic

All personnel involved in field work will be required to review this Programmatic UFP-QAPP and associated SOPs as well as the UFP-QAPP Addenda prior to performing field work.

BACKGROUND

PFAS are classified as emerging environmental contaminants based on increasing regulatory interest, potential risk to human health and the environment, and evolving regulatory standards. The U.S. Environmental Protection Agency (USEPA) issued Drinking Water Health Advisories for perfluorooctanoic acid (PFOA) and perfluorooctane sulfonate (PFOS) in May 2016 (USEPA 2016a and 2016b).

In 2019, DoD adopted Screening Levels (SLs) for soil and groundwater, as described in a memorandum from the Office of the Assistant Secretary of Defense (ASD) titled "*Investigating PFAS Substances within the DoD Cleanup Program*" and signed into use on 15 September 2021 (ASD 2021). The ANG program under which these RIs will be performed follows this DoD policy. The maximum site concentrations for sampled media exceeded the values established in the ASD memorandum for Joe Foss Field, Truax Field, and Volk Field, based on the results of site inspections (SIs) completed at these facilities, and each are being carried forward to the next phase (RIs) following the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) process. The ASD SLs apply to three compounds: PFOS, PFOA, and perfluorobutanesulfonic acid (PFBS). Screening levels to be used during the RI are provided in UFP-QAPP Worksheet #15.

During the SIs at Joe Foss Field, Truax Field and Volk Field, multiple potential AFFF release locations were investigated at each installation (Figures 1 through 3). A summary of previous investigations is included in the installation-specific UFP-QAPP addendum for each installation.

PURPOSE AND SCOPE OF WORK

The overall goal of this project is to conduct RIs at Joe Foss Field, Truax Field, and Volk Field where AFFF or other PFAS containing materials were stored, used, and released as confirmed in the SI, in compliance with CERCLA, as amended; the National Contingency Plan (40 Code of Federal Regulations Part 300); and in compliance with USACE Requirements and Guidance for field investigations including specific requirements for sampling for PFAS. RI activities will be consistent with the ANG guidance for conducting investigations under the Environmental Restoration Program (ERP) (ANG 2009).

The Programmatic UFP-QAPP and site-specific addenda will provide instruction and guidance to support the collection, analysis, and reporting of data generated under this TO to ensure that data are scientifically valid, legally defensible, and meet the established quality assurance (QA) and quality control (QC) objectives. These documents have been developed to address the data acquisition, management, sampling locations, sample analysis, installation information, and DQOs.

The list of PFAS that will be analyzed during the execution of this TO is included in Worksheet #15. PFAS analyses will be conducted using liquid chromatography and tandem mass spectrometry (LC/MS/MS) using isotope dilution compliant with Table B-15 of the Quality Systems Manual for Environmental Laboratories (QSM), Version 5.3 (Department of Defense

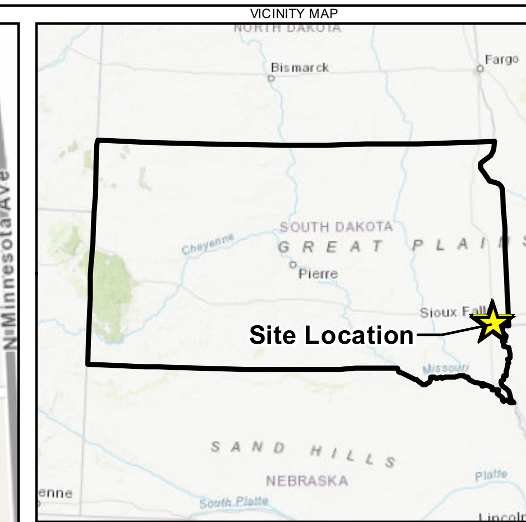
[DoD] and Department of Energy [DoE], 2019) or a more recent version to which the laboratory is accredited.

PLAN ORGANIZATION

This UFP-QAPP is organized with the original 37 worksheets consolidated into optimized UFP-QAPP worksheets (IDQTF 2012). The UFP-QAPP is intended to provide the problem definition; approach to resolving the problem; and QA/QC activities, to ensure that the data collected are usable. The table of contents of this document presents a listing of all the UFP-QAPP worksheets.

Appendices to this UFP-QAPP, provided as separate tabs, are as follows:

- Appendix A – Field SOPs
- Appendix B – Laboratory SOPs and Certificates
- Appendix C – Quality Control Plan
- Appendix D – Accident Prevention Plan (APP)
  - Attachment A – Activity Hazard Analyses
  - Attachment B – Occupational Safety and Health Administration (OSHA) Form 300 and 300A
  - Attachment C – Resumes and Certifications
  - Attachment D – Safety Field Forms
  - Attachment E – Site Safety and Health Plan (SSHP)
  - Attachment F – Safety Data Sheets
  - Attachment G – Biological Photographic Log
- Appendix E – Waste Management Plan
- Appendix F – Field Forms



Legend

- Installation Boundary
- Potential Release Areas (PRLs)

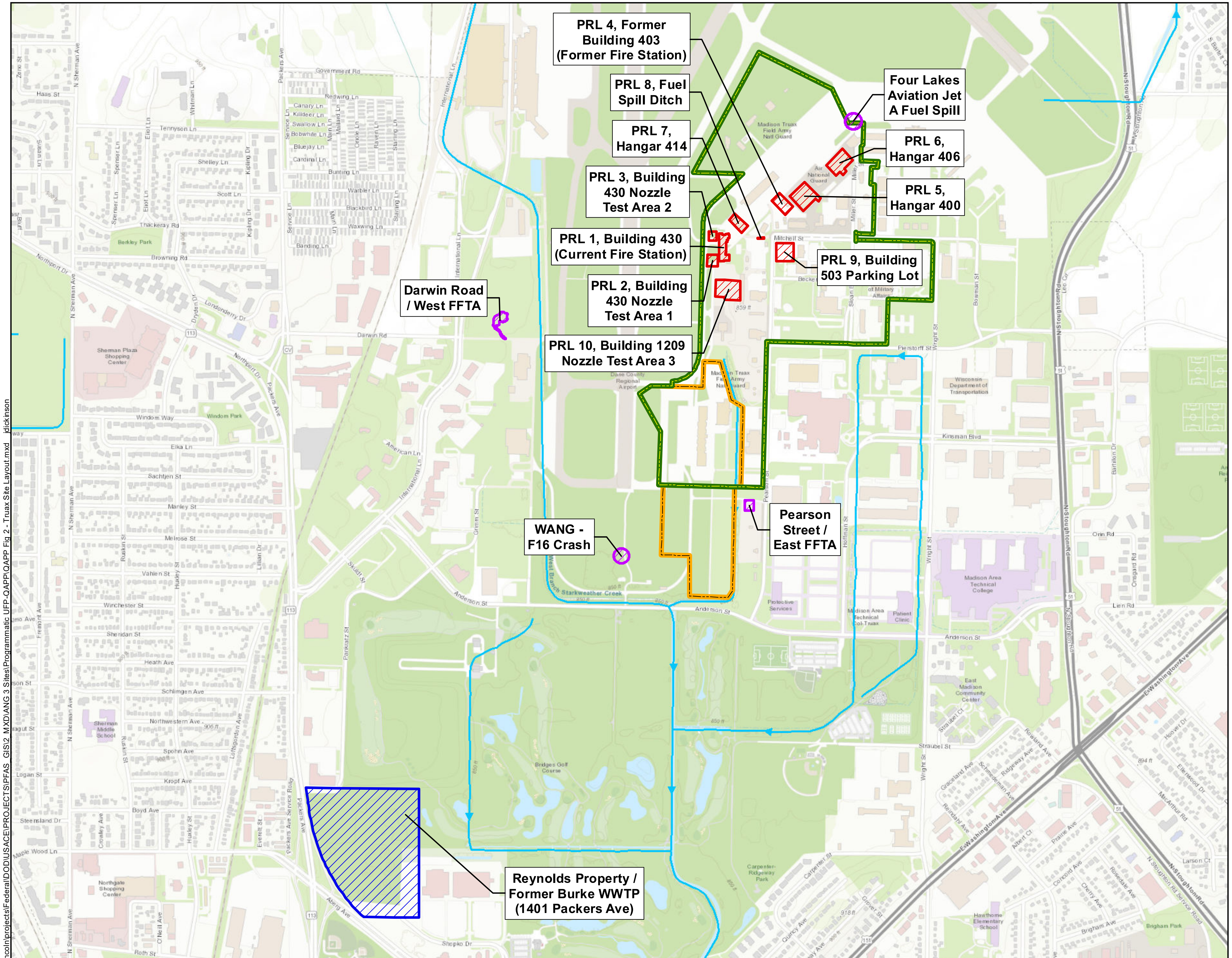
Map Date: 9/20/2021

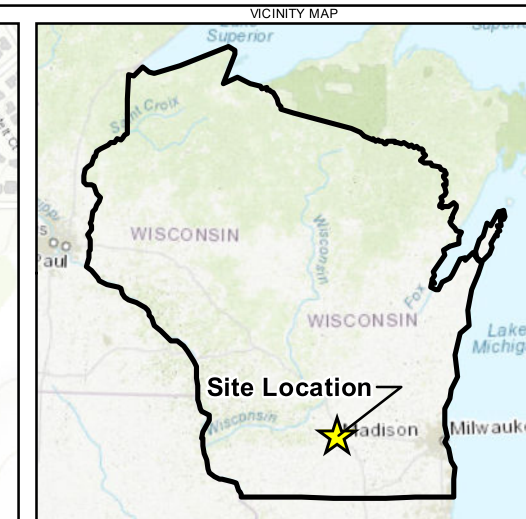
Coordinate System: NAD 1983 StatePlane South Dakota South FIPS 4002 Feet

0 600 1,200
Feet

Figure 1
Joe Foss Field Air National Guard Base
Site Layout Map
RIs at Multiple ANG Installations
Sioux Falls, South Dakota

\\lincoln\projects\Federal\DOD\USACE\PROJECTS\PFAS_GIS\2_MXD\ANG 3 Sites\Programmatic UFP-QAPP\QAPP Fig 1 - Joe Foss Site Layout.mxd jdickinson





- Installation Boundary
- Wisconsin Army National Guard
- On-Base PRLs and FFTAs
- Off-Base PRLs and FFTAs
- Reynolds Property / Former Burke WWTP

PRLs - Potential Release Area
FFTAs - Fire Fighting Training Area
WWTP - Waste Water Treatment Plant

Map Date: 12/13/2021

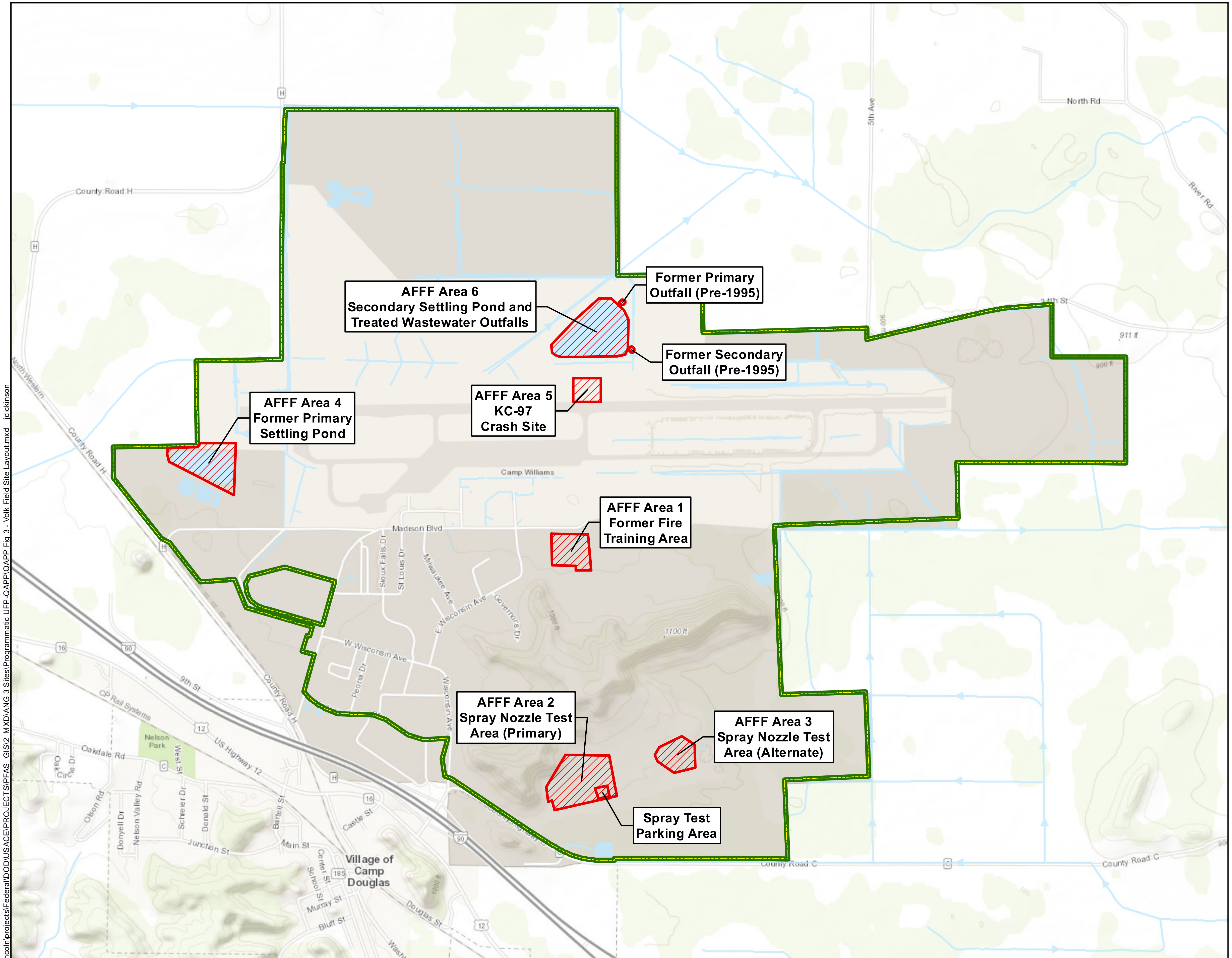
Coordinate System: NAD 1983 StatePlane Wisconsin South FIPS 4803 Feet

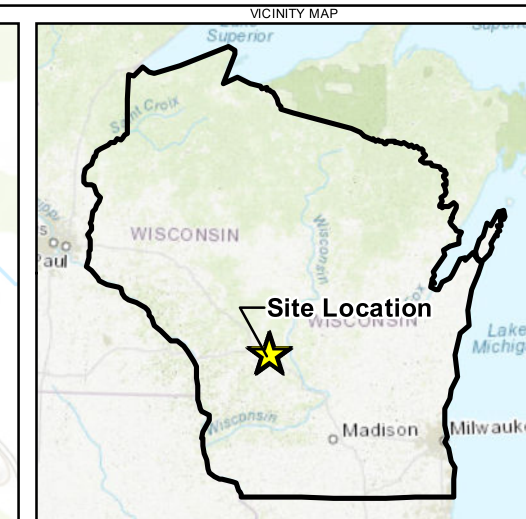
N

0 1,000 2,000
Feet

Figure 2
Truax Field Air National Guard Base Site Layout Map
RIs at Multiple ANG Installations
Madison, Wisconsin

\\lincoln\projects\Federal\DOD\USACE\PROJECTS\PFAS_GIS\2_MXD\ANG 3 Sites\Programmatic UFP-QAPP\QAPP Fig 2 - Truax Site Layout.mxd jdickinson





Legend

- Installation Boundary
- AFFF Areas

Map Date: 9/20/2021

Coordinate System: NAD 1983 StatePlane Wisconsin South FIPS 4803 Feet

0 1,500 3,000
Feet

Figure 3
Volk Field CRTC
Site Layout Map
RIs at Multiple ANG Installations
Camp Douglas, Wisconsin

\\lincoln\projects\Federal\DOD\USACE\PROJECTS\PFAS_GIS\2_MXD\ANG 3 Sites\Programmatic UFP-QAPP\QAPP Fig 3 - Volk Field Site Layout.mxd jdickinson

QAPP Worksheets #1 & 2: Title and Approval Page

Site Number/Code: Joe Foss Field, SD; Truax Field, WI; Volk Field, WI

Contractor Name: EA Engineering, Science, and Technology, Inc., PBC (EA)

Contract Number: W9128F-18-D-0026

Work Assignment Number: Task Order W9128F20F0325

Document Title: Programmatic Uniform Federal Policy Quality Assurance Project Plan, Remedial Investigation at Multiple Air National Guard Installations

Project Lead: National Guard Bureau/Environmental Restoration Branch (NGB/A4VR)

Preparation Date: December 2021

Investigative Organization
Signature/Date: ____
Printed Name/Title: Cybil Boss / EA Project Manager

Project Lead
Signature/Date: ____
Printed Name/Title: Bill Myer / NGB/A4VR Restoration Program Manager (RPM) (Truax Field and Volk Field)

Project Lead
Signature/Date: ____
Printed Name/Title: Keith Freihofer / NGG/A4VR RPM (Joe Foss Field)

Contracting Organization PM
Signature/Date: ____
Printed Name/Title: Rich Anderson / USACE Omaha District Project Manager

Other Approval
Signature/Date: ________________________________
Printed Name/Title: Frank Barranco PhD, PG, PE, CMQ/OE / EA Director of Quality Control

Other Approval
Signature/Date: ________________________________
Printed Name/Title: Samantha Saalfield, PhD / EA Program Chemist.

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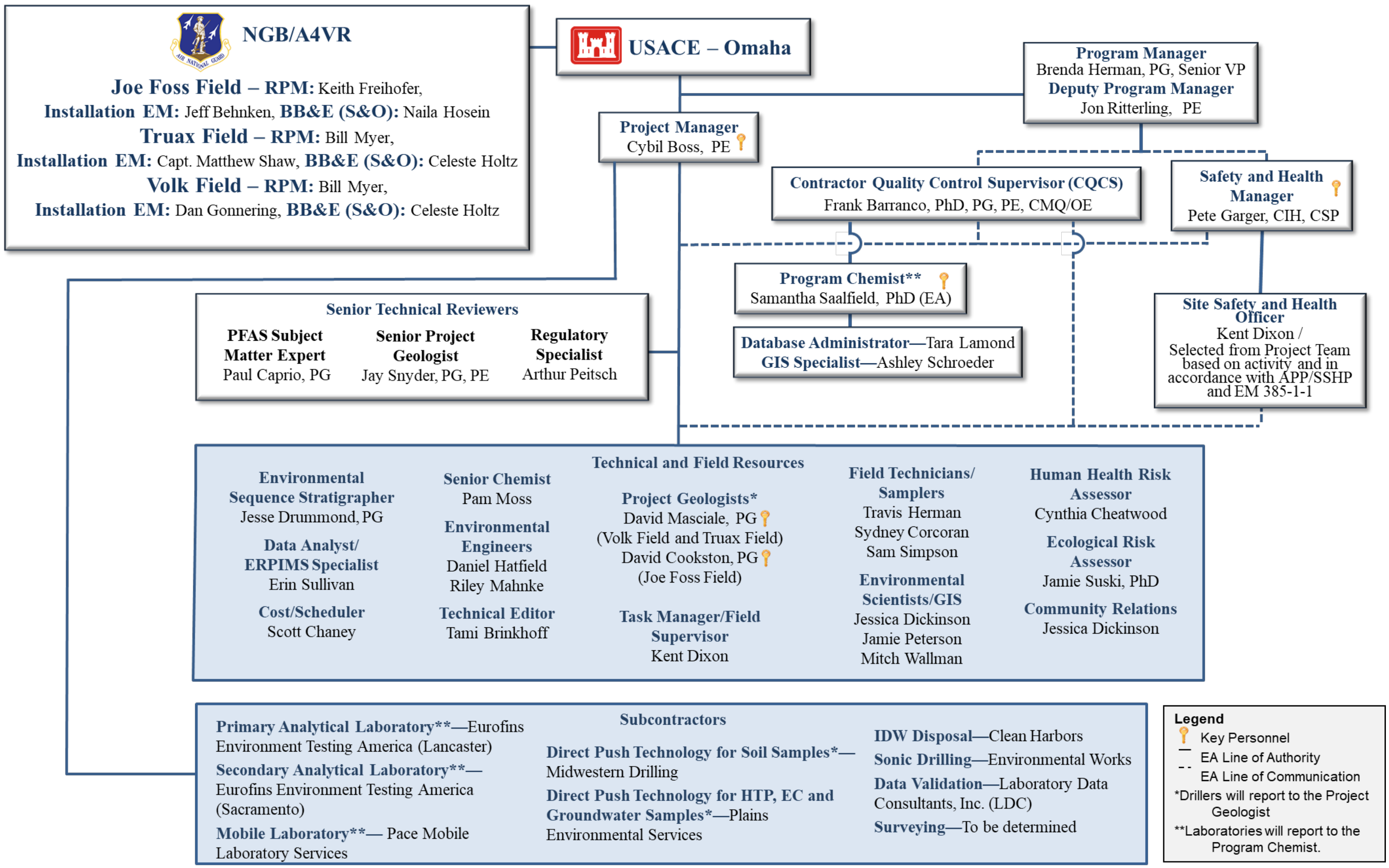
QAPP Worksheets #3 & 5: Project Organization and QAPP Distribution



Distribution List:

Draft:	2 Electronic copies to USACE Project Manager (PM) 2 Electronic copies NGB/A4VR RPM 1 Hard Copy and 2 Electronic Copies to Installation Environmental Manager (EM)	**Draft-Final and Final:**	2 Electronic copies to USACE PM 2 Electronic copies NGB/A4VR RPM 1 Hard Copy and 2 Electronic Copies to Installation EM* 1 Hard Copy and 2 Electronic Copies to State Regulator* * For installation-specific UFP-QAPPs. Distribution timing and type (electronic/hard copies) preferences will be discussed with the team prior to submittal.

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605-988-5798
jeffrey.behnken.2@us.af.mil

<u>Installation EM (Truax Field)</u>
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Dane County Regional Airport
Truax Field
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matthew.shaw.3@us.af.mil

Installation EM (Volk Field)
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daniel.gonnering.1@us.af.mil

State Regulatory Agency
Agency point of contact (POC) – Completed as part of site-specific addendum

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

Name	Project Title/Role	Education/Experience	Specialized Training/Certifications	Signature/Date
Organization: EA				
Brenda Herman	EA Program Manager	Master of Science (M.S.) Geology, Bachelor of Science (B.S.) Biology; 30 years of experience managing environmental contracts and projects, including 18 years of experience as a Program Manager for USACE contracts	Professional Geologist (PG)	
Jon Ritterling	EA Deputy Program Manager	M.S. Civil Engineering, B.S. Civil Engineering; 25+ years of experience in environmental remediation, including managing hazardous, toxic, and radioactive waste (HTRW) projects at multiple locations across the United States, including more than 20 military installations, both active and inactive. More than 15 years of experience providing oversight of RIs.	Professional Engineer (PE) PM (EA)	
Cybil Boss	EA Project Manager	B.S. Chemical Engineering; 15+ years of experience in environmental remediation and project management, including planning, investigation, remedial design, task and field manager supervision, data analysis and reporting, and regulatory/stakeholder engagement and coordination at multiple Air Force installations.	PE PM (EA)	
Frank Barranco	EA Contractor Quality Control Supervisor (CQCS)	B.S. Geology, Doctor of Philosophy (PhD) Environmental Science and Engineering; 25 years of experience in environmental site investigation, providing technical and quality direction on contaminated groundwater/soil/ sediment projects. 11 years as Corporate QC Officer for $600 million of federal contracts, including remediation activities at HTRW and emerging contaminants (PFAS) sites. 2,000+ hours of training in quality management, HTRW field sampling protocol, sustainability, DQO development, contaminant transport, and environmental engineering.	PhD PG PE Manager of Quality/ Organizational Excellence (CMQ/OE)	

Name	Project Title/Role	Education/Experience	Specialized Training/Certifications	Signature/Date
Samantha Saalfield	EA Program Chemist	PhD Earth Sciences, Bachelor of Arts (B.A.) Geology-Chemistry; 15 years of environmental chemistry experience. Supported chemistry needs on 50+ project sites with environmental contamination, including PFAS at 5 sites. Ensures laboratories used have proper DoD Environmental Laboratory Accreditation Program (ELAP) method/lab specific accreditations. Oversees analytical method selection, laboratories, and data validators.	PhD	
Pete Garger	EA Health and Safety Manager	M.S. Environmental Health Science, B.A. Chemistry; 33 years of experience in managing and conducting industrial hygiene services including inspections and oversight on environmental remediation projects. Oversees development of: APP /SSHP; identification/evaluation of chemical, physical, radiological, and biological hazards; medical surveillance programs; personal protective equipment; employee training requirements; environmental monitoring; and proper reporting.	Certified Industrial Hygienist (CIH) Certified Safety Professional (CSP)	
Organization: Eurofins Lancaster Laboratories Environmental (Analytical Laboratory)				
Vanessa Badman	Project Manager	B.S. in Biology, 18 years of environmental laboratory experience.	Not applicable	
Dorothy Love	Director, Quality Assurance	B.S. Environmental Health; 30 years of experience in laboratory analyses and quality control.	Not applicable	
Organization: Eurofins TestAmerica Sacramento California (Analytical Laboratory)				
David Alltucker	Project Manager	B.A. Chemistry, 13 years of experience in laboratory project management.	Not applicable	

Name	Project Title/Role	Education/Experience	Specialized Training/Certifications	Signature/Date
Lisa Stafford	Quality Assurance Manager	B.S. Chemistry, 13 years of experience in the analytical industry to her current role in the Quality Assurance department.	Not applicable	
Organization: Pace Mobile Laboratory (On-Site Screening Laboratory)				
Mike Rossi	Project Manager	B. S. Chemistry, M.S. Environmental Engineering, 30 years of experience.	Not applicable	
Patrick Letterer	Quality Assurance Manager	B. A. Biology, 35 years of experience	Not applicable	
Organization: Laboratory Data Consultants (Data Validation)				
Stella Cuenco	Principal Chemist and Program Manager	B.S. Chemistry; Over 27 years of environmental laboratory and data validation experience under DoD and USEPA guidelines. Experience includes performance of data validation in LC/MS/MS for PFAS.	Not applicable	
Pei Geng	Project Manager	M.S. Chemistry; 28 years of overall laboratory and data validation experience, and 21 years of data validation experience. Performs data validation for LC/MS/MS PFAS analyses, and serves as a peer reviewer in the initial validation review process.	Not applicable	

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QAPP Worksheet #6: Communication Pathways

Discussion with stakeholders in the decision process will be aided by the submittal of monthly progress reports detailing activities at ANG installations.

Communication Drivers	**Responsible Entity**	**Name**	**Phone Number**	**Role/Procedure** (Timing, pathways, etc.)
Modifications to Program	USACE PM	Rich Anderson	402-995-2295	Primary POC for USACE. Programmatic information, coordination issues, and draft and final reports. Coordination and resolution of issues between USACE / NBG/A4VR / State Regulatory Agencies. By email or phone as needed.
Modifications of Contractual Responsibilities	USACE Contracting Officer	Lisa Sirois	402-995-2072	All contracting, work/invoice approval/authorization. By email or phone as needed.
Contractual modification and/or program performance	EA Program Manager	Brenda Herman	402-584-7000 410-913-1681 (cell)	Communicates with USACE Contracting Officer and other USACE personnel at the programmatic level regarding overall performance.
Manage all project phases/overall technical leads	EA Project Manager	Cybil Boss	402-817-7613 402-304-3243 (cell)	Responsible for overall management and execution of the project. Maintains lines of communication with USACE and NGB/A4VR. Communicates field changes to the USACE and NGB/A4VR and discusses options prior to implementation. Receives direction from the USACE regarding communications with other stakeholders.
Project Safety	EA Health & Safety Supervisor	Pete Garger	410-527-2425	Communicates with EA PM regarding safety issues. Reviews and approves safety plans, conducts audits, and exercises stop-work authority, if needed.
Project QA/QC and Corrective Actions	EA CQCS	Frank Barranco, PhD, PG, PE, CMQ/OE	410-584-7000	Communicates with EA PM regarding QC/QA issues. Reviews and approves corrective action plans.
Modifications to Analytical Corrective Actions	EA Program Chemist	Samantha Saalfield, PhD	410-584-7000	Reports on the adequacy, status, and effectiveness of the QA program by phone or email during weekly progress calls and as needed.
Laboratory Corrective Actions and QA Modifications	Eurofins Lancaster Laboratory QA Manager	Dorothy Love	717-556-7327	Reports project nonconformance issues within 1 week to the Laboratory Project Manager in person or by phone, or email.

Communication Drivers	Responsible Entity	Name	Phone Number	Role/Procedure (Timing, pathways, etc.)
Laboratory Corrective Actions and QA Modifications	Eurofins TestAmerica Sacramento QA Manager	Lisa Stafford	916-373-5600	Reports project nonconformance issues within 1 week to the Laboratory Project Manager in person or by phone, or email.
Laboratory Corrective Actions and QA Modifications	Pace Laboratory QA Manager	Patrick Letterer	608-221-8700	Reports project nonconformance issues within 1 week to the Laboratory Project Manager in person or by phone, or email.
Modifications to Eurofins analytical responsibilities	Eurofins Lancaster Project Manager	Vanessa Badman	717-556-9762	Report project nonconformance issues within 1 week to the Program Chemist by phone, or email
Modifications to Eurofins analytical responsibilities	Eurofins TestAmerica Sacramento Project Manager	David Alltucker	906-373-5600	Report project nonconformance issues within 1 week to the Program Chemist by phone, or email
Modifications to Pace analytical responsibilities	Pace Project Manager	Mike Rossi	802-839-0544	Report project nonconformance issues within 1 week to the Program Chemist by phone, or email
Modification to data validation responsibilities	Data Validation Project Manager	Pei Geng	760-827-1100	Report project nonconformance issues within 1 week to the Program Chemist by phone, or email.
Installation Interface	NGB/A4VR RPMs and Installation EMs	Various, Installation specific	To be determined (TBD)	Communicate project scope/schedule and coordinate logistics between project team and installation personnel on an as-needed basis, documented via phone records and emails. Facilitate information transfer between contractor and installation and support contractor acquisition of site-specific information (i.e., drawing layers, access information, utility maps, etc.) as needed to conduct the RI.
Regulatory Agency Interface	NGB/A4VR RPMs and /or Installation EMs	Various, Installation specific	TBD	Communicate technical approaches, schedule, and decisions directly to regulatory agencies' representative(s) on an as-needed basis, documented via phone records and emails. Facilitate/support setup of project planning meeting(s) with regulator, USACE and NGB/A4VR, document distribution and comment/response process.

QAPP Worksheet #9: Project Planning Session Summary

KICKOFF MEETING

Title: Kickoff Meeting
Meeting Location: Teleconference
Date of Session: 7 October 2020

Participants:

Attendees	Organization/TO Role
Jordan Bradley	USACE PM
Jennifer Zorinsky	USACE Technical Expert
Brian Boccellato	USACE Geologist
Andrea Sansom	USACE Chemist
Jessica Hoppmann	USACE Risk Assessor
Veronica Brieno-Rankin	NGB/A4VR Environmental Restoration Branch Chief
Jim King	NGB/A4VR RPM, Volk Field and Truax Field
Keith Freihofer	NBG/A4VR RPM, Joe Foss Field
Naila Hosein	BB&E
Celeste Holtz	BB&E
Cybil Boss	EA – PM
Jon Ritterling	EA – Senior PM
Samantha Saalfield	EA – Program Chemist

Notes/Comments:

1. Introductions

- Jon Ritterling started the call with an introduction for himself and for each of the EA personnel on the call, following by introductions from the USACE Omaha District Project Delivery Team (PDT) and the NGB/A4VR team.
- Jon Ritterling stated that Cybil Boss will be acting as the EA Project Manager for the project, and he will be involved as the Senior Project Manager.

2. Overview of PWS/Scope

- Cybil Boss stated the basic goal of the project is to complete RIs for PFAS from AFFF use for three ANG installations including Volk Field, Joe Foss Field, and Truax Field. Cybil mentioned that the investigation will follow the PWS and will include soil sampling at the source areas, surface water and sediment sampling, and groundwater sampling from direct-push technology (DPT) boreholes and from existing and new monitoring wells. The objectives for the RIs (as described in the PWS) are to (1) develop a comprehensive understanding of the vertical and lateral extent of PFAS in soil, groundwater, sediment, and surface water; (2) evaluate the source strength of residual PFAS in soil; (3) update the CSM; and (4) perform a human health risk assessment.
- Cybil discussed the general scope elements of each of the base awards and optional contract line item numbers. She also discussed the breakdown of the Performance

Requirements Summary elements that will be utilized throughout the project and were described in the PWS.

- EA will utilize a CSM development process created during the proposal to complete the RIs, which includes updating the CSM following each phase of work and project planning meetings. The Draft Preliminary CSM was developed during the proposal and will be described/updated in the planning documents. Following the synoptic event (Volk Field only) and Mobilization 1 (soil and groundwater investigation using high resolution site characterization [HRSC] technology and surface and sediment sampling at all installations), the data generated will be used to develop the Refined CSM. Data collected during Mobilization 2 (monitoring well installation and sampling and additional soil sampling/lysimeter installation and sampling) will be incorporated into the Updated CSM. At the conclusion of RI field activities and project scoping meetings, the RI CSM will be described in the RI Reports for each installation. By following this iterative model of CSM development, EA anticipates ample opportunity for the team to discuss and eliminate data gaps prior to finalizing the RI CSM.

3. Investigation Activities

- Jon stated that EA plans to utilize Pace Mobile Lab Services for analyzing screening data in the field during Mobilization 1. Screening level analysis was selected for the higher throughput that can be achieved (approximately 30 samples per day). Fixed-base laboratory analysis (Eurofins Lancaster) will be used to provide definitive data.
- During field activities, a hydraulic profiling tool (HPT) combined with electrical conductivity (EC) will be used to obtain real time aquifer measurements of permeability and conductivity. The data will be used to identify permeable zones or preferential pathways for contaminant migration and combined with screening level analytical results to identify monitoring well locations to be installed during Mobilization 2.
- During the HPT/EC process, water will be injected to complete analysis. To ensure representative sampling, groundwater sampling will be completed in adjacent borings at targeted intervals. The results of groundwater sampling in Mobilization 1 will be used to identify the monitoring well locations and depths to be completed in Mobilization 2.
- Both groundwater and soil screening-level data will be collected during Mobilization 1, with soil samples also sent to the fixed-base laboratory for definitive analysis.
- Jon also discussed step-out sampling that may be required for the RIs, and the team will ensure that the necessary pre-approvals (e.g., dig permits) are in place such that step-out sampling can be achieved without delay.
- Andrea Sansom inquired as to the reasons a contingency to the mobile lab may be required while in the field. Jon mentioned that the contingency options (ex: shipping samples for quick turn analysis to the Pace fixed-base laboratory in Madison, Wisconsin) would only be utilized to ensure field work continues in the event of a breakdown with the mobile laboratory.
- Celeste Holtz asked if a set percentage of samples would be sent for fixed-base laboratory analysis. Jon stated that samples submitted to the laboratory for fixed-base analysis are

expected to include the quantities listed in the PWS at a minimum. The idea is that samples submitted to the fixed-base laboratory would be used to support the identification of contaminated intervals and determination that delineation is complete.

- Jon discussed CSM considerations for each installation that will be studied while developing the Preliminary CSM (to be included in planning documents). For example, the influence of production wells at Volk Field will be evaluated for their influence on groundwater flow direction as well as contaminant migration. The basic geology and current interpretation of plumes for each installation was also discussed, as described on figures included in EA's proposal.
- The general sampling plan for each installation employs a concept of transects across the plumes to evaluate the nature and extent of PFAS. The team will evaluate the results to determine where to sample next, including pre-approval of potential step-out locations.
- Keith Freihofer mentioned that lots of private drinking water wells are located around Volk Field. PFAS impacts at the wastewater treatment plant are also present at this location and are possibly related to the storm sewer system. Jon asked if the production wells at Volk Field have been sampled previously; Keith indicated that all detections were below 70 nanograms per liter (ng/L).
- A fluvial depositional environment, including significant amounts of sand, is present at Joe Foss Field. Groundwater flow is generally to the northwest. There were significant PFAS detections during the SI, and two primary source areas of PFAS were identified.
- Andrea asked if surface topography was considered during CSM development. Jon stated one of the goals of CSM development during the RI process is to evaluate the interaction between surface water and groundwater. EA has experience at other installations where these interactions can play a role in PFAS migration. The sample plan will be developed to address those questions. Jon also stated that nearby municipal wells will also be evaluated for impacts to groundwater flow.
- The primary aquifer at Truax Field includes sand and may extend deeper than at the other installations. The direction of flow at Truax is to the southeast. Keith mentioned that a drinking water well is currently offline due to PFAS detections of 17 ng/L (combined PFOS and PFOA).
- The F-35 beddown process is ongoing at Truax Field, with public concern about the spread of PFAS. The Base Civil Engineer has been heavily involved in the beddown process (e.g., construction of new facilities) which included sampling for PFAS.
- Celeste mentioned that three fire training areas (FTAs) are present that may or may not have been evaluated during the SI at Truax Field. Keith stated that a Draft Revised Preliminary Assessment (PA) that includes the three FTAs was developed, and he will send this document to the project team. The off-base FTAs may have been used by Truax Field personnel; however, the FTAs were not owned or operated by the ANG. The exact locations of the FTAs are still being evaluated.
- Celeste also mentioned that the adjacent airport has sampled for surface water, and this data may be available for evaluation by the project team.

4. Schedule

- Jon stated that the task order award date (24 September 2020) came within a few days of that estimated for the proposal. EA will adjust the schedule accordingly and will include it in the upcoming draft Project Management Plan. EA assumed a staggered award of the RIs at each installation; however, all were awarded at the same time. EA will evaluate the ability to coordinate schedules for efficiency while developing baseline schedule.

5. Planning & Logistics

- Regulators in Wisconsin and South Dakota are currently not part of the Defense and State Memorandum of Agreement program for ANG. The ANG team is working on new ANG Memorandums of Agreement that includes regulatory support for this project.
- EA will establish bi-weekly teleconferences with the USACE PDT for the remainder of calendar 2020. ANG personnel will be included in these teleconferences on an as-needed basis, and Jim King agreed that this approach would work for the ANG team.
- The team discussed hosting kick-off meetings with the regulators during work plan development. Jon requested that the team provide the current installation and regulatory POCs for inclusion in the planning documents.
- The ability of project team members to travel at this time was reviewed. Jon mentioned that EA personnel can travel for projects, and Jordan mentioned that USACE personnel will hopefully begin to travel in November. Jim mentioned that the NGB is not traveling yet, and the team will need to verify whether visitors are allowed at the individual installations. The status of visitors and access would be coordinated through the Installation POCs.

QAPP Worksheet #10: Conceptual Site Model

This project involves the review of existing CSMs from the PAs/SIs as well as utilizing any newly acquired information pertaining to sources, pathways, and receptors including hydrology, hydrogeology, topography, source area(s), site boundaries, and surrounding activities to evaluate the ANG facility and propose a sampling strategy to complete the RI.

The preliminary CSM for each site will be developed and presented in the installation specific QAPP addenda. The CSMs will generally include the information presented in **Table 2**. Fluorine-containing AFFF was used by the Air Force for firefighting and firefighting training, and these products were also potentially stored, disposed, intentionally discharged, or spilled on the installation. Due to their persistence, bioaccumulation potential, and toxicity, PFAS may potentially impact human health and the environment.

Potential source areas on installations may include current and former fire training areas, current and former fire stations, associated spray nozzle test areas, aircraft hangars, crash sites, fuel spill areas, hazardous waste storage facilities, and current and former wastewater treatment facilities. Secondary sources resulting from movement of contaminated media into an area that was previously uncontaminated (e.g., reuse and application of biosolids) may also be present. Firefighting foams may be released to the environment through various practices and mechanisms, including: low-volume releases during storage, transfer, or operational requirements for calibration testing; medium-volume releases for equipment testing and discharge from fire suppression systems within buildings and hangars; high-volume discharge during emergency response activities, high-volume discharge during fire training activities; and accidental leaks from distribution piping and storage tanks. Once released to the environment, PFAS may be present in soil, surface water, sediment, and groundwater.

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Table 2: Conceptual Site Model Parameters

Facility Profile	Physical Profile	Release Profile	Land Use and Exposure Profile
<u>Installation Description:</u> • Years of operation • Total area occupied by installation (acres) • Inspection area (acres) • Description of historical activities on installation • Installation mission **<u>Area History:</u>** • Location(s) on installation • Activities conducted at the site(s) • Years of operation • Frequency of operation	**<u>Topography:</u>** • General topography across installation • Topography in vicinity of area • Approximate elevation **<u>Vegetation:</u>** • General overview of vegetation at the area • Stressed vegetation **<u>Surface Water:</u>** • Presence of streams, lakes, etc. • Drainage pathways (define if gaining or losing) **<u>Soils:</u>** • Primary soil makeup (sand, silt, clay, etc.) **<u>Geology:</u>** • Formation information and name • Depth intervals **<u>Hydrogeology:</u>** • Aquifer formation names • Depths to groundwater • Saturated thicknesses • Confined, unconfined, and/or perched aquifers • Aquifer recharge and transmissivity • Groundwater flow directions in aquifers of interest • Hydraulic gradient, hydraulic conductivity, and seepage velocity (if known) • Aquifer uses • Existing wells and their function (potable, industrial, monitoring, etc.) **<u>Climate:</u>** • Average annual precipitation • Wet and dry seasons • Average temperature/climate	**<u>Contaminants of Potential Concern:</u>** • PFOS/PFOA/PFBS primary concern as determined from previous reports • Note any historical contaminants (chlorinated solvents, fuels, etc.) associated with the area(s) • Note any adjacent areas of PFAS release that are operated by other DoD or private entities which may potentially impact the subject installation. **<u>Media of Potential Concern:</u>** • Soil, groundwater, surface water, and sediment **<u>Confirmed AFFF Releases:</u>** • Per area training records • Dates of AFFF release/use • Quantities of AFFF used (if known) **<u>Primary Releases from Area:</u>** • Infiltration into groundwater (unconsolidated material, fracture flow, etc.) • Direct discharge into drains, plumbing infrastructure, and outfall locations • Infiltration into underground piping • Adsorption to soil matrix near source. **<u>Secondary Releases:</u>** • Soil excavations and disposal • Pump and treat systems discharge(s), including holding ponds or sludge areas • Landfills • Chrome plating facilities • Car washes • Biosolids application areas	**<u>Current Land Use:</u>** • Area-specific information **<u>Future Land Use:</u>** • Potential development • Land use restrictions **<u>Potential Secondary Sources:</u>** • Surface water bodies • Municipal wells • Private wells • Public wells **<u>Potential Receptors:</u>** • On-site human receptors (e.g., installation personnel or construction workers) • Off-site residents • On-site terrestrial receptors • On-site aquatic receptors • Off-site aquatic receptors

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QAPP Worksheet #11: Project/Data Quality Objectives

The Project/DQOs for the TO are outlined below. Specific DQOs will be established for each site and will be described in the installation-specific UFP-QAPP Addenda. These DQOs will follow the USEPA's seven-step iterative process for DQO development (USEPA 2006). DQOs are influenced by the ongoing project planning discussions with stakeholders and will be updated if new consensus decisions materialize.

Step 1: State the Problem

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

DoD has adopted a policy to retain facilities in the CERCLA process based on risk-based SLs for soil and groundwater, as described in a memorandum from the ASD signed into use 15 September 2021 (ASD 2021). The ANG program under which these RIs will be performed follows this DoD policy. Following delineation of the nature and extent of PFAS exceeding the SLs established in the ASD memorandum, the sites will proceed to the next phase under CERCLA (feasibility study). The ASD SLs apply to PFOS and PFOA, and PFBS. The SLs are presented in **Worksheet #15**.

Step 2: Identify the Goal of the Study

The goals of the RIs include the following:

- Determine the presence or absence of PFOA, PFOS, and PFBS at or above SLs (Worksheet #15) at sources and in all pathways at the ANG Installations.

- Collect or develop data to evaluate the releases, delineate the nature and extent of PFAS in soil, groundwater, surface water, and sediment, and utilize the data to update the CSM.

- Determine the concentration of PFOA, PFOS, and PFBS at or above SLs (Worksheet #15) in soil, groundwater, surface water, pore water, and sediment, both in source areas and all pathways, to establish concentration gradients.

- Determine the horizontal and vertical boundaries of sources and pathways of contamination.

- Determine the mechanism(s) of contaminant release to pathways and direction of pathway transport.

- Determine the route(s) of exposure to potential human and ecological receptors and evaluate risk and complete risk assessments as warranted.

Step 3: Identify the Information Inputs

Primary information inputs include:

- Information contained in the PA/SI Reports for the ANG installations;

- Analytical data collected during other environmental sampling efforts at or near each ANG installation;

- Hydrogeologic and lithologic data using high resolution site characterization methodologies;

- Groundwater, surface water, pore water (from lysimetry), soil and/or sediment sample data collected in accordance with this Programmatic UFP-QAPP/installation-specific UFP-QAPP Addenda; and

- Field data collected including survey data, groundwater elevation, and water quality parameters measured using a multi-parameter water quality meter.

Step 4: Define the Boundaries of the Study

The spatial boundaries will define the physical area to be studied and where samples will be collected (in general terms). The spatial boundaries for this project are those associated with the boundaries of the installations (Joe Foss Field, Truax Field, and Volk Field) and the upgradient and downgradient extents of PFAS plume(s) upon delineation to SLs. For the RIs, it is likely that off-site sampling will be conducted. For sites on private property or other property outside the control of the ANG, a written request to the USACE PM will be submitted a minimum of 120 days in advance of the proposed entry date stating that a Right of Entry will be needed, which shall include appropriate property identification information as available. If possible, parcels that may be utilized for potential off-base investigation, if needed, will be identified during scoping sessions prior to each mobilization, such that sufficient time is allowed to obtain Right of Entry, with the goal of providing flexibility, depending on where step-outs are needed to laterally define extent of PFAS above SLs resulting from installation releases.

The spatial boundaries of the soil investigation at potential and identified release areas will generally be confined to the limits of the former site features; however, the investigation will proceed outside the former site features as necessary for soil delineation. The spatial boundaries of surface water and sediment sampling is dependent upon observations in the field regarding the presence of surface water in conveyances and knowledge of the established pathways for surface water discharge. Laboratory analysis of samples will be completed for PFAS by LC/MS/MS compliant with Table B-15 of DoD QSM 5.3 for the compounds listed in Worksheet #15.

The temporal boundaries describe the project time frame and when samples will be taken. The temporal boundaries include Spring to Fall 2022. Fieldwork is expected to occur through approximately mid to late 2022. Some data will be collected quarterly, which can be used to account for seasonal variation, such as lysimeter data or GW/SW levels at selected locations. Further details including the vertical and seasonal boundaries of the study area, will be defined in installation-specific UFP-QAPP Addenda.

Step 5: Develop the Project Data Collection and Analysis Approach

Although the analytic approach will be installation-specific (e.g., sample locations, matrices, depths, etc.) and described in the installation-specific UFP-QAPP Addenda, in summary, all samples will be analyzed at a DoD Environmental Laboratory Accreditation Program certified laboratory, sampling data will be compared to selected SLs (Worksheet #15), and additional sampling will be completed as required to meet the goals of the RIs. The decision to collect additional samples will include an evaluation of the following:

<u>Groundwater/Surface Water:</u>

1) What are the concentrations of PFOA, PFOS, and PFBS at potential source areas?
2) What are the concentrations of PFOA, PFOS, and PFBS at the installation boundary?
3) Are the concentrations of PFOA, PFOS, and PFBS defined to the selected SLs?
4) What does the conceptual site model suggest in terms of sources, pathways, and potential receptors?

<u>Soil/Sediment:</u>

1) What are the concentrations of PFOA, PFOS, and PFBS in shallow surface soil/sediment (0-2 feet below ground surface)?
2) What are the concentrations of PFOA, PFOS, and PFBS in subsurface soil (i.e., vadose zone and capillary fringe)?
3) What does the conceptual site model suggest in terms of sources, pathways, and potential receptors?

Step 6: Specify Performance or Acceptance Criteria

The data need to be of adequate quality to make decisions established for the project. The purpose of this is to minimize the possibility of making erroneous conclusions or failing to keep uncertainty estimates to within acceptable levels. Worksheet #12 presents the applicable measurement performance criteria. Worksheet #15 presents the project screening levels. Worksheet #37 presents information regarding the data usability assessment. Data usability will be assessed in terms of whether study goals (Step 2) have been achieved, to be evaluated during scoping sessions for each subsequent phase of fieldwork.

Step 7: Develop the Detailed Plan for Obtaining Data

The detailed plan for obtaining data will be defined in the installation-specific UFP-QAPP Addenda. The basis for the sampling design will be briefly explained in Worksheet #11, with the detailed sampling design and rationale presented in Worksheet #17.

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QAPP Worksheet #12-1: Measurement Performance Criteria

This worksheet documents the project-specific measurement performance criteria (MPC) in terms of data quality indicators (DQI) (i.e., precision, accuracy, sensitivity, representativeness, completeness, and comparability). Analytical methods for IDW characterization are not included in this worksheet because data generated using these methods will not be subject to validation.

Matrix: Water
Analytical Group: PFAS
Concentration Level: Low/Medium/High

Sampling Procedure	Analytical Method/SOP	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or Both (S&A)
Groundwater and Surface Water sampling (SOPs 07, 13, 47, 48, 73)	LC/MS/MS compliant with DoD QSM Version 5.3 (or more recent) Table B-15 (SOP WI36458 or WS-LC-0025)	Bias Contamination	<1/2 LOQ	Field Blank/ Equipment Blank	S&A
		Precision – Overall	RPD ≤ 30% when both results exceed LOQ; otherwise, difference < LOQ.	Field Duplicate	S&A
		Accuracy	Recovery limits per QSM 5.3 or more recent.	Isotope Extracted Labeled Standards	A
		Accuracy/Bias/Precision	Recovery limits per QSM 5.3 or more recent; RPD ≤30%	Laboratory Control Spike/Matrix Spike and Duplicates	S&A
		Accuracy/Laboratory Contamination	No analytes detected > 1/2 LOQ or >1/10 the amount measured in any sample or 1/10 the regulatory limit, whichever is greater	Method Blank	A
		Accuracy/Laboratory Contamination	No analytes detected > 1/2 LOQ	Instrument Blank	A
		Sensitivity	Detection limits ≤ to SLs	Detection limits	S
		Completeness	100%	Reported Sample Data	S&A

Notes:

LC/MS/MS = Liquid Chromatography Tandem Mass Spectrometry.
LOQ = Limit of quantification.
QSM = Quality Systems Manual.
RPD = Relative Percent Difference.
SL = Screening Level.
SOP = Standard Operating Procedure.

QAPP Worksheet #12-2: Measurement Performance Criteria

Matrix: Soil/Sediment
Analytical Group: PFAS
Concentration Level: Low/Medium/High

Sampling Procedure	Analytical Method/SOP	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or Both (S&A)
Soil and Sediment sampling (SOPs 21, 25, 47 and 73)	LC/MS/MS compliant with DoD QSM Version 5.3 (or more recent) Table B-15 (SOP WI36459 or WS-LC-0025)	Bias Contamination	<1/2 LOQ	Field Blank/ Equipment Blank	S&A
		Precision – Overall	RPD ≤ 50% when both results exceed LOQ; otherwise, difference < LOQ	Field Duplicate	S&A
		Accuracy	Recovery limits per QSM 5.3. or more recent	Isotope Extracted Labeled Standards	A
		Accuracy/Bias/Precision	Recovery limits per QSM 5.3. or more recent; RPD ≤30%	Laboratory Control Spike/Matrix Spike and Duplicates	S&A
		Accuracy/Laboratory Contamination	No analytes detected > 1/2 LOQ or >1/10 the amount measured in any sample or 1/10 the regulatory limit, whichever is greater	Method Blank	A
		Accuracy/Laboratory Contamination	No analytes detected > 1/2 LOQ	Instrument Blank	A
		Sensitivity	Detection limits ≤ to SLs	Detection limits	S
		Completeness	100%	Reported Sample Data	S&A

Notes:
LC/MS/MS = Liquid Chromatography Tandem Mass Spectrometry.
LOQ = Limit of quantification.
SL = Screening Level.
QSM = Quality Systems Manual.
RPD = Relative Percent Difference.
SOP = Standard Operating Procedure.

QAPP Worksheet #12-3: Measurement Performance Criteria

Matrix: Water
Analytical Group: PFAS Screening (Mobile Laboratory)
Concentration Level: Low/Medium/High

Sampling Procedure	Analytical Method/SOP	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or Both (S&A)
Groundwater and Surface Water sampling (SOPs 07, 13, 47, 48, 73)	LC/MS/MS Screening Method (ENV-SOP-MAD1-0101)	Bias Contamination	<1/2 LOQ	Field Blank/ Equipment Blank	S&A
		Precision – Overall	RPD ≤30% when both results exceed LOQ; otherwise, difference < LOQ	Field Duplicate	S&A
		Accuracy	Recoveries within 40-160% of ICAL midpoint standard area (or area measured in the opening CCV on days when an ICAL is not performed)	Extracted Internal Standards	A
		Accuracy/Bias/Precision	60-140% Recovery, until in-house limits are established; RPD ≤30%	Matrix Spike and Duplicates	S&A
		Accuracy/Bias/Precision	44.8-138%Recovery PFOA, 63.8-126%Recovery PFOS, 60.4-127%Recovery PFBS	Laboratory Control Sample	A
		Accuracy/Laboratory Contamination	No analytes detected > 1/2 LOQ (or >LOQ for common laboratory contaminants) or >1/10 the amount *measured* in any sample.	Method Blank	A
		Accuracy/Laboratory Contamination	No analytes detected > 1/2 LOQ	Instrument Blank	A
		Sensitivity	Detection limits ≤ to SLs	Detection limits	S
		Completeness	100%	Reported Sample Data	S&A

Notes:
LC/MS/MS = Liquid Chromatography Tandem Mass Spectrometry.
LOQ = Limit of quantification.
SL = Screening Level.
QSM = Quality Systems Manual.
RPD = Relative Percent Difference.
SOP = Standard Operating Procedure.

QAPP Worksheet #12-4: Measurement Performance Criteria

Matrix: Soil/Sediment
Analytical Group: PFAS Screening (Mobile Laboratory)
Concentration Level: Low/Medium/High

Sampling Procedure	Analytical Method/SOP	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or Both (S&A)
Soil and Sediment sampling (SOPs 21, 25, 47 and 73)	LC/MS/MS Screening Method (ENV-SOP-MAD1-0101)	Bias Contamination	<1/2 LOQ	Field Blank/ Equipment Blank	S&A
		Precision – Overall	RPD 50% when both results exceed LOQ; otherwise, difference < LOQ	Field Duplicate	S&A
		Accuracy	Recoveries within 40-160% of ICAL midpoint standard area (or area measured in the opening CCV on days when an ICAL is not performed)	Extracted Internal Standards	A
		Accuracy/Bias/Precision	60-140% Recovery, until in-house limits are established; RPD ≤50%	Matrix Spike and Duplicates	S&A
		Accuracy/Bias/Precision	48.3-132%Recovery PFOA, 67.4-122%Recovery PFOS, 66.6-126%Recovery PFBS	Laboratory Control Sample	A
		Accuracy/Laboratory Contamination	No analytes detected > 1/2 LOQ (or >LOQ for common laboratory contaminants) or >1/10 the amount measured in any sample.	Method Blank	A
		Accuracy/Laboratory Contamination	No analytes detected > 1/2 LOQ	Instrument Blank	A
		Sensitivity	Detection limits ≤ to SLs	Detection limits	S
		Completeness	100%	Reported Sample Data	S&A

Notes:
LC/MS/MS = Liquid Chromatography Tandem Mass Spectrometry.
LOQ = Limit of quantification.
SL = Screening Level.
QSM = Quality Systems Manual.
RPD = Relative Percent Difference.
SOP = Standard Operating Procedure.

QAPP Worksheet #12-5: Measurement Performance Criteria

Matrix: Soil
Analytical Group: TOC
Concentration Level: Low

Sampling Procedure	Analytical Method/SOP	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or Both (S&A)
Soil sampling (SOP 25, 47, and 73)	SW9060A (SOP WI11627)	Bias Contamination	<1/2 LOQ	Field Blank/ Equipment Blank	S&A
		Precision – Overall	RPD ≤ 50% when both results exceed LOQ; otherwise, difference < LOQ	Field Duplicate	S&A
		Accuracy/Bias	47-143% Recovery	Laboratory Control Spike/Matrix Spike	A
		Accuracy/Laboratory Contamination	No analytes detected > LOQ or >1/10 the amount measured in any sample, whichever is greater	Method Blank	A
		Precision	RPD ≤ 20%	Lab Duplicate	A
		Completeness	100%	Reported Sample Data	S&A

Notes:
LOQ = Limit of quantification.
SL = Screening Level.
RPD = Relative Percent Difference.
SOP = Standard Operating Procedure.

QAPP Worksheet #12-6: Measurement Performance Criteria

Matrix: Soil
Analytical Group: pH
Concentration Level: Low

Sampling Procedure	Analytical Method/SOP	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or Both (S&A)
Soil sampling (SOP 25, 47, and 73)	SW9045C (SOP WI11518)	Precision – Overall	RPD ≤ 10%	Field Duplicate	S&A
		Precision	RPD ≤ 4%	Duplicates	A
		Accuracy/Bias	95-105%	LCS	A
		Completeness	100%	Reported Sample Data	S & A

Notes:
LCS = Laboratory control sample.
LOQ = Limit of quantification.
NA = Not Applicable.
SL = Screening Level.
RPD = Relative Percent Difference.
SOP = Standard Operating Procedure.

QAPP Worksheet #12-7: Measurement Performance Criteria

Matrix: Soil
Analytical Group: Grain Size
Concentration Level: Low

Sampling Procedure	Analytical Method/SOP	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or Both (S&A)
Soil sampling (SOP 25, 47, and 73)	ASTM D422 (SOP WI11514)	Precision – Overall	RPD ≤ 50%	Field Duplicate	S&A
		Completeness	100%	Reported Sample Data	S&A

QAPP Worksheet #12-8: Measurement Performance Criteria

Matrix: Soil
Analytical Group: Cation Exchange Capacity
Concentration Level: Low

Sampling Procedure	Analytical Method/SOP	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or Both (S&A)
Soil sampling (SOP 25, 47, and 73)	SW-846 Method 9081 and Method 6010B (SOP CC-ATM-M020)	Precision	RPD ≤ 20%	Lab Duplicate	A
		Accuracy/Laboratory Contamination	No detections > reporting limit	Method Blank	A
		Completeness	100%	Reported Sample Data	S&A

QAPP Worksheet #12-9: Measurement Performance Criteria

Matrix: Soil
Analytical Group: Anion Exchange Capacity (AEC)
Concentration Level: Low

Sampling Procedure	Analytical Method/SOP	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or Both (S&A)
Soil sampling (SOP 25, 47, and 73)	SOP AEC	Precision	Within 10%	Lab Duplicate	A
		Accuracy/Laboratory Contamination	<0.05 parts per million	Method Blank (KCl/K_2HPO_4)	A
		Accuracy	Within 10%	Check Soil	A
		Completeness	100%	Reported Sample Data	S&A

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QAPP Worksheet #13: Secondary Data Uses and Limitations

The following worksheet will be included in the installation-specific UFP-QAPP addenda and will identify data used in the generation of the installation-specific UFP-QAPP addenda (previous environmental sampling reports, etc.).

Data Type	Data Source (Originating Organization, Report Title, and Date)	Data Uses Relative to Current Project	Factors Affecting the Reliability of Data and Limitations on Data Use
Past site assessment	BB&E, Inc., Final Perfluorinated Compounds Preliminary Assessment Site Visit Report, South Dakota Air National Guard, 114th Fighter Wing, February 2016	Historic site information	None
Past site investigation	Amec Foster Wheeler Environmental & Infrastructure, Inc., Final Report, FY16 Phase I Regional Site Inspections, South Dakota Air National Guard Base, May 2018	Historic site data	Qualifiers applied to validated data may limit data use
Past site assessment	BB&E, Inc., Final Perfluorinated Compounds Preliminary Assessment Site Visit Report, Wisconsin Air National Guard, Truax Field, December 2015	Historic site information	None
Past site investigation	Amec Foster Wheeler Environment & Infrastructure, Inc., Final Report, FY16 Phase I Regional Site Inspections for Perfluorinated Compounds, Wisconsin Air National Guard, Truax Air National Guard Base, March 2019	Historic site data	Qualifiers applied to validated data may limit data use
Past site assessment	CH2M HILL, Final Preliminary Assessment Report for Perfluorinated Compounds at Volk Field Combat Readiness Training Center, June 2015	Historic site information	None
Past site investigation	Final Site Inspection Report of Aqueous Film Forming Foam Areas at Volk Field Air Combat Readiness Training Center, December 2017	Historic site data	Qualifiers applied to validated data may limit data use

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QAPP Worksheet #14 & 16: Project Tasks & Schedule

The field activities are anticipated to begin in early 2022. The general schedule for RI fieldwork performed at each ANG installation will vary and will follow the general task sequence in the table below. An installation-specific schedule will be included as part of the installation-specific UFP-QAPP addenda; however, a sample schedule is summarized below. Fieldwork will be conducted in accordance with the SOPs provided in Appendix A.

Task	Responsible Party	Planned Start Date	Planned Completion Date	Deliverable(s)
Pre-Mobilization 1	EA – Field Manager and personnel	1 February 2022	11 March 2022	Not applicable
Mobilization 1	EA, Direct push subcontractor, HRSC subcontractor, Pace Mobile Laboratory	14 March 2022	16 March 2022	Daily Quality Control Reports (DQCRs)
Fieldwork 1	EA, Direct push subcontractor, HRSC subcontractor, Pace Mobile Laboratory	17 March 2022	13 April 2022	DQCRs, Tables/Figures with Screening Data
Demobilization 1	EA, Direct push subcontractor, HRSC subcontractor, Pace Mobile Laboratory	Variable with remaining mobilization on 14 April 2022	15 April 2022	DQCRs
Data Review/Validation	Eurofins (Lancaster and/or Sacramento), Data validation subcontractor, EA	Variable with final shipment of samples received by 14 April 2022	Variable with final Mobilization 1 results received by 04 May 2022; Final data validation receive by 20 May 2022	Laboratory data packages, Data validation reports, ERPIMS submittals
Interim Reporting/Planning Meetings	EA	1 May 2022	31 May 2022	Draft DPT Investigation Report (with 2 months for stakeholder review)
Pre-Mobilization 2	EA	1 August 2022	12 August 2022	Not applicable
Mobilization 2	EA, Sonic drilling subcontractor, Surveying subcontractor, Direct push subcontractor (if needed)	15 August 2022	16 August 2022	DQCRs
Fieldwork 2	EA, Sonic drilling subcontractor, Surveying subcontractor, Direct push subcontractor (if needed)	17 August 2022	14 September 2022	DQCRs
Demobilization 2	EA, Sonic drilling subcontractor, Surveying subcontractor, Direct push subcontractor (if needed)	15 September 2022	16 September 2022	DQCRs

Task	Responsible Party	Planned Start Date	Planned Completion Date	Deliverable(s)
Data Review/Validation	Eurofins (Lancaster or Sacramento), Data validation subcontractor, EA	Variable with final shipment of samples received by 15 September 2022	Variable with final Mobilization 2 results received by 05 October 2022	Laboratory data packages, Data validation reports, ERPIMS submittals
Reporting	EA	01 October 2022	28 February 2023	Draft RI Report

QAPP Worksheet #15-1: Project Screening Levels and Laboratory-Specific Detection/Quantitation Limits

Matrix: Groundwater/Surface Water
Analytical Group: PFAS
Method: LC/MS/MS compliant with DoD QSM Version 5.3 (or more recent) Table B-15
Laboratory: Eurofins Lancaster Laboratories Environmental, Eurofins TestAmerica Sacramento, and Pace Mobile Laboratory (Screening)

				Eurofins Lancaster– Laboratory Limits (ng/L)			Eurofins TestAmerica Sacramento – Laboratory Limits (ng/L)			Pace Mobile Laboratory (ng/L)
Analyte	Acronym	CAS	SL (ng/L)	LOQ	LOD	DL	LOQ	LOD	DL	LOQ[4]
4:2 Fluorotelomer sulfonate	4:2 FTS	75124-72-4	--	2.00	1.00	0.50	20.00	15.00	5.20	--
6:2 Fluorotelomer sulfonate	6:2 FTS	27619-97-2	--	5.00	4.00	2.00	40.00	20.00	7.00	--
8:2 Fluorotelomer sulfonate	8.2 FTS	39108-34-4	--	3.00	2.00	1.00	20.00	10.00	3.00	--
N-ethyl perfluorooctane sulfonamidoacetic acid	NEtFOSAA	2991-50-6	--	3.00	1.00	0.50	20.00	10.00	2.80	--
N-methyl perfluorooctane sulfonamidoacetic acid	NMeFOSAA	2355-31-9	--	2.00	1.20	0.60	20.00	10.00	3.00	--
Perfluorobutane sulfonate	PFBS	375-73-5	600[1]	2.00	1.00	0.50	2.00	1.00	0.46	10
Perfluorobutanoic acid	PFBA	375-22-4	--	5.00	4.00	2.00	2.00	1.50	0.59	--
Perfluorodecane sulfonate	PFDS	335-77-3	--	2.00	1.00	0.50	2.00	1.50	0.56	--
Perfluorodecanoic acid	PFDA	335-76-2	--	2.00	1.00	0.50	2.00	1.00	0.48	--
Perfluorododecanoic acid	PFDoA	307-55-1	--	2.00	1.00	0.50	2.00	1.50	0.52	--
Perfluoroheptane sulfonate	PFHpS	375-92-8	--	2.00	1.00	0.50	2.00	1.00	0.37	--
Perfluoroheptanoic acid	PFHpA	375-85-9	--	2.00	1.00	0.50	2.00	1.50	0.61	--
Perfluorohexane sulfonate	PFHxS	355-46-4	--	2.00	1.00	0.50	2.00	1.00	0.38	--
Perfluorohexanoic acid	PFHxA	307-24-4	--	2.00	1.00	0.50	2.00	1.00	0.47	--
Perfluorononane sulfonate	PFNS	68259-12-1	--	2.00	1.00	0.50	2.00	1.00	0.4	--
Perfluorononanoic acid	PFNA	375-95-1	--	2.00	1.00	0.50	2.00	1.50	0.52	--
Perfluorooctanesulfonamide	PFOSA	754-91-6	--	2.00	1.00	0.50	4.00	3.00	1.30	--
Perfluorooctane sulfonate	PFOS	1763-23-1	40[1,2]	2.00	1.00	0.50	4.00	3.00	1.10	10
Perfluorooctanoic acid	PFOA	335-67-1	40[1,2]	2.00	1.00	0.50	2.00	1.50	0.54	10
Perfluoropentane sulfonate	PFPS	2706-91-4	--	2.00	1.00	0.50	2.00	1.00	0.30	--
Perfluoropentanoic acid	PFPA	2706-90-3	--	2.00	1.00	0.50	2.00	1.00	0.43	--

Analyte	Acronym	CAS	SL (ng/L)	Eurofins Lancaster–Laboratory Limits (ng/L)			Eurofins TestAmerica Sacramento – Laboratory Limits (ng/L)			Pace Mobile Laboratory (ng/L)
				LOQ	LOD	DL	LOQ	LOD	DL	LOQ[4]
Perfluorotetradecanoic acid	PFTeDA	376-06-7	--	2.00	1.00	0.50	4.00	3.00	0.83	--
Perfluorotridecanoic acid	PFTriDA	72629-94-8	--	2.00	1.00	0.50	4.00	3.00	0.76	--
Perfluoroundecanoic acid	PFUnA	2058-94-8	--	2.00	1.00	0.50	2.00	1.50	0.72	--

Notes:

1. Assistant Secretary of Defense. 2021. Risk Based Screening Levels Calculated for PFOS, PFOA, and PFBS in Groundwater using USEPA's RSL Calculator with HQ=0.1 (Assistant Secretary of Defense, 2021).
2. The SLs presented for PFOA and PFOS (40 ng/L) and PFBS (600 ng/L) are applicable in cases where more than one PFAS analyte is present in concentrations above the reporting limit. If only one PFAS analyte is present, a Hazard Quotient (HQ) of 1 applies and the SL values presented would increase by a factor of x 10.
3. Screening method reports down to LOQ. No LODs are used.

CAS = Chemical Abstracts Service Registry Number.
DL = Detection Limit.
LOD = Limit of Detection.
LOQ = Limit of Quantification.
ng/L = Nanogram(s) per liter.
SL = Screening Level.

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QAPP Worksheet #15-2: Project Screening Levels and Laboratory-Specific Detection/Quantitation Limits

Matrix: Soil/Sediment
Analytical Group: PFAS compounds
Method: LC/MS/MS compliant with DoD QSM Version 5.3 (or more recent) Table B-15
Laboratory: Eurofins Lancaster Laboratories Environmental, Eurofins TestAmerica Sacramento, and Pace Mobile Laboratory (Screening)

Analyte	Acronym	CAS	SL (µg/kg) 0-2 feet below ground surface	SL (µg/kg) >2 feet below ground surface	Eurofins Lancaster– Laboratory Limits (µg/kg)			Eurofins TestAmerica Sacramento – Laboratory Limits (µg/kg)			Pace Mobile Laboratory (µg/kg)
					LOQ	LOD	DL	LOQ	LOD	DL	LOQ[4]
4:2 Fluorotelomer sulfonate	4:2 FTS	75124-72-4	--	--	2.00	1.60	0.60	0.20	0.15	0.051	--
6:2 Fluorotelomer sulfonate	6:2 FTS	27619-97-2	--	--	2.00	1.60	0.60	0.30	0.10	0.027	--
8:2 Fluorotelomer sulfonate	8.2 FTS	39108-34-4	--	--	3.00	1.60	0.60	0.20	0.10	0.035	--
N-ethyl perfluorooctane sulfonamidoacetic acid	NEtFOSAA	2991-50-6	--	--	2.00	0.400	0.20	0.20	0.10	0.048	--
N-methyl perfluorooctane sulfonamidoacetic acid	NMeFOSA A	2355-31-9	--	--	2.00	0.40	0.20	0.20	0.05	0.023	--
Perfluorobutane sulfonate	PFBS	375-73-5	1,900[2]	24,600[2]	2.00	1.60	0.40	0.20	0.10	0.038	0.5
Perfluorobutanoic acid	PFBA	375-22-4	--	--	2.00	1.60	0.60	0.30	0.10	0.046	--
Perfluorodecane sulfonate	PFDS	335-77-3	--	--	0.60	0.40	0.20	0.20	0.15	0.052	--
Perfluorodecanoic acid	PFDA	335-76-2	--	--	0.60	0.40	0.20	0.20	0.10	0.048	--
Perfluorododecanoic acid	PFDoA	307-55-1	--	--	0.60	0.40	0.20	0.20	0.10	0.03	--
Perfluoroheptane sulfonate	PFHpS	375-92-8	--	--	0.60	0.40	0.20	0.20	0.10	0.049	--
Perfluoroheptanoic acid	PFHpA	375-85-9	--	--	0.60	0.40	0.20	0.20	0.10	0.038	--
Perfluorohexane sulfonate	PFHxS	355-46-4	--	--	0.60	0.40	0.20	0.20	0.10	0.029	--
Perfluorohexanoic acid	PFHxA	307-24-4	--	--	0.60	0.40	0.20	0.20	0.10	0.031	--
Perfluorononane sulfonate	PFNS	68259-12-1	--	--	0.60	0.40	0.20	0.20	0.10	0.029	--
Perfluorononanoic acid	PFNA	375-95-1	--	--	0.60	0.40	0.20	0.20	0.05	0.022	--
Perfluorooctanesulfonamide	PFOSA	754-91-6	--	--	0.60	0.40	0.20	0.20	0.10	0.033	--
Perfluorooctane sulfonate	PFOS	1763-23-1	130[1,2]	1,600[1,2]	0.60	0.40	0.20	0.30	0.10	0.043	0.5
Perfluorooctanoic acid	PFOA	335-67-1	130[1,2]	1,600[1,2]	0.60	0.40	0.20	0.30	0.15	0.053	0.5
Perfluoropentane sulfonate	PFPS	2706-91-4	--	--	3.00	0.40	0.20	0.20	0.10	0.037	--

Analyte	Acronym	CAS	SL (µg/kg) 0-2 feet below ground surface	SL (µg/kg) >2 feet below ground surface	Eurofins Lancaster– Laboratory Limits (µg/kg)			Eurofins TestAmerica Sacramento – Laboratory Limits (µg/kg)			Pace Mobile Laboratory (µg/kg)
					LOQ	LOD	DL	LOQ	LOD	DL	LOQ[4]
Perfluoropentanoic acid	PFPA	2706-90-3	--	--	0.60	0.40	0.20	0.20	0.10	0.041	--
Perfluorotetradecanoic acid	PFTeDA	376-06-7	--	--	0.60	0.40	0.20	0.20	0.10	0.037	--
Perfluorotridecanoic acid	PFTriDA	72629-94-8	--	--	0.60	0.40	0.20	0.20	0.05	0.021	--
Perfluoroundecanoic acid	PFUnA	2058-94-8	--	--	0.60	0.40	0.20	0.20	0.10	0.042	--

Notes:

1. Assistant Secretary of Defense. 2021. Risk Based Screening Levels Calculated for PFOS, PFOA, PFBS in soil using USEPA's RSL Calculator with HQ=0.1 (Assistant Secretary of Defense, 2019).
2. The SL for soil is based on incidental ingestion of soil for two scenarios: residential 0-2 feet and industrial/commercial worker >2 feet. These SLs will be applied to the soil intervals reasonably anticipated to be encountered in these scenarios. The industrial/commercial worker screening levels are valid between 2-15 feet.
3. Screening method reports down to LOQ. No LODs are used.

µg/kg = Microgram(s) per kilogram.
CAS = Chemical Abstracts Service Registry Number.
DL = Detection Limit.
LOD = Limit of Detection.
LOQ = Limit of Quantification.
SL = Screening Level.

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QAPP Worksheet #15-3: Project Soil Ecological Screening Levels

Matrix: Soil
Analytical Group: PFAS compounds
Method: LC/MS/MS compliant with DoD QSM Version 5.3 (or more recent) Table B-15
Laboratory: Eurofins Lancaster Laboratories Environmental, Eurofins TestAmerica Sacramento

Analyte	Acronym	CAS	SL[1] (µg/kg) Terrestrial Invertebrates	SL[1] (µg/kg) Terrestrial Plants	SL[1] (µg/kg) Terrestrial Mammals	SL[1] (µg/kg) Terrestrial Birds
4:2 Fluorotelomer sulfonate	4:2 FTS	75124-72-4	--	--	--	--
6:2 Fluorotelomer sulfonate	6:2 FTS	27619-97-2	--	--	--	--
8:2 Fluorotelomer sulfonate	8.2 FTS	39108-34-4	--	--	--	--
N-ethyl perfluorooctane sulfonamidoacetic acid	NEtFOSAA	2991-50-6	--	--	--	--
N-methyl perfluorooctane sulfonamidoacetic acid	NMeFOSAA	2355-31-9	--	--	--	--
Perfluorobutane sulfonate	PFBS	375-73-5	100,000		817	15,800
Perfluorobutanoic acid	PFBA	375-22-4	--	--	2,980	--
Perfluorodecane sulfonate	PFDS	335-77-3	--	--	--	--
Perfluorodecanoic acid	PFDA	335-76-2	--	--	67.7	--
Perfluorododecanoic acid	PFDoA	307-55-1	--	--	--	--
Perfluoroheptane sulfonate	PFHpS	375-92-8	--	--	--	--
Perfluoroheptanoic acid	PFHpA	375-85-9	--	--	--	--
Perfluorohexane sulfonate	PFHxS	355-46-4	10,000	--	2.8	--
Perfluorohexanoic acid	PFHxA	307-24-4	--	--	6,200	--
Perfluorononane sulfonate	PFNS	68259-12-1	--	--	--	--
Perfluorononanoic acid	PFNA	375-95-1	10,000	--	24.2	--
Perfluorooctanesulfonamide	PFOSA	754-91-6	--	--	--	--
Perfluorooctane sulfonate	PFOS	1763-23-1	48,100	40,200	8.7	38.6
Perfluorooctanoic acid	PFOA	335-67-1	22,400	79,500	3,840	--
Perfluoropentane sulfonate	PFPS	2706-91-4	--	--	--	--
Perfluoropentanoic acid	PFPA	2706-90-3	--	--	--	--
Perfluorotetradecanoic acid	PFTeDA	376-06-7	--	--	--	--
Perfluorotridecanoic acid	PFTriDA	72629-94-8	--	--	--	--
Perfluoroundecanoic acid	PFUnA	2058-94-8	--	--	--	--

Analyte	Acronym	CAS	SL[1] (µg/kg) Terrestrial Invertebrates	SL[1] (µg/kg) Terrestrial Plants	SL[1] (µg/kg) Terrestrial Mammals	SL[1] (µg/kg) Terrestrial Birds

Notes:

1. U.S Department of Energy, Argonne National Laboratory, Air Force Civil Engineer Center. 2021. Derivation of PFAS Ecological Screening Values (U.S. DOE, et al., 2021).

µg/kg = Microgram(s) per kilogram.
CAS = Chemical Abstracts Service Registry Number.
SL = Screening Level.

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QAPP Worksheet #15-4: Project Surface Water Ecological Screening Levels

Matrix: Surface Water
Analytical Group: PFAS compounds
Method: LC/MS/MS compliant with DoD QSM Version 5.3 (or more recent) Table B-15
Laboratory: Eurofins Lancaster Laboratories Environmental, Eurofins TestAmerica Sacramento

Analyte	Acronym	CAS	SL[1] (ng/L) Freshwater Aquatic Life	SL[1] (ng/L) Freshwater Aquatic-Dependent Mammals	SL[1] (ng/L) Freshwater Aquatic-Dependent Birds	SL[1] (ng/L) Marine Aquatic Life
4:2 Fluorotelomer sulfonate	4:2 FTS	75124-72-4	--	--	--	--
6:2 Fluorotelomer sulfonate	6:2 FTS	27619-97-2	--	--	--	--
8:2 Fluorotelomer sulfonate	8.2 FTS	39108-34-4	--	--	--	--
N-ethyl perfluorooctane sulfonamidoacetic acid	NEtFOSAA	2991-50-6	--	--	--	--
N-methyl perfluorooctane sulfonamidoacetic acid	NMeFOSAA	2355-31-9	--	--	--	--
Perfluorobutane sulfonate	PFBS	375-73-5	400,000	5,710,000	88,600,000	--
Perfluorobutanoic acid	PFBA	375-22-4	64,600	8,370,000	--	--
Perfluorodecane sulfonate	PFDS	335-77-3	--	--	--	--
Perfluorodecanoic acid	PFDA	335-76-2	2,940	660	--	--
Perfluorododecanoic acid	PFDoA	307-55-1	--	--	--	--
Perfluoroheptane sulfonate	PFHpS	375-92-8	--	--	--	--
Perfluoroheptanoic acid	PFHpA	375-85-9	--	--	--	--
Perfluorohexane sulfonate	PFHxS	355-46-4	65,300	5,500	--	--
Perfluorohexanoic acid	PFHxA	307-24-4	28,800	2,210,000	--	--
Perfluorononane sulfonate	PFNS	68259-12-1	--	--	--	--
Perfluorononanoic acid	PFNA	375-95-1	16,400	2,080	--	--
Perfluorooctanesulfonamide	PFOSA	754-91-6	--	--	--	--
Perfluorooctane sulfonate	PFOS	1763-23-1	22,600	117	2,570	3,960
Perfluorooctanoic acid	PFOA	335-67-1	307,000	1,580,000	--	6,120
Perfluoropentane sulfonate	PFPS	2706-91-4	--	--	--	--
Perfluoropentanoic acid	PFPA	2706-90-3	--	--	--	--
Perfluorotetradecanoic acid	PFTeDA	376-06-7	--	--	--	--
Perfluorotridecanoic acid	PFTriDA	72629-94-8	--	--	--	--
Perfluoroundecanoic acid	PFUnA	2058-94-8	--	--	--	--

Analyte	Acronym	CAS	SL[1] (ng/L) Freshwater Aquatic Life	SL[1] (ng/L) Freshwater Aquatic-Dependent Mammals	SL[1] (ng/L) Freshwater Aquatic-Dependent Birds	SL[1] (ng/L) Marine Aquatic Life

Notes:

1. U.S Department of Energy, Argonne National Laboratory, Air Force Civil Engineer Center. 2021. Derivation of PFAS Ecological Screening Values (U.S. DOE et al., 2021).

ng/L = Nanogram(s) per liter.
CAS = Chemical Abstracts Service Registry Number.
SL = Screening Level.

QAPP Worksheet #15-5: Laboratory-Specific Detection/Quantitation Limits

Matrix: Soil/Sediment
Analytical Group: Total Organic Carbon
Method: SW9060A
Laboratory: Eurofins Lancaster Laboratories Environmental

Analyte	CAS	Eurofins Lancaster– Laboratory Limits (mg/kg)		
		LOQ	LOD	DL
Total Organic Carbon	7440-44-0	300	200	100

Notes:
DL = Detection limit.
LOD = Limit of detection.
LOQ = Limit of quantitation.
mg/kg = Milligram(s) per kilogram.
NA = Not applicable.

QAPP Worksheet #15-6: Laboratory-Specific Detection/Quantitation Limits

Matrix: Soil/Sediment
Analytical Group: pH
Method: SW9045C
Laboratory: Eurofins Lancaster Laboratories Environmental

		Eurofins Lancaster– Laboratory Limits (su)		
Analyte	**CAS**	**LOQ**	**LOD**	**LOQ**
pH	NA	0.01	0.01	0.01

Notes:
DL = Detection limit.
LOD = Limit of detection.
LOQ = Limit of quantitation.
NA = Not applicable.
su = Standard unit(s).

QAPP Worksheet #15-7: Laboratory-Specific Detection/Quantitation Limits

Matrix: Soil/Sediment
Analytical Group: Grain size
Method: D422
Laboratory: Eurofins Lancaster Laboratories Environmental

		Eurofins Lancaster– Laboratory Limits (%)		
Analyte	**CAS**	**LOQ**	**LOD**	**LOQ**
Gravel (>4.75 mm)	NA	1.0	0.5	1.0
Sand (0.075-4.75 mm)	NA	1.0	0.5	1.0
Silt (0.074-0.005 mm)	NA	1.0	0.5	1.0
Clay (<0.005 mm)	NA	1.0	0.5	1.0

Notes:
DL = Detection limit.
LOD = Limit of detection.
LOQ = Limit of quantitation.
mm = millimeter
NA = Not applicable.

QAPP Worksheet #15-8: Laboratory-Specific Detection/Quantitation Limits

Matrix: Soil Extract
Analytical Group: Cation-Exchange Capacity by SW-846 Method 9081 and Method 6010B
Concentration Level: Low
Laboratory: Eurofins TestAmerica Corpus Christi

Analyte	CAS No.	Achievable Laboratory Limits[1] (mg/L)	
		MDL	RL
Sodium	7440-23-5	0.3100	1.0000

Notes:
1. Eurofins TestAmerica, Corpus Christi presents laboratory limits as MDL and RL.

CAS = Chemical Abstracts Service.
CEC = Cation exchange capacity.
MDL = Method detection limit.
mg/L = Milligram(s) per liter.
RL = Reporting limit.

QAPP Worksheet #15-9: Laboratory-Specific Detection/Quantitation Limits

Matrix: Soil Extract
Analytical Group: Anion-Exchange Capacity
Concentration Level: Low
Laboratory: Colorado State University

		Achievable Laboratory Limits (parts per million)
Analyte	CAS No.	MDL
Phosphorus	7723-14-0	0.001

Notes:
CAS = Chemical Abstracts Service.
MDL = Method detection limit.

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QAPP Worksheet #17: Sampling Design and Rationale

The general approach to complete the RIs at each installation is described below. Worksheet #17 in the site-specific addenda will present additional information on the number and locations of samples proposed for the RI. The worksheet will describe the sampling design and basis for selection for each sampling location. If a sample cannot be collected where planned, the decision and rationale for changing the location will be identified and documented following discussions with the USACE and NGB/A4VR.

Mobilizations

Field activities during the initial mobilization(s) will include: (1) initial synoptic water level measurement event (Volk Field), (2) baseline groundwater sampling of existing MWs (Volk Field), (3) DPT soil and groundwater investigation, including use of HRSC and a mobile PFAS lab, and (4) initial surface water/sediment sampling. HRSC methodology will utilize the HPT/EC sensor and groundwater sampler. HPT/EC will be completed in separate boreholes, prior to groundwater sampling. The combination of HRSC and PFAS screening analyses by the mobile laboratory will support delineation of source areas and selection of monitoring well (MW) locations and screen intervals for definitive fixed-base lab analysis during Mobilization 2.

Following the synoptic event and initial field activities, the data generated will be incorporated into an updated CSM. The results of initial field activities will be presented in a DPT Investigation Report and used to select MW and lysimeter locations and complete planned RI field activities. Scoping sessions will be hosted with the entire project team (USACE, NGB/A4VR, and the regulatory agency) to discuss the updated CSM and refined sampling plan prior to the second mobilization.

Field activities during second mobilization will include: (1) MW installation and development, (2) completion of source area soil investigation with installation of lysimeters based on soil sampling results, (3) surface water/sediment sampling/additional delineation (if warranted following initial results), (4) synoptic water level measurement event (new and existing MWs), and (5) groundwater sampling event (new and existing MWs). Aquifer testing (i.e., slug testing) will be performed on all new MWs to assess hydraulic conductivity.

At the conclusion of RI field activities, the data will be integrated into an updated CSM. Additional scoping sessions to discuss the updated site understanding and potential data gaps will be completed. If it is determined that there are data gaps based on sampling results, optional additional investigation will be completed.

Field Activities

The RI field activities will be completed in accordance with this Programmatic UFP-QAPP and site-specific UFP-QAPP Addenda, in addition to the Geology Supplement to the Performance Work Statement (USACE 2020a) and ANG guidance for conducting investigations under the ERP (ANG 2009). Equipment to be used onsite will be reviewed ahead of mobilization to evaluate the compatibility for PFAS investigative work and evaluated again when the equipment is physically onsite prior to the start of field activities. Equipment and material compatibility will be in accordance with the PFAS Chemistry Instructions for Scopes of Services for Contracted Environmental Studies (USACE 2020).

All water used for decontamination activities will be certified PFAS-free by confirmation sampling prior to initiating RI field activities. A sample from the identified hose bib or hydrant will be collected for PFAS analysis by LC/MS/MS compliant with Table B-15 of DoD QSM Version 5.3 or a more recent version to which the laboratory is accredited. Aqueous samples will also be collected for PFAS analysis by LC/MS/MS compliant with Table B-15 of DoD QSM Version 5.3 (or more recent) to verify that water storage vessels brought onsite by the drilling subcontractors during field activities are PFAS-free. The source water and storage vessels will be considered acceptable if the PFAS concentration is less than $1/10^{th}$ of the screening level (Worksheet #15) or not detected at the LOD. Storage vessels are anticipated to be used by the drilling subcontractors for containerizing water for activities such as grouting, equipment decontamination, and other miscellaneous tasks.

Soil, groundwater, pore water, surface water, and sediment samples will be analyzed for 24 PFAS compounds by LC/MS/MS compliant with DoD QSM Version 5.3 (or more recent), Table B-15. The screening criteria for the RI at each installation will be in accordance with the 15 October 2019 Assistant Secretary of Defense Memorandum, Investigating PFAS within the DoD Cleanup Program and April 2021 USEPA Fact Sheet for PFBS, as presented in Worksheet #15. The memorandum lists specific screening values for PFOS and PFOA and the fact sheet presents human toxicity values for calculating the SL for PFBS.

Coordination completed prior to mobilization will include coordinating site access, determining the locations of an equipment staging area and IDW storage and decontamination areas, utility clearance utilizing the installation dig permits/digger's hotline, flight line activities (as needed), private property owners (as needed), and addressing any other installation concerns ahead of investigative site activities. This includes identifying items such as routes for access, timeframes that are optimal for ongoing installation activities or property owners and understanding the expectations of property owners for work completed on their property.

Coordination with the Installation EM and Airfield Management will be completed to verify all requirements and restrictions for working on the flight line are followed, and any necessary training is completed. For work on the flight line, a Federal Aviation Administration waived is not anticipated; however, if a key location for sampling or monitoring well installation is located within the runway or taxiway clearance areas, coordination for the waiver would be completed in advance. All work completed on adjacent airport property will be coordinated with the airport authority through the Installation EM. Requirements for digging (beyond the digger's hotline) will be completed as required by the airport authority.

Within 30 days of mobilization, all field personnel will complete Level I Operations Security training and Antiterrorism Level I training. Training certificates will be provided to the USACE Project Manager within 5 days of completing the training, and the training well be completed on an annual basis.

Synoptic Event

An initial synoptic GW level measurement and baseline GW sampling event will be completed at Volk Field. GW level measurements will be collected at all identified wells, and an evaluation of hydraulic conductivity using both rising and falling head slug testing may be completed if warranted. SW elevations at adjacent water bodies and drainages will also be level-surveyed and locations recorded with Global Positioning System (GPS) to evaluate GW-SW interaction. Following completion of the GW level measurement, GW samples for PFAS analysis by LC/MS/MS compliant with Table B-15 of DoD QSM Version 5.3 (or more recent) at MWs identified for the baseline event will be collected. Potentiometric maps will be developed using the groundwater elevation data, and PFAS analytical data will be shown on maps for the project team to review.

High Resolution Site Characterization (HRSC)

DPT will be used to refine the lateral and horizontal extent of PFAS in groundwater. EA will use DPT to collect HRSC data using HPT/EC sensors and groundwater sampler. The groundwater sampler will be advanced in an adjacent boring, after HPT/EC data analysis has been completed, and targeting hydraulically preferential zones. DPT will also be used for soil sampling in the areas of soil source delineation, as described in Soil Sampling and Lysimeters.

During initial field activities (Mobilization 1), HPT/EC/groundwater sampling points will be selected based on the preliminary CSM along transects representative of migration pathways, which will allow vertical and horizontal plume delineation and understanding of mass flux of PFAS at each of the sites and across the installations. The results of HPT/EC/groundwater will be used to select step-out sampling locations (both on and off the installation as needed) and MW locations and screen intervals. Preference will be given to locations that transect the inferred PFAS migration pathway, where potential offsite migration may occur or has occurred (as applicable).

The HPT will provide real-time downhole discrete measurement of aquifer permeability (i.e., an indication of preferential flow paths) by continuously injecting PFAS-free water at a constant flow rate as the tool is advanced. The injection pressure will be recorded, and is inversely proportional to permeability (i.e., high pressure indicates low permeability). The EC sensor will record the degree of soil electrical conductivity (fine-grained soils are more conductive, but less permeable). At each probe location, aquifer permeability and EC will be logged continuously. Sands and gravels have lower conductivity and are highly permeability resulting in low HPT injection pressure. As soil particle size decreases, EC results typically increase as will HPT injection pressure because of the lower permeability of these soils. Based on HPT/EC analysis, a subset of borings will be selected to complete an additional adjacent boring for continuous soil logging to verify soil lithology. It is estimated that approximately two such borings will be completed along each mass flux transect or at each release area.

The HPT/EC logs will be provided to the USACE Project Geologist and project team (USACE and NGB/A4VR) on a daily or weekly basis, as needed, to facilitate discussion regarding interpretation of the lithology and observed permeable zones. The team will also discuss targeted intervals for groundwater sampling based on the HPT/EC data generated at each boring.

Collection of grab groundwater samples from discrete zones will be completed during probe advancement (in an adjacent borehole), preferentially from more permeable zones as informed by HPT/EC data, to collect groundwater screening samples ahead of MW installation. Groundwater samples for PFAS analysis by LC/MS/MS compliant with Table B-15 of DoD QSM Version 5.3 (or more recent) will be collected from an estimated three to five depth intervals, represented by more permeable zones, per probe location.

A mobile PFAS laboratory in conjunction with HPT/EC/groundwater sampling points will be used to provide screening-level onsite PFAS analysis by LC/MS/MS. All samples for definitive analyses will be sent to an offsite laboratory.

Soil Sampling and Lysimeters

Surface and subsurface soil samples will be collected from DPT borings to delineate source areas. A minimum of three soil samples will be collected from each boring, one from the surface (0-0.5 ft below ground surface [bgs]) and two from the subsurface (anticipated maximum depth of 30 ft bgs at Volk, 15 ft bgs at Joe Foss, and 10 ft at Truax), unless groundwater is encountered at less than 10 ft bgs, at which two samples will be collected (one at surface and one directly above water table). Continuous soil logging will be completed to observe lithology. Soil samples will initially be analyzed onsite (screening level) to better delineate source areas, with samples to demonstrate source area extent and delineation sent for offsite definitive lab analysis.

Lysimeters will be installed at locations representative of release areas (i.e., locations within release areas where soil concentrations exceed SLs) to assess the mass discharge of PFAS to groundwater. Borehole logging will be completed during lysimeter installation to place the screens within the zone immediately above the water table. Lysimeter installation will be completed in accordance with manufacturer instructions. To the extent practicable, EA will co-locate lysimeter locations with a drilled soil boring and MW for the purposes of evaluating phase-partitioning and initial dissolved phase mixing. Infiltration rates will be estimated based on soil characteristics. Pore water samples will be collected quarterly for 1 year and analyzed for PFAS by LC/MS/MS compliant with Table B-15 of DoD QSM 5.3. Data obtained during the initial and quarterly lysimeter sampling events will be used to quantify the soluble PFAS present in the water within the pore spaces of soils. Additionally, the quarterly data will provide information regarding temporal variability in the pore water concentration.

At each installation, soil samples will be collected in areas anticipated to be outside and/ not downgradient or downstream of any potential release areas for the purpose of evaluating the background concentration range of PFAS (e.g., from non-ANG sources). Eight soil borings will be drilled at each installation, with one surface soil sample and one subsurface sample (total of two samples) collected at each boring. Sample locations will be outside drainage channels and located with ground elevations higher than the identified source areas. Statistical evaluation of the background soil data set will be completed as described in the UFP-QAPP Addenda using ProUCL statistical software.

Surface Water and Sediment Sampling

Surface water, stormwater, and/or sediment sampling will be completed at stormwater conveyances, ditches, outfalls, and creeks that direct stormwater away from release areas during a rain event and where contaminated groundwater may discharge to surface water. Samples will also be collected at locations upstream of release areas, to compare upstream vs. downstream concentrations. Additional samples may be collected at adjoining tributaries to better evaluate whether or not occurrences downstream are site-related. Surface water samples at outfalls and stormwater samples within stormwater conveyances will be collected during rain events, to the extent practical. For the purposes of this RI, surface water will indicate a body of water classified as a "Water of the United States" or "Water of the State." The stormwater designation will indicate samples collected from locations do not qualify as a "Water of the United States" or "Water of the State." Detailed information regarding where a sample is collected will be included on the field form and in the field logbook.

Surface water or stormwater samples will be collected before co-located sediment samples to avoid suspending solids. Water quality parameters will be collected for each sample, and all samples will be analyzed for PFAS by LC/MS/MS compliant with Table B-15 of DoD QSM 5.3. Surface water samples will not be filtered prior to submittal for analysis and sediment samples will be collected using single-use liners.

Monitoring Well Installation and Sampling

New MWs will be installed at potential release areas at each installation to delineate plumes, potentially to bedrock and laterally as necessary to define the plumes to the proposed screening levels. MWs will be installed by state-licensed drillers, with oversight and lithologic logging provided by an EA state-licensed geologist (except for SD where state licensing is not currently required). Monitoring well installation will be completed in accordance with Federal, State, and local requirements with any associated fees paid by the drilling subcontractor. Any applications (such as a notice of intent) required prior to well installation or forms documenting well installation, will be submitted by the drilling subcontractor in accordance with the regulatory requirements.

Surface and subsurface soil samples will be collected from MW borings within anticipated areas of soil source delineation. A minimum of three soil samples will be collected from each boring, one from the surface (0-0.5 ft below ground surface [bgs]) and two from the subsurface (anticipated maximum depth of 30 ft bgs at Volk, 15 ft bgs at Joe Foss, and 10 ft at Truax), unless groundwater is encountered at less than 10 ft bgs, at which two samples will be collected (one at surface and one directly above water table).

Within each identified release area, three soil samples will be collected for geotechnical analysis (pH, grain size, permeability, total organic carbon, and anion/cation exchange capacity) at locations and intervals considered to be presentative of saturated flow zones. Grain size, permeability, and pH data will be used to evaluate aquifer permeability and hydraulic conductivity. Total organic carbon and anion/cation exchange capacity will be used to evaluate PFAS fate and transport in the subsurface.

During all drilling activities, the geologist will ensure confining materials are not present at any of the boreholes. If natural confining materials greater than 2-ft thickness or engineered confining materials are encountered, drilling will be stopped and the USACE Project Geologist will be contacted to evaluate options for proceeding with the investigation in such a manner as to prevent cross contamination between distinct water-bearing zones. Drilling equipment will be decontaminated prior to drilling at each site, and in between drilling locations. All MWs will be installed using sonic drilling techniques with collection of continuous soil cores.

All newly installed monitoring wells will be survey in accordance with the Geology Supplement to the Performance Work Statement (USACE 2018). The location coordinates will be within one foot and reference the State Plane Coordinate System. The ground elevation (closet 0.1-foot) and top of the well riser (closest 0.01-foot) will also be obtained for each new monitoring well. Elevations will reference mean seal level to the North American Vertical Datum of 1988.

All existing and newly installed MWs will be developed by pumping groundwater until a minimum of four well volumes have been removed, the pumped water is clear and free of fines, and groundwater parameters have stabilized. Temperature, pH, specific conductivity, and turbidity will be monitored during pumping with a minimum of one parameter reading collected per well volume purged. Stabilization is achieved when pH is within 0.2 units, turbidity is less than 25 NTU, and less than 10 percent changed is observed for the other parameters between four consecutive readings. Use of surge blocks for well development will be evaluated as an option, based on the ability to verify material compatibility with PFAS sampling and surging is appropriate given the soil type within the screened interval. If the construction materials of the surge block cannot be verified and surging is needed for well development, an equipment rinsate blank will be collected off the surge block.

Following well development, the hydraulic conductivity will be evaluated at all newly installed MWs using both rising and falling head slug tests. All liquid IDW generated will be managed in accordance with the waste management plan (Appendix E).

Groundwater samples will be collected from new and existing MWs listed in the site-specific UFP-QAPP addenda and analyzed for PFAS by LC/MS/MS compliant with Table B-15 of DoD QSM 5.3. Groundwater sampling will be completed using low-stress purging and sampling techniques. Water quality parameters including temperature, pH, conductivity, redox potential, dissolved oxygen, and turbidity will be recorded during well purging activities. Drawdown will also be recorded along with water quality parameters to ensure groundwater representative of the surrounding formation is sampled. Newly installed and developed MWs will be allowed to equilibrate for 2 weeks prior to sampling.

Synoptic Event

Following installation of all new MWs, a synoptic event will be completed. Basewide groundwater measurements will be collected at all existing and new MWs, and groundwater samples will be collected at all MWs appropriate for evaluating PFAS concentrations in groundwater at the installation.

Human Health Risk Assessment

The Human Health Risk Assessment (HHRA) will include a quantitative estimation of potential excess cancer risk and noncancer hazards to current and potential future human receptors in contact with PFAS in soil, groundwater, surface water, and sediment. Specific risk assessment methodology will be described in the site-specific UFP-QAPP addenda and will be consistent with the USEPA Assessment Guidance for Superfund: Part A (USEPA 1989) and utilize the USEPA Regional Screening Level Calculator. The HHRA will consist of: (1) chemicals of potential concern (COPC) selection, (2) toxicity assessment, (3) exposure assessment, (4) risk characterization, and (5) uncertainty evaluation.

Summary statistics will be prepared for COPC selection for each data set (i.e., soil, sediment, groundwater, and surface water) and the USEPA ProUCL software will be used to calculate 95% upper confidence limits (UCLs). The USEPA has published Regional Screening Levels (RSLs) for PFBS, which include resident soil (1,900 µg/kg), industrial soil (2,500 µg/kg), tap water (600 ng/L), and soil for protection of groundwater (0.19 µg/kg). In addition, the USEPA has established a drinking water lifetime Health Advisory (HA) of 70 ng/L (equal to 70 parts per trillion) for PFOS and PFOA, individually or combined, and published soil and groundwater screening criteria for these chemicals through its RSL calculator using the reference dose (RfD) set forth in the drinking water lifetime HAs (e.g., for PFOS and PFOA, 130 µg/kg in residential soil, 40 ng/L in tap water). Soil and groundwater screening criteria will be used as surrogate criteria for sediment and surface water, respectively.

PFAS toxicity criteria are continually evolving. PFAS are currently evaluated for noncarcinogenic health effects because the toxicological research database is insufficient to support quantitative evaluation of cancer risk. At this time, the RfD is the toxicity value that will be used in the HHRA. The carcinogenic slope factor for PFOA and non-carcinogenic RfDs for PFOA and PFOS were specified in an October 2019 Assistant Secretary of Defense Memorandum. The RfD for PFBS was specified in an April 2021 USEPA fact sheet.

Onsite receptors that will be evaluated are expected to include current and future industrial workers, current and future construction workers, and hypothetical future residents. Potentially complete exposure pathways include incidental ingestion and dermal contact of soil, dust inhalation, soil leaching to groundwater, and ingestion of groundwater. Offsite receptors may include recreational users of impacted surface water features. Potentially complete exposure pathways include ingestion and dermal contact of surface water, incidental ingestion and dermal contact of sediment, and ingestion of fish.

The HHRA will provide a quantitative determination of cancer risks and noncancer hazards to all potential receptors for all completed exposure pathways identified in the CSM. Cancer risks and noncancer hazards will be determined by combining the toxicity assessment and exposure assessment set forth in the HHRA. Uncertainties will be qualitatively evaluated and presented in the HHRA.

Ecological Risk Assessment

A quantitative Screening Level Ecological Risk Assessment (SLERA) (if warranted and based on funding) will be prepared to evaluate the potential for adverse ecological effects attributable to site contamination, specifically from PFAS compounds. The SLERA methodology will be described in the site-specific UFP-QAPP addenda and will be consistent with Step 1 of the Ecological Risk Assessment Guidance for Superfund (ERAGS; EPA 1997) and other relevant guidance documents (e.g., EPA 1998; USACE Engineering Pamphlet 200-1-15, Engineering Pamphlet 200-1-4; TSERAWG TG-090801).

As part of the SLERA, an ecological conceptual site model (ECSM) will be developed, which is the initial step in the screening-level and problem formulation phase. Based on the site history, information from the PA/SI, data collected during RI fieldwork, and initial site visit documenting habitat and biota diversity, the ESCM will address the following five components: (1) characterization of the environmental setting and known or suspected contaminants, (2) fate and transport mechanisms, (3) mechanisms of potential ecotoxicity associated with contaminants and likely categories of receptors that could be affected, (4) complete exposure pathways, and (5) selection of appropriate endpoints supporting site-specific management objectives to screen for ecological risks.

Potential exposure pathways to identified wildlife receptors will be evaluated during the SLERA. Desktop research will be completed via a literature search of peer-reviewed scientific journals to describe the ecotoxicity of PFAS. Currently, with the ever-growing number of PFAS compounds, there is likely only sufficient toxicity information available for a handful of compounds: PFOS, PFOA, and perfluorohexanoic acid, with the majority of ecotoxicity data only for aquatic animals (e.g., fish, plants, invertebrates, and amphibians) (Salice et al. 2018; Suski et al. in review). A literature search will be completed to identify relevant toxicity reference values available for other organisms and in other media using known scientific databases and peer-reviewed sources. Relevant sources include, but are not limited to, State and Federal Ambient Water Quality Criteria; EPA's Ecological Soil Screening Levels guidance and documents; benchmarks from EPA, state agencies, National Oceanic and Atmospheric Administration, International sources (e.g., Ontario, Australia), U.S. Army Public Health Command, and Oak Ridge National Laboratory; and recent peer-reviewed scientific journal articles (e.g., Conder et al. 2019; McCarthy et al. 2017; Salice et al. 2018, 2020; Dennis et al. 2020; Suski et al. in review).

Assessment and measurement endpoints will be identified to support the site-specific management objectives to screen for ecological risks. Assessment endpoints are explicit expressions of the actual environmental values (e.g., ecological resources) that are to be protected and are selected based on the ecosystems, communities, and/or species potentially present at the site. Measurement endpoints are measurable biological responses to stressors and are developed for each assessment endpoint. A weight-of-evidence approach is used if more than one measurement endpoint is selected for an assessment endpoint. If some lines of evidence conflict with others, professional judgment will be used to determine which data are considered more reliable or relevant than others.

QAPP Worksheet #18: Sampling Locations and Methods

Worksheet #18 will be completed as part of the installation-specific UFP-QAPP Addenda. The table shown below describes the information that will be provided within each installation-specific addenda.

Sample Identifier	Matrix	Depth (feet below ground surface)	Type (Sampling Tool)	Analyte/ Analytical Group	Sampling SOP

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

Laboratories:

Eurofins Lancaster Laboratories Environmental
2425 New Holland Pike
Lancaster, PA 17601
Phone: (717) 556-7327
Contact: Kay Hower, KayHower@eurofinsus.com
Accreditation/Expiration Date: DoD ELAP QSM Version 5.3 Certificate Number 0001.01/ November 30, 2022

Eurofins TestAmerica Sacramento
880 Riverside Parkway
West Sacramento, CA 95605
Phone: (916) 373-5600
Contact: David Alltucker, David.Alltucker@Eurofinset.com
Accreditation/Expiration Date: DoD ELAP QSM Version 5.3 Certificate Number 1.01/November 30, 2022

Pace Mobile Laboratory
Mobilized to the Site
Contact: Mike Rossi
Mobile Phone: (802) 839-0544
Accreditation/Expiration Date: DoD ELAP for PFAS by LCMSMS Compliant with Table B-15 of QSM 5.3/March 31, 2022
Accreditation/Expiration Date: DoD ELAP QSM Version 5.3 Certificate Number 3269.01/March 24, 2022

Sample Delivery Method: Laboratory Courier/Overnight Shipping (not applicable for mobile laboratory)

Note: Analytical methods for investigation-derived waste (IDW) characterization are included in this worksheet and in Worksheet #23 (Analytical Standard Operating Procedures). These methods are not included in worksheets focused on quality control and measurement performance; data generated using these methods will not be subject to validation.

Analyte/ Analyte Group	Matrix	Method	Container(s) (number, size & type per sample)	Preservation	Maximum Holding Time (Preparation/ Analysis)	Data Package Turnaround
PFAS (Eurofins Lancaster)	Aqueous	LC/MS/MS compliant with DoD QSM Version 5.3 (or more recent) Table B-15.	HDPE w/ HDPE screw cap 2 x 250mL	Cool ≤6 ºC	14/28 days	28 business days
PFAS (Eurofins TestAmerica)	Aqueous	LC/MS/MS compliant with DoD QSM Version 5.3 (or more recent) Table B-15.	HDPE w/ HDPE screw cap 2 x 250mL	Cool ≤6 ºC	14/28 days	28 business days
PFAS Screening (Pace Mobile Laboratory)	Aqueous	LC/MS/MS Screening Method	2 x 125mL HDPE bottles (4 x 125mL for samples designated MS/MSD)	Cool ≤6 ºC	14/28 days	Preliminary 24-hours; Final report 21-days
PFAS (Eurofins Lancaster)	Solid	LC/MS/MS compliant with DoD QSM Version 5.3 (or more recent) Table B-15.	4.5-ounce plastic bottle	Cool ≤6 ºC	14/28 days	28 business days
PFAS (Eurofins TestAmerica)	Solid	LC/MS/MS compliant with DoD QSM Version 5.3 (or more recent) Table B-15.	1 x 4-ounce HDPE jar	Cool ≤6 ºC	14/28 days	28 business days
PFAS Screening (Pace Mobile Laboratory)	Solid	LC/MS/MS Screening Method	1 x 125mL HDPE bottle (includes samples designated MS/MSD)	Cool ≤6 ºC	14/28 days	Preliminary 24-hours; Final report 21-days
Total Organic Carbon	Solid	SW9060A	1, 4-ounce glass jar (20 grams)	Cool ≤ 6 ºC	28 days	28 business days
pH	Solid and IDW	SW9045C	1, 4-ounce glass jar with Teflon lined lid (50 grams)	Cool ≤ 6 ºC	Analyze as soon as possible	28 business days
pH	Water (IDW)	SW9040C	1, 250-mL	Cool ≤ 6 ºC	Analyze as soon as possible	28 business days
Grain Size	Solid	ASTM D422	16-ounce glass or plastic (500 grams)	None	None	28 business days

Analyte/ Analyte Group	Matrix	Method	Container(s) (number, size & type per sample)	Preservation	Maximum Holding Time (Preparation/ Analysis)	Data Package Turnaround
TCLP RCRA VOCs	Solid (IDW)	SW1311/8260C	100 g, 2-ounce glass jar, no headspace	Chilled to 2-6 ºC for shipping, stored at ≤6 ºC	14/14 days	28 business days
RCRA VOCs	Water (IDW)	SW8260	3, 40-mL glass vials	HCL or None, chilled to 2-6 ºC for shipping, stored at ≤6 ºC	14 days preserved; 7 days not preserved	28 business days
TCLP RCRA SVOCs	Solid (IDW)	SW1311/SW8270D	200 grams, 16- or 32-ounce glass jars	Chilled to 2-6 ºC for shipping, stored at ≤6 ºC	14 days to leach prep, 40 days to analysis	28 business days
RCRA SVOCs	Water (IDW)	SW8270D	2; 25-mL amber glass bottle	Chilled to 2-6 ºC for shipping, stored at ≤6 ºC	7/40 days	28 business days
TCLP RCRA Metals	Solid (IDW)	SW1311/6010C and SW7470A	200 grams;16- or 32-ounce glass jar	Chilled to 2-6 ºC for shipping, stored at ≤6 ºC	6/6 months; 28/28 days for mercury	28 business days
RCRA Metals	Water (IDW)	SW6010C and SW7470A	250-mL plastic	HNO3, chilled to 2-6 ºC for shipping, stored at ≤6 ºC	6 months; 28 days for mercury	28 business days
Reactive Sulfide	Solid (IDW)	SW9034	100 grams, 4- or 8-ounce glass jar	Chilled to 2-6 ºC for shipping, stored at ≤6 ºC	None	28 business days
Reactive Sulfide	Water (IDW)	SW9034	4- or 8-ounce glass jar	Chilled to 2-6 ºC for shipping, stored at ≤6 ºC	None	28 business days
Reactive Cyanide	Solid (IDW)	SW9012B	100 grams, 4- or 8-ounce glass jar	Chilled to 2-6 ºC for shipping, stored at ≤6 ºC	None	28 business days
Reactive Cyanide	Water (IDW)	SW9012B	4- or 8-ounce glass jar	Chilled to 2-6 ºC for shipping, stored at ≤6 ºC	None	28 business days
TCLP RCRA Pesticides	Solid (IDW)	SW 1311/8081B	200 grams, 16- or 32-ounce glass jar	Chilled to 2-6 ºC for shipping, stored at ≤6 ºC	14 days to leach prep, 40 days to analysis	28 business days

Analyte/ Analyte Group	Matrix	Method	Container(s) (number, size & type per sample)	Preservation	Maximum Holding Time (Preparation/ Analysis)	Data Package Turnaround
RCRA Pesticides	Water (IDW)	SW8081B	2; 250-mL amber glass bottle	Chilled to 2-6 ºC for shipping, stored at ≤6 ºC	7/40 days	28 business days
TCLP RCRA Herbicides	Solid (IDW)	SW 1311/8151A	200 grams, 16- or 32-ounce glass jar	Chilled to 2-6 ºC for shipping, stored at ≤6 ºC	14 days to leach prep, 40 days to analysis	28 business days
RCRA Herbicides	Water (IDW)	SW8151A	2; 1,000-mL amber glass bottle	Chilled to 2-6 ºC for shipping, stored at ≤6 ºC	7/40 days	28 business days
Flash Point	Water (IDW)	SW1010A	250-mL plastic or glass bottle	none	30 days	28 business days
Cation Exchange Capacity	Solid	SW9081	4 or 8 oz. glass jar	none	6 months	28 business days
Anion Exchange Capacity	Solid	SOP AEC	4 or 8 oz. glass jar	none	6 months	28 business days
Permeability	Solid	ASTM D5084-16	Shelby tube	none	6 months	28 business days

Notes:
°C = Degrees Celsius.
HDPE = High-density polyethylene.
mL = Milliliter(s).
RCRA = Resource Conservation and Recovery Act.
SVOC = Semivolatile organic compound.
TCLP = Toxicity Characteristic Leaching Procedure.
VOC = Volatile organic compound.

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QAPP Worksheet # 20: Field QC Summary

Matrix	Analyte/Analytical Group	Concentration Level	Field Samples	Field Duplicates	MS/MSD	Field Blank	Equipment Blank	Total # Samples to Lab[1]
Water	PFAS	Low/Medium/High	Installation specific	10%	5%	1 per day	1 per day[2]	Installation specific
Soil/Sediment	PFAS	Low/Medium/High	Installation specific	10%	5%	1 per day	1 per day[2]	Installation specific

Notes:
1. Number of samples collected will vary between installations and are installation specific.
2. Equipment blanks will be collected with samples involving reusable equipment. No equipment blanks will be collected with samples that are collected directly from a tap/faucet.

MS = Matrix spike.
MSD = Matrix spike duplicate.

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QAPP Worksheet #21: Field SOP

SOP Reference Number	Responsible Organization	Title	Equipment Type or Instrument	Comments
01	EA	Sample Labels	NA	Delineates protocols for the use of sample labels.
02	EA	Chain-of-Custody Form	NA	Delineates protocols for use of chain-of-custody forms.
03	EA	Subsurface Utility Clearance	NA	Delineates protocols for subsurface utility clearance.
04	EA	Sample Packing and Shipping	NA	Delineates protocols for packing and shipping of environmental samples for laboratory for analysis. Note: vermiculite will not be used in packing coolers.
05	EA	Field Decontamination	NA	Describes procedures for decontamination of sampling equipment and site personnel.
07	EA	Surface Water Sampling	NA	Delineates protocols for surface water sampling.
10	EA	Water Level and Well Depth Measurements	NA	Delineates protocols for the collection of water levels and well depth measurements.
11	EA	Photoionization Detection	NA	Defines field procedures for using a photoionization detector.
13	EA	Collection of Monitoring Well Samples	NA	Delineates protocols for the collection of groundwater samples from monitoring wells.
16	EA	Surface Water, Groundwater, and Soil/Sediment Field Logbooks	NA	Delineates protocols for filling out field logbooks.
19	EA	Monitoring Well Installation	NA	Delineates protocol for installing monitoring wells
21	EA	Sediment Sampling	NA	Delineates protocols for sediment sampling.
25	EA	Soil Sampling	NA	Delineates protocols for soil sampling.
28	EA	Well and Boring Abandonment	NA	Defines protocols for well and boring abandonment.
34	EA	Drum Sampling	NA	Defines protocols for collecting samples from drums.
39	EA	Sample Preservation and Container Requirements	NA	Defines the preservatives and techniques for preserving environmental samples.
42	EA	Disposal of Investigation-Derived Material	NA	Defines the required steps for disposing of IDW generated during field activities.
43	EA	Multi-Probe Water Quality Monitoring Instruments	NA	Defines the calibration and operation of a meter used during low flow sampling techniques
47	EA	Direct-Push Technology Sampling	NA	Defines field procedures for sampling using direct push technology
48	EA	Low Flow Sampling	NA	Defines field procedures for purging and sampling using low flow sampling techniques

SOP Reference Number	Responsible Organization	Title	Equipment Type or Instrument	Comments
73	EA	Sampling for Per- and Polyfluorinated Alkyl Substances	NA	Delineates protocols for collecting environmental samples for analysis of PFAS, also known generally as PFCs.
MK3137	Geoprobe	Geoprobe Hydraulic Profiling Tool System	Hydraulic Profiling Tool	Describes the system, tools, equipment, assembly, field operation, troubleshooting and common problems.
MK3201	Geoprobe	Geoprobe Electrical Conductivity System	Electrical Conductivity System	Describes the system, tools, equipment, assembly, and field operation.
Notes: All SOPs were reviewed and modified (if required) to meet the requirements associated with project specific PFAS sampling. In addition to the Field SOPs, field activities will be completed in accordance with the ANG guidance for conducting investigations under the ERP (ANG 2009), Geology Supplement to the Scope of Services (USACE 2020a), and PFAS Chemistry Instructions for Scopes of Services (USACE 2020b).				

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

This worksheet documents procedures for performing testing, inspections, and QC for all field equipment. References to the applicable activity and SOPs are included. Where appropriate, the failure response will prescribe a Corrective Action (CA). All information summarized in this worksheet will be recorded in the field notes and field logs/forms.

Field Equipment	Calibration Activity	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference[1]
PFAS-free Source Water	Not applicable	Not applicable	PFAS analysis of source water for drilling and decontamination	Not applicable	Once (prior to field activities)	PFAS concentration < 1/10th the screening level or not detected at the LOD	Source alternate water for drilling and decontamination activities; Complete verification of alternate source water.	Field personnel	SOP 05, SOP 47
Multi-probe Water Quality Meter	Calibrate with pH, conductivity, oxidation reduction potential (ORP), dissolved oxygen (DO), turbidity standards	Decontaminate and protect in hard case. Keep instrument clean, see manufacturer's specifications, and keep battery charged for operation.	Field test in accordance with the manual	Inspect for external damage (connections, liquid crystal display screen, etc.)	Daily, before use, and when unstable readings occur	Within calibration standard(s) range	Recalibration or replacement of equipment	Field personnel	SOP 43
Global positioning survey equipment	Calibrate in accordance with the manual	Protect in hard case. Keep instrument clean, see manufacturer's specifications, and keep battery charged for operation.	Field test in accordance with the manual	Inspect for external damage	Daily check shots 'pre' and 'post' use	Field checks: horizontal: 1.0 meter; vertical 2.0 meters between known and measured points For post-processed data: horizontal quality – 0.15 meter; vertical quality – 0.15 meter	If daily QC checks do not meet acceptance criteria, return equipment to vendor for repair or work with the vender to rectify the issue.	Field personnel	Equipment manual
Water Level Meter	Not applicable. Operate in accordance with the manufacturer's instructions	Decontaminate between wells	Field test in accordance with the manual	Inspect tape for kinks and cuts, inspect probe for dirt, check batteries	Daily	Response	Replace battery if no response during test button check.	Field personnel	SOP 10
Hydraulic Profiling Tool (HPT) Probe	Pressure Reference Testing	Decontaminate probe and tubing between test hole locations	Field checks per manufacturer SOP	Inspect for external damage and tubing integrity	Prior to, and after each log	HPT reference test = 0, pass/fail test	Re-run test until reference reading within manufacturer limits	Subcontractor	Geoprobe SOP Tech. Bulletin MK3137
Electrical Conductivity Probe	EC Load Test	Decontaminate and clean contacts between test hole locations	Field checks per manufacturer SOP	Inspect for external damage and cable integrity	Prior to, and after each log	EC Load tests must pass within 10% acceptance criteria	Make adjustments on test jig and re-run EC Lad Test; if failure continues run EC Troubleshooting Tests	Subcontractor	Geoprobe SOP Tech. Bulletin MK3137
Photoionization Detector (PID)	Calibrate with calibration gas of known concentration	Clean and inspect instrument before use. Clean UV lamp lens with lens cleaning cloth/solution as needed to maintain operation.	Field checks per manual	Inspect for external damage/electrical cord integrity	Daily	Instrument calibrates to within 5% of calibration gas concentration.	Clean lamp lens and recalibrate. Operator correction or return to rental agency/manufacturer	Field personnel	Equipment manual

1. Field SOPs are provided in Appendix A.

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QAPP Worksheet #23: Analytical Standard Operating Procedures

The analytical SOPs summarized below are provided in Appendix D. Methods represent those currently certified by the laboratory and may undergo revision during periodic UFP-QAPP review. UFP-QAPP revisions will be submitted for approval.

SOP No.	Title, Date, and URL (if available)	Definitive or Screening Data	Matrix/ Analytical Group	SOP Option or Equipment Type	Modified for Project? Y/N
Eurofins Lancaster Laboratories Environmental LLC, Lancaster, Pennsylvania					
WI11572	Reactive Sulfide (titration) by SW-846 9034 (1996) or Chapter 7.3 (1996) in Solid or Liquid Waste, Rev 11, effective 11/30/2020	Definitive	Solid or Water/ Reactive Sulfide	Flow Analyzer	N
WI11629	Cyanide (Total, Amenable, Free, WAD, Reactive) in Waters and Soils by Methods SW-846 9012A/B, EPA 335.4, and SM 4500-CN G/E/I-1999/2011, Rev 20, effective 03/11/2021	Definitive	Solid or Water/ Cyanide	Flow Analyzer	N
WI10437	Flash Point for Liquids and Solids by ASTM D93, EPA 1010A o EPA 1010B, Rev 11, effective 11/30/2020	Definitive	Water/ Flash Point	Pensky Marten Closed Cup Tester	N
WI11880	Balances, Syringe, Pipette Verification, Rev 11, effective 8/31/2020	NA	Maintenance	Balance	N
WI11514	Particle Size Distribution of Soils and Solids/Grain Size Classification by ASTM D-422-63, Rev 10, effective 01/24/2019	Definitive	Solid / Particle Size	Sieve, Hydrometer	N
WI11931	Metals by ICP for Methods SW-846 6010B/C/D (aqueous, solid, tissue) and EPA 200.7(aqueous) Rev 14, effective 11/30/2020	Definitive	Solid, liquid/ Metals	ICP	N
WI11941	Sample Preparation of Wastewater and Leachates for Analysis of Total Metals by Inductively Coupled Plasma Atomic Emission Spectrometry (ICP) and Inductively Coupled Plasma Mass Spectrometer (ICM-MS), Rev. 13, effective 12/14/2020	NA	Inorganic Preparation Method 3010A	NA	N
WI7965	Mercury in Aqueous, Solid and Tissue Samples by EPA 7471A, 7471B, 7470A, and 245.1 rev 3 by Cold Vapor AA, Rev 19, effective 11/30/2020	Definitive	Solid, liquid/ Metals	Cold Vapor AA	N

SOP No.	Title, Date, and URL (if available)	Definitive or Screening Data	Matrix/ Analytical Group	SOP Option or Equipment Type	Modified for Project? Y/N
WI11924	Digestion of Aqueous Samples by SW-846 Method 7470A, Rev 22, effective 11/05/2020	NA	Liquid Inorganic Preparation SW-846 7470A	NA	N
WI9999	Pesticides in Water by Method 8081B using GC-ECD, Rev 8, effective 11/30/2020	Definitive	Water/ Pesticides	GC	N
WI10920	Separatory Funnel Extraction by Method 3510C, 608, 608.3 or 622 for Pesticides and PCBs in Wastewater, Rev 21, effective 12/16/2019	NA	Organic Preparation Method 3510C	NA	N
WI9202	Analysis of Chlorinated Herbicides by 8151A in Water, Rev 18, effective 02/11/2021	Definitive	Water/ Herbicides	GC	N
WI10919	Extraction of Chlorinated Herbicides in Water by SW-846 8151A, Rev 19, effective 03/11/2020	NA	Organic Preparation Method 8151A	NA	N
WI36458	Polyfluorinated Alkyl Substances (PFAS) in Aqueous Samples by Method 537 Version 1.1 Modified QSM5.3 Table B-15 Using LC/MS/MS, Version 1, effective 01/28/2021	Definitive	Water/PFAS	LC/MS/MS	N
WI36459	Polyfluorinated Alkyl Substances (PFASs) in Solids by Method 537 Version 1.1 Modified QSM 5.3 Table B-15 Using LC/MS/MS Version 1 effective 01/29/2021	Definitive	Solid/PFAS	LC/MS/MS	N
WI36413	Preventative and Corrective Maintenance for the API 4000 and AB Sciex 4500/5500 Liquid Chromatograph Mass Spectrometers (LC/MS/MS), Rev 1, effective 10/06/2020	NA	PFAS Maintenance	LC/MS/MS	N
WI11518	pH by EPA 9045C, 9045D and Corrosivity by SW-846 Chap 7 of Solids, Soils, and Solvents using Electrometric Methods, Rev 13, effective 07/08/2019	Definitive	Solid/pH	pH meter	N
WI9617	Semivolatile Organic Compounds by Method 8270D/E in Aqueous and Non-Aqueous Matrices using GC-MS, Rev 12, effective 06/10/2020	Definitive	Water, solid, leachate/ GC/MS SVOCs	GC/MS	N

SOP No.	Title, Date, and URL (if available)	Definitive or Screening Data	Matrix/ Analytical Group	SOP Option or Equipment Type	Modified for Project? Y/N
WI10935	Separatory Funnel Extraction (Method 3510C) of Base Neutrals and Acid Extractables in Leachates. Rev 15, effective 02/28/2021	Definitive	SVOC Prep	Prep	N
WI11627	TOC and TC in Solids and Sludges by Combustion by SM 5310B, EPA 415.1, SW-846 9060/9060A, Lloyd Kahn, Rev 17, effective 07/09/2019	Definitive	Solid/TOC	TOC Analyzer	N
WI8194	VOCs and GRO by GC/MS in Waters and Wastewaters by EPA 8260C/D, Rev 9, effective 03/25/2020	Definitive	Water GC/MS VOCs	GC/MS	N
WI8544	Toxicity Characteristic Leaching Procedure (TCLP) and Synthetic Precipitate Leaching Procedure (SPLP); VOCs by GCMS in Zero Headspace Extraction (ZHE) by 8260B/C/D, Rev 14, effective 11/02/2020	NA	TCLP Extraction SW-846 1311	NA	N
WI7563	Waste Extraction Test Leaching Procedure for Volatile and Non-Volatile Analytes, Rev. 10, effective 05/06/2020	Definitive	TCLP Extraction SW-846 1311	NA	N
Eurofins TestAmerica Sacramento, West Sacramento, California					
WS-LC-0025	Per- and Polyfluorinated Alkyl Substances (PFAS) in Water, Soils, Sediments and Tissue, [Method 537 (Modified), Method PFAS by LCMSMS Compliant with QSM Table B-15, Rev. 5.3 and higher], Rev. 4.0, effective 01/27/2021	Definitive	Solid and Water/PFAS	LC/MS/MS	N
Eurofins TestAmerica Corpus Christi, Corpus Christi, Texas					
CC-ATM-M020	Cation-Exchange Capacity (CEC) of Soils, Rev. 8, effective 05/20/2019	Definitive	Solid/Cation Exchange Capacity	ICP	N

SOP No.	Title, Date, and URL (if available)	Definitive or Screening Data	Matrix/ Analytical Group	SOP Option or Equipment Type	Modified for Project? Y/N
Colorado State University					
AEC	The Method for Anion Exchange Capacity (P-Fixation)	Definitive	Solid/Anion Exchange Capacity	ICP	N
GeoTesting Express					
ASTM D5084	Standard Operating Procedure: Standard Test Method for Measurement of Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter	Definitive	Solid/ Permeability	Permeameter	N
Pace Mobile Laboratory					
ENV-SOP-MAD1-0101	PFAS Analysis by Accredited LCMSMS, Rev. 0, effective 10/02/2020	Screening	Solid and Water/PFAS	LC/MS/MS	N

Notes:
AA = Atomic absorption.
GC = Gas chromatography.
GC/MS = Gas chromatography/mass spectrometry.
HPLC = High-performance liquid chromatography.
ICP = Inductively coupled plasma.
TOC = Total organic carbon.

QAPP Worksheet #24: Analytical Instrument Calibration

The calibration procedures, criteria, and corrective actions specified in this worksheet are in compliance with Table B-15 of the DoD QSM Version 5.3. The analytical SOPs referenced below are provided in Appendix D. Methods represent those currently certified by the laboratory and may undergo revision during periodic UFP-QAPP review. UFP-QAPP revisions will be submitted for approval. Note: Calibration of instruments for IDW characterization is not included in this worksheet.

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
Eurofins Lancaster Laboratories Environmental LLC, Lancaster, Pennsylvania						
LC/MS/MS	Mass Calibration	Instrument must have a valid mass calibration prior to any sample analysis. Mass calibration is verified after each mass calibration, prior to initial calibration (ICAL).	Per manufacturer specifications. Mass calibration range must bracket the ion masses of interest. The most recent mass calibration must be used for every acquisition in an analytical run. Mass calibration must be verified to be ±0.5 amu of the true value, by acquiring a full scan continuum mass spectrum of a PFAS stock standard.	If the mass calibration fails, then recalibrate. If it fails again, consult manufacturer instructions on corrective maintenance.	Analyst	WI36458, WI36459
LC/MS/MS	Tuning of LC/MS/MS	When masses fall outside ± 0.5 amu of true masses	Within 0.5 amu of true value	Retune and verify. If tuning fails acceptance criteria, perform a mass calibration, and repeat the tune check.	Analyst	WI36458, WI36459
LC/MS/MS	Mass Spectral Acquisition Rate	Each analyte and extracted internal standard analyte	A minimum of 10 spectra scans are acquired across each chromatographic peak	NA	Analyst	WI36458, WI36459

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
LC/MS/MS	Initial calibration with a minimum 5 points	At instrument set-up and after initial or continuing calibration verification fails, prior to sample analysis	Analytes must be within 70-130% of their true value for each calibration standard. ICAL must meet one of the two options below: Option 1: The RSD of the RFs for all analytes must be ≤ 20%. Option 2: Linear or nonlinear calibrations must have r2 ≥ 0.99	Correct problem, then repeat ICAL.	Analyst	WI36458, WI36459
LC/MS/MS	MDL standard	After each initial calibration	All compounds must be detected	Repeat ICAL procedure prior to analyzing samples. Repeat maintenance if needed.	Analyst	WI36458, WI36459
LC/MS/MS	Instrument Sensitivity Check	Prior to analysis and at least once every 12 hours.	Analyte concentrations must be at the LOQ. Analyte concentrations must be within ±30% of their true value	Correct problem and rerun ISC. If problem persists, repeat ICAL	Analyst	WI36458, WI36459
LC/MS/MS	ICV Standard	Once after each ICAL, analysis of a second source standard prior to sample analysis.	Analyte concentrations must be within ±30% of their true value	Correct problem, rerun the ICV and samples associated with the non-compliant ICV. If problem persists, repeat ICAL.	Analyst	WI36458, WI36459
LC/MS/MS	LOD standard	Quarterly	All compounds must be detected	Re-prep and reanalyze LOD.	Analyst	WI36458, WI36459
LC/MS/MS	LOQ Verification	Quarterly	Within 50% of true value	Re-prep and reanalyze LOQ.	Analyst	WI36458, WI36459

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
LC/MS/MS	CCV Standard	Prior to sample analysis, after every 10 field samples, and at the end of the analytical sequence.	Concentrations of analytes must range from the LOQ to the mid-level calibration concentration. Analyte concentrations must be within ±30% of their true value	Immediately analyze two additional consecutive CCVs. If both pass, samples may be reported without reanalysis. If either fails, or if two consecutive CCVs cannot be run, perform corrective action(s) and repeat CCV and all associated samples since last successful CCV. Alternately, recalibrate if necessary; then reanalyze all associated samples since the last acceptable CCV.	Analyst	WI36458, WI36459
LC/MS/MS	Instrument Blanks	Immediately following the highest standard analyzed and daily prior to sample analysis	Concentration of each analyte must be ≤1/2 LOQ. Instrument Blank must contain EIS to enable quantitation of contamination.	If acceptance criteria are not met after the highest calibration standard, calibration must be performed using a lower concentration for the highest standard until acceptance criteria is met. If sample concentrations exceed the highest allowed standard and the sample(s) following exceed this acceptance criteria (>1/2 LOQ), they must be reanalyzed	Analyst	WI36458, WI36459
pH	Calibration using at least 3 points, sloped with pH 4, 7, and 10 buffers	Daily	Percent slope between 92% and 102%	Correct the problem and recalibrate	Analyst	WI11518
pH	CCV Standard	After each calibration, every 10 samples, and end of batch	±10% D	Correct the problem, recalibrate, and reanalyze affected samples	Analyst	WI11518

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
TOC Analyzer	Initial calibration with a minimum 4 points ranging from 0.3 mg C to 6 mg C	Monthly or after continuing calibration fails	$r^2 \geq 0.995$	Perform more aggressive instrument maintenance and recalibrate	Analyst	WI11627
TOC Analyzer	ICB Standard	After each initial calibration	No analytes detected > LOQ	Perform more aggressive instrument maintenance and recalibrate	Analyst	WI11627
TOC Analyzer	ICV Standard	After each initial calibration	Within +/- 10% of the nominal concentration	Reanalyze the ICV. If ICV fails again do system maintenance and recalibrate.	Analyst	WI11627
TOC Analyzer	MDL Standard	Yearly	All compounds must be detected	Repeat ICAL procedure prior to analyzing samples. Repeat maintenance if needed.	Analyst	WI11627
TOC Analyzer	CCV Standard	If instrument is idle >4 hours, after every 10 field samples, and at the end of the sequence	Within +/- 10% of the nominal concentration	All affected samples are reanalyzed	Analyst	WI11627
TOC Analyzer	CCB Standard	If instrument is idle >4 hours, after every 10 field samples, and at the end of the sequence	No analytes detected > LOQ	All affected samples are reanalyzed	Analyst	WI11627

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
Eurofins TestAmerica Sacramento, West Sacramento, California						
LC/MS/MS	Mass Calibration	Mass calibration is verified after each mass calibration, prior to initial calibration (ICAL).	Per manufacturer specifications. Mass calibration range must bracket the ion masses of interest. The most recent mass calibration must be used for every acquisition in an analytical run. Mass calibration must be verified to be ±0.5 amu of the true value, by acquiring a full scan continuum mass spectrum of a PFAS stock standard.	If the mass calibration fails, then recalibrate. If it fails again, consult manufacturer instructions on corrective maintenance.	Analyst	WS-LC-0025
LC/MS/MS	Minimum five-point initial calibration for target analytes, lowest concentration standard at or below the LOQ.	At instrument set-up and after initial or continuing calibration verification fails, prior to sample analysis	Each analyte must be within 70-130% of its true value for each calibration standard. ICAL must meet one of the two options below: Option 1: The RSD of the RFs for all analytes must be ≤ 20%. Option 2: Linear or nonlinear calibrations must have r2 ≥ 0.99	Correct problem, then repeat ICAL.	Analyst	WS-LC-0025

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
LC/MS/MS	Instrument blanks	Immediately following the highest standard analyzed and daily prior to sample analysis	Concentration of each analyte must be ≤1/2 LOQ. Instrument Blank must contain EIS to enable quantitation of contamination.	If acceptance criteria are not met after the highest calibration standard, calibration must be performed using a lower concentration for the highest standard until acceptance criteria is met. If sample concentrations exceed the highest allowed standard and the sample(s) following exceed this acceptance criteria (>1/2 LOQ), they must be reanalyzed	Analyst	WS-LC-0025
LC/MS/MS	Second-source or initial calibration verification (ICV)	Once after each ICAL, analysis of a second source standard prior to sample analysis.	Analyte concentrations must be within ±30% of their true value	Correct problem, rerun the ICV and samples associated with the non-compliant ICV. If problem persists, repeat ICAL.	Analyst	WS-LC-0025
LC/MS/MS	Instrument sensitivity check (ISC)	Prior to analysis and at least once every 12 hours.	Analyte concentrations must be at the LOQ. Analyte concentrations must be within ± 30% of their true values.	Correct problem, rerun ISC. If problem persists, repeat ICAL.	Analyst	WS-LC-0025

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
LC/MS/MS	Continuing calibration verification (CCV)	Prior to sample analysis, after every 10 field samples, and at the end of the analytical sequence.	Concentrations of analytes must range from the LOQ to the mid-level calibration concentration. Analyte concentrations must be within ±30% of their true value.	Immediately analyze two additional consecutive CCVs. If both pass, samples may be reported without reanalysis. If either fails, or if two consecutive CCVs cannot be run, perform corrective action(s) and repeat CCV and all associated samples since last successful CCV. Alternately, recalibrate if necessary; then reanalyze all associated samples since the last acceptable CCV.	Analyst	WS-LC-0025
Pace Mobile Laboratory						
LC/MS/MS	Mass Calibration	Prior to initial use and after any major maintenance is performed.	Calibrate the mass scale of the Mass Spectrometer with calibration compounds and procedures described by manufacturer. Entire range needs to be mass calibrated.	Not Applicable	Analyst	ENV-SOP-MAD1-0101
LC/MS/MS	Minimum five-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 > 10:1 for all ions used for quantitation. Confirmation ions for PFOS and PFOA must have S/N > 3:1. The % Relative Standard Deviation (RSD) for all analytes must be <20%. Linear or non-linear calibrations must have a correlation coefficient (r2) > 0.99 for each analyte.	Evaluate standards, chromatography, and mass spectrometer response. If problem found with above, correct as appropriate, then repeat initial calibration.	Analyst	ENV-SOP-MAD1-0101
LC/MS/MS	Instrument blanks	Immediately following the highest standard analyzed and daily prior to sample analysis.	Concentration of each analyte must be < 1/2 the LOQ.	Re-analyze the IBLK. No sample shall be analyzed until the IBLK has met acceptance criteria.	Analyst	ENV-SOP-MAD1-0101

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
LC/MS/MS	Second-source or initial calibration verification (ICV)	Once after each ICAL prior to sample analysis.	All reported analytes and labelled compounds within ± 30% of their true value.	Remaking/Rerunning the ICV or recalibrating are possible solutions. ICV must meet criteria.	Analyst	ENV-SOP-MAD1-0101
LC/MS/MS	Instrument sensitivity check (ISC)	Prior to analysis and at least once every 12 hours. ISC can serve as a bracketing CCV.	Analyte concentrations must be at the LOQ and within + 30% of their true values.	Correct problem, rerun ISC. If problem persists, repeat ICAL.	Analyst	ENV-SOP-MAD1-0101
LC/MS/MS	Continuing calibration verification (CCV)	Before sample analysis, after every 20 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 CCVs. If both pass, samples may be reported without re-analyses. If either CCV fails or if two consecutive CCVs cannot be run, perform corrective action and repeat CCV and all associated samples. Alternately, recalibrate if necessary, then reanalyze all associated samples since the last acceptable CCV. All CCV's must meet acceptance criteria, if bracketing CCV fails high, only samples that are ND can be reported. If bracketing CCV fails low, all samples must be re-analyzed.	Analyst	ENV-SOP-MAD1-0101

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference

Notes:
%RSD = Percent relative standard deviation.
amu = Atomic mass unit(s).
C = Carbon.
CCB = Continuing calibration blank.
CCV = Continuing calibration verification.
ICAL = Initial calibration.
ICB = Initial calibration blank.
ICV = Initial calibration verification.
MDL = Method detection limit.
mg = Milligram(s).

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

The analytical SOPs referenced below are provided in Appendix D. Methods represent those currently certified by the laboratory and may undergo revision during periodic UFP-QAPP review. UFP-QAPP revisions will be submitted for approval.

Instrument/ Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference
Eurofins Lancaster Laboratories Environmental LLC, Lancaster, Pennsylvania								
Analytical balance	Assure the balance is in a vibration-free area, is level, and the interior housing is clean.	Verification with ASTM certified weights	Visual inspection and weight verification	Each day of use	The reading must be ±0.1% or ±0.5 mg, whichever is greater.	1) verify cleanliness of weights 2) remove balance from service and place a call to service firm 3) management must evaluate data generated since last acceptable reading to determine any potential impacts to data quality	Analyst	WI11880
Analytical balance	Annual calibration and maintenance	Annual calibration and maintenance	Annual calibration and maintenance	Annual	As per vendor's specifications in compliance with ISO certification	As per vendor's specifications in compliance with ISO certification	Analyst	WI11880
pH/ISE Meter	As needed replacement of components	Calibration checks	Visual inspection of components	As needed maintenance/calibration checks every 10 injections	90-110% for calibration checks	Recalibration	Analyst	WI11518

Instrument/ Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference
TOC Analyzer	As needed replacement of components	Calibration checks	Visual inspection of components	As needed maintenance/calibration checks every 10 injections	90-110% for calibration checks	Recalibration	Analyst	WI11627
LC/MS/MS	Backflush of column, injection port and pre-columns, cleaning of ion spray cone, adjustment of collision energies, others as needed	Calibration Check	Visual	As Needed	Initial calibration or calibration verification passes method specifications	Perform additional maintenance prior to instrument calibration or calibration verification	Analyst	WI36413

Instrument/ Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference
Eurofins TestAmerica Sacramento, West Sacramento, California								
LC/MS/MS	Replace columns as needed, check eluent reservoirs	Sensitivity check	Instrument performance and sensitivity	Daily or as needed	CCV pass criteria	Recalibrate	Analyst	WS-LC-0025
Pace Mobile Laboratory								
LC/MS/MS	Check column pressure and mobile phase levels/ expirations daily. Perform the following as needed: prepare aqueous mobile phase, clean/replace injection needle, replace guard cartridge, backflush/ replace column, replace injector seat, clean curtain/orifice plate, retune MS	Instrument performance	Inspect all tubing connections at time of maintenance to assure no leaks present. Monitor instrument performance via calibrations, CCVs, and blanks.	Daily or as needed	Same as initial calibration and CCV	Same as initial calibration and CCV	Analyst	ENV-SOP-MAD1-0101

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QAPP Worksheet #26 & 27: Sample Handling, Custody, and Disposal

Sampling Organization: EA Engineering, Science, and Technology, Inc., PBC

Laboratory: Eurofins Lancaster Laboratories Environmental LLC, Lancaster, Pennsylvania (PFAS – Joe Foss Field; TOP assay, pH, grain size, total organic carbon – all sites); Eurofins TestAmerica, West Sacramento, California (PFAS – Truax Field, Volk Field); Eurofins TestAmerica, Corpus Christi, Texas (cation exchange capacity – all sites); GeoTesting Express in Acton, Massachusetts (permeability – all sites), and Pace Mobile Laboratory (PFAS screening – all sites)

Method of sample delivery (shipper/carrier): Express Overnight or Next Day Air (not applicable for mobile laboratory)

Number of days from reporting until sample disposal: Minimum 30 days after final report sent to client (EA); unless there is a written request to hold them longer.

Activity	Organization and Title or Position of Person Responsible for the Activity	SOP Reference
Sample Collection	EA, Field Personnel	EA SOP 01
Chain-of-custody form completion	EA, Field Personnel	EA SOP 02
Packaging	EA, Field Personnel	EA SOP 04
Shipping coordination	EA, Field Personnel Laboratory Sample Receipt	NA
Sample receipt, inspection, and log-in	Laboratory, Sample Receipt	QA-QM11872; WS-QAMrev6.0; ENV-SOP-MAD1-0101
Sample custody and storage	Laboratory, Sample Receipt	QA-QM11872; WS-QAMrev6.0; ENV-SOP-MAD1-0101
Sample disposal	Laboratory, Sample Receipt	QA-QM11872; WS-QAMrev6.0; ENV-SOP-MAD1-0101

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QAPP Worksheet #28-1: Analytical Quality Control Corrective Action

Matrix: Groundwater / Surface Water
Analytical Group: PFAS
Analytical Method/SOP: LC/MS/MS compliant with DoD QSM Version 5.3 (or more recent) Table B-15/SOP WI36458 or WS-LC-0025

QC Sample	Number / Frequency	Method / SOP Acceptance Criteria	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Project-Specific MPC
Method blanks	1 per prep batch of up to 20 samples	No analytes detected >1/2 LOQ or >1/10 the amount measured in any sample or 1/10 the regulatory limit, whichever is greater	Correct problem. If required, re-extract and reanalyze method blank and all QC samples and field samples processed with the contaminated blank. Samples may be re-extracted and analyzed outside of hold times, as necessary for corrective action associated with QC failure.	Analyst	Accuracy/ Laboratory Contamination	No analytes detected >1/2 LOQ or >1/10 the amount measured in any sample or 1/10 the regulatory limit, whichever is greater
LCS/LCSD	1 per prep batch of up to 20 samples	Blank spiked with all analytes at a concentration ≥ LOQ and ≤ the mid-level calibration concentration. DoD QSM Appendix C Limits for batch control.	Correct problem, then re-extract and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes if sufficient sample material is available. Samples may be re-extracted and analyzed outside of hold times, as necessary for corrective action associated with QC failure.	Analyst	Accuracy/Bias/ Precision	Results within acceptance limits

Matrix: Groundwater / Surface Water
Analytical Group: PFAS
Analytical Method/SOP: LC/MS/MS compliant with DoD QSM Version 5.3 (or more recent) Table B-15/SOP WI36458 or WS-LC-0025

QC Sample	Number / Frequency	Method / SOP Acceptance Criteria	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Project-Specific MPC
MS/MSD	1 per prep batch of up to 20 samples	Sample spiked with all analytes at a concentration ≥ LOQ and ≤ the mid-level calibration concentration. DoD QSM Appendix C Limits for batch control.	Flag outliers. Examine the project- specific requirements. Contact the client as to additional measures to be taken.	Analyst	Accuracy/ Bias/Precision	Results within acceptance limits
Isotopically Labeled Extraction Standards	Every sample (including MS/MSD, LCS, and blanks) prior to preparation	Extracted Internal Standard Analyte recoveries must be within 50% to 150% of ICAL midpoint standard area or area measured in the initial CCV on days when an ICAL is not performed.	Correct problem. If required, re-extract and reanalyze associated field and QC samples. If recoveries are acceptable for QC samples, but not field samples, the field samples must be re-extracted and analyzed (greater dilution may be needed). Samples may be re-extracted and analyzed outside of hold times, as necessary for corrective action associated with QC failure.	Analyst	Accuracy	Results within acceptance limits
Post Spike Sample	Aqueous samples prepared by serial dilution instead of SPE that have reported values <LOQ	70-130% recovery	Reanalyze sample, sample duplicate and post spike sample at higher dilutions until criteria is met	Analyst	Accuracy	Results within acceptance limits

Matrix: Groundwater / Surface Water
Analytical Group: PFAS
Analytical Method/SOP: LC/MS/MS compliant with DoD QSM Version 5.3 (or more recent) Table B-15/SOP WI36458 or WS-LC-0025

QC Sample	Number / Frequency	Method / SOP Acceptance Criteria	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Project-Specific MPC
Aqueous Sample Preparation	Every sample (including MS/MSD, LCS, and blanks)	Solid Phase Extraction (SPE) must be used unless samples are known to contain high PFAS concentrations. Inline SPE is acceptable. Entire sample plus bottle rinsate must be extracted using SPE. Known high PFAS concentration samples require serial dilution be performed in duplicate, and require documented project approval.	Not Applicable	Not Applicable	Reproducibility/ Comparability	Compliance with acceptance criteria
Sample Cleanup Procedure	Every sample (including MS/MSD, LCS, and blanks)	ENVI-Carb™ or equivalent must be used on each sample and batch QC sample.	Not Applicable	Not Applicable	Reproducibility/ Comparability	Compliance with acceptance criteria

Matrix: Groundwater / Surface Water
Analytical Group: PFAS
Analytical Method/SOP: LC/MS/MS compliant with DoD QSM Version 5.3 (or more recent) Table B-15/SOP WI36458 or WS-LC-0025

QC Sample	Number / Frequency	Method / SOP Acceptance Criteria	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Project-Specific MPC
Sample PFAS Identification	All analytes detected in a sample	The chemical derivation of ion transitions must be documented. A minimum of two ion transitions (Precursor → quant ion and precursor → confirmation ion) and the ion transitions ratio per analyte are required for confirmation, except where two transitions do not exist (PFBA and PFPeA). Documentation of primary and confirmation transition and the ion ratio is required. In-house acceptance criteria for ion ratios must not exceed 50-150%. Signal to Noise Ratio (S/N) must be ≥ 10 for all ions used for quantification and must be ≥ 3 for all ions used for confirmation. Quant ion and confirmation ion must be present and must maximize simultaneously (±2 seconds).	PFAS identified with Ion ratios that fail acceptance criteria must be flagged. Any quantitation ion peak that does not meet the maximization criteria shall be included in the summed integration and the resulting data flagged as "estimated, biased high".	Analyst/ QC Manager	Comparability	Compliance with acceptance criteria

Matrix: Groundwater / Surface Water
Analytical Group: PFAS
Analytical Method/SOP: LC/MS/MS compliant with DoD QSM Version 5.3 (or more recent) Table B-15/SOP WI36458 or WS-LC-0025

QC Sample	Number / Frequency	Method / SOP Acceptance Criteria	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Project-Specific MPC
Ion Transitions	Every sample (including MS/MSD, LCS, and blanks)	In order to avoid biasing results high due to known interferences for some transitions, the following transitions must be used for the quantification of the following analytes: PFOA: 413 → 369 PFOS: 499 → 80 PFHxS: 399 → 80 PFBS: 299 → 80 4:2 FTS: 327 → 307 6:2 FTS: 427 → 407 8:2 FTS: 527 → 507 NEtFOSAA: 584 → 419 NMeFOSAA: 570 → 419 If these transitions are not used, the reason must be technically justified and documented (e.g., alternate transition was used due to observed interferences).	Not Applicable	Not Applicable	Comparability/ Accuracy	Compliance with acceptance criteria
Retention Time Window Establishment	Once per ICAL and at the beginning of the analytical sequence.	Position shall be set using the midpoint standard of the ICAL curve when ICAL is performed. On days when ICAL is not performed, the initial CCV is used.	Not Applicable	Analyst	Comparability	Compliance with acceptance criteria

Matrix: Groundwater / Surface Water
Analytical Group: PFAS
Analytical Method/SOP: LC/MS/MS compliant with DoD QSM Version 5.3 (or more recent) Table B-15/SOP WI36458 or WS-LC-0025

QC Sample	Number / Frequency	Method / SOP Acceptance Criteria	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Project-Specific MPC
Retention Time Window Width	Every sample (including MS/MSD, LCS, and blanks)	RT of each analyte and EIS analyte must fall within 0.4 minutes of the predicted retention times from the daily calibration verification or, on days when ICAL is performed, from the midpoint standard of the ICAL. Analytes must elute within 0.1 minutes of the associated EIS. This criterion applies only to analyte and labeled analog pairs.	Correct problem and reanalyze samples	Analyst	Comparability/ Accuracy	Compliance with acceptance criteria

Notes:
LCS = Laboratory control sample.
LCSD = Laboratory control sample duplicate.

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QAPP Worksheet #28-2: Analytical Quality Control and Corrective Action

Matrix: Soil / Sediment
Analytical Group: PFAS
Analytical Method/SOP: LC/MS/MS compliant with DoD QSM Version 5.3 (or more recent) Table B-15/SOP WI36459 or WS-LC-0025

QC Sample	Number / Frequency	Method / SOP Acceptance Criteria	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Project-Specific MPC
Method blanks	1 per prep batch of up to 20 samples	No analytes detected >1/2 LOQ or >1/10 the amount measured in any sample or 1/10 the regulatory limit, whichever is greater	Correct problem. If required, re-extract and reanalyze method blank and all QC samples and field samples processed with the contaminated blank. Samples may be re-extracted and analyzed outside of hold times, as necessary for corrective action associated with QC failure.	Analyst	Accuracy/Laboratory Contamination	No analytes detected >1/2 LOQ or >1/10 the amount measured in any sample or 1/10 the regulatory limit, whichever is greater
LCS/LCSD	1 per prep batch of up to 20 samples	Blank spiked with all analytes at a concentration ≥ LOQ and ≤ the mid-level calibration concentration. DoD QSM Appendix C Limits for batch control.	Correct problem, then re-extract and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes if sufficient sample material is available. Samples may be re-extracted and analyzed outside of hold times, as necessary for corrective action associated with QC failure.	Analyst	Accuracy/Bias/Precision	Results within acceptance limits

Matrix: Soil / Sediment
Analytical Group: PFAS
Analytical Method/SOP: LC/MS/MS compliant with DoD QSM Version 5.3 (or more recent) Table B-15/SOP WI36459 or WS-LC-0025

QC Sample	Number / Frequency	Method / SOP Acceptance Criteria	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Project-Specific MPC
MS/MSD	1 per prep batch of up to 20 samples	Sample spiked with all analytes at a concentration ≥ LOQ and ≤ the mid-level calibration concentration. DoD QSM Appendix C Limits for batch control.	Flag outliers. Examine the project-specific requirements. Contact the client as to additional measures to be taken.	Analyst	Accuracy/Bias/ Precision	Results within acceptance limits
Isotopically Labeled Extraction Standards	Every sample (including MS/MSD, LCS, and blanks) prior to preparation	Extracted Internal Standard Analyte recoveries must be within 50% to 150% of ICAL midpoint standard area or area measured in the initial CCV on days when an ICAL is not performed.	Correct problem. If required, re-extract and reanalyze associated field and QC samples. If recoveries are acceptable for QC samples, but not field samples, the field samples must be re-extracted and analyzed (greater dilution may be needed). Samples may be re-extracted and analyzed outside of hold times, as necessary for corrective action associated with QC failure.	Analyst	Accuracy	Results within acceptance limits
Solid Sample Preparation	Every sample (including MS/MSD, LCS, and blanks)	Entire sample received by the laboratory must be homogenized prior to subsampling.	Not Applicable	Not Applicable	Reproducibility/ Comparability	Compliance with acceptance criteria

Matrix: Soil / Sediment
Analytical Group: PFAS
Analytical Method/SOP: LC/MS/MS compliant with DoD QSM Version 5.3 (or more recent) Table B-15/SOP WI36459 or WS-LC-0025

QC Sample	Number / Frequency	Method / SOP Acceptance Criteria	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Project-Specific MPC
Sample Cleanup Procedure	Every sample (including MS/MSD, LCS, and blanks)	ENVI-Carb™ or equivalent must be used on each sample and batch QC sample.	Not Applicable	Not Applicable	Reproducibility/ Comparability	Compliance with acceptance criteria
Sample PFAS Identification	All analytes detected in a sample	The chemical derivation of ion transitions must be documented. A minimum of two ion transitions (Precursor → quant ion and precursor → confirmation ion) and the ion transitions ratio per analyte are required for confirmation, except where two transitions do not exist (PFBA and PFPeA). Documentation of primary and confirmation transition and the ion ratio is required. In-house acceptance criteria for ion ratios must not exceed 50-150%. Signal to Noise Ratio (S/N) must be ≥ 10 for all ions used for quantification and must be ≥ 3 for all ions used for confirmation. Quant ion and confirmation ion must be present and must maximize simultaneously (±2 seconds).	PFAS identified with Ion ratios that fail acceptance criteria must be flagged. Any quantitation ion peak that does not meet the maximization criteria shall be included in the summed integration and the resulting data flagged as "estimated, biased high".	Analyst/ QC Manager	Comparability	Compliance with acceptance criteria

Matrix: Soil / Sediment
Analytical Group: PFAS
Analytical Method/SOP: LC/MS/MS compliant with DoD QSM Version 5.3 (or more recent) Table B-15/SOP WI36459 or WS-LC-0025

QC Sample	Number / Frequency	Method / SOP Acceptance Criteria	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Project-Specific MPC
Ion Transitions	Every sample (including MS/MSD, LCS, and blanks)	In order to avoid biasing results high due to known interferences for some transitions, the following transitions must be used for the quantification of the following analytes: PFOA: 413 → 369 PFOS: 499 → 80 PFHxS: 399 → 80 PFBS: 299 → 80 4:2 FTS: 327 → 307 6:2 FTS: 427 → 407 8:2 FTS: 527 → 507 NEtFOSAA: 584 → 419 NMeFOSAA: 570 → 419 If these transitions are not used, the reason must be technically justified and documented (e.g., alternate transition was used due to observed interferences).	Not Applicable	Not Applicable	Comparability/ Accuracy	Compliance with acceptance criteria

Matrix: Soil / Sediment
Analytical Group: PFAS
Analytical Method/SOP: LC/MS/MS compliant with DoD QSM Version 5.3 (or more recent) Table B-15/SOP WI36459 or WS-LC-0025

QC Sample	Number / Frequency	Method / SOP Acceptance Criteria	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Project-Specific MPC
Retention Time Window Establishment	Once per ICAL and at the beginning of the analytical sequence.	Position shall be set using the midpoint standard of the ICAL curve when ICAL is performed. On days when ICAL is not performed, the initial CCV is used.	Not Applicable	Analyst	Comparability	Compliance with acceptance criteria
Retention Time Window Width	Every sample (including MS/MSD, LCS, and blanks)	RT of each analyte and EIS analyte must fall within 0.4 minutes of the predicted retention times from the daily calibration verification or, on days when ICAL is performed, from the midpoint standard of the ICAL. Analytes must elute within 0.1 minutes of the associated EIS. This criterion applies only to analyte and labeled analog pairs.	Correct problem and reanalyze samples	Analyst	Comparability/ Accuracy	Compliance with acceptance criteria

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QAPP Worksheet #28-3: Analytical Quality Control and Corrective Action

Matrix: Groundwater / Surface Water / Soil / Sediment
Analytical Group: PFAS Screening (Mobile Laboratory)
Analytical Method/SOP: LC/MS/MS Screening Method (ENV-SOP-MAD1-0101)

QC Sample	Number / Frequency	Method / SOP Acceptance Criteria	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Project-Specific MPC
Method blanks	1 per prep batch of up to 20 samples	No analytes detected >1/2 LOQ or >1/10 the amount measured in any sample or 1/10 the regulatory limit, whichever is greater	Correct problem. If required, re-extract and reanalyze method blank and all QC samples and field samples processed with the contaminated blank. If sample result >10x blank detects and sample cannot be reanalyzed, report sample with appropriate qualifier indicating blank contamination. If sample result <10x blank detects, report sample with appropriate qualifier to indicate an estimated value. Flagging is only appropriate in cases where samples cannot be reanalyzed.	Analyst	Accuracy/ Laboratory Contamination	No analytes detected >1/2 LOQ or >1/10 the amount measured in any sample or 1/10 the regulatory limit, whichever is greater
MS/MSD	1 per prep batch of up to 20 samples	Laboratory will use limits of 60-140% until in-house limits are established Water: RPD ≤ 30 Soil/Sediment: RPD ≤ 50	Failures are flagged but do not prevent reporting data if method blank and LCS meet criteria.	Analyst	Accuracy/Bias/ Precision	Results within acceptance limits

Matrix: Groundwater / Surface Water / Soil / Sediment
Analytical Group: PFAS Screening (Mobile Laboratory)
Analytical Method/SOP: LC/MS/MS Screening Method (ENV-SOP-MAD1-0101)

QC Sample	**Number / Frequency**	**Method / SOP Acceptance Criteria**	**Corrective Action**	**Person(s) Responsible for Corrective Action**	**Data Quality Indicator (DQI)**	**Project-Specific MPC**
LCS	1 per prep batch of up to 20 samples	For Water: 44.8-138% Recovery PFOA, 63.8-126% Recovery PFOS, 60.4-127% Recovery PFBS For Soil/Sediment: 48.3-132% Recovery PFOA, 67.4-122% Recovery PFOS, 66.6-126% Recovery PFBS	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.	Analyst	Accuracy/Bias/ Precision	Results within acceptance limits
Extracted Internal Standards	Every sample (including MS/MSD, LCS, and blanks) prior to preparation	Extracted Internal Standard recoveries must be within 40% to 160% of ICAL midpoint standard area or area measured in the initial CCV on days when an ICAL is not performed.	Correct problem. If required, re-extract and reanalyze associated field and QC samples.	Analyst	Accuracy	Results within acceptance limits

QAPP Worksheet #28-5: Analytical Quality Control and Corrective Action

Matrix: Soil
Analytical Group: pH
Analytical Method/SOP: SW9245C SOP WI11518

QC Sample	Number/ Frequency	Method/ SOP Acceptance Criteria	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Project-Specific MPC
LCS	1 per batch	95-105%	Correct problem, reprepare and reanalyze the LCS and all sample associated	Analyst	Accuracy/Bias	Results within acceptance limits
Duplicate	1 per 10 samples	RPD ≤ 4%	No corrective action, matrix related	Analyst	Precision	Results within acceptance limits

QAPP Worksheet #28-6: Analytical Quality Control and Corrective Action

Matrix: Soil
Analytical Group: TOC
Analytical Method/SOP: SW9060 SOP WI11627

QC Sample	Number/ Frequency	Method/ SOP Acceptance Criteria	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Project-Specific MPC
Method blanks	1 per prep batch of up to 20 samples	No analytes detected > LOQ or >1/10 the amount measured in any sample or 1/10 the regulatory limit, whichever is greater	Reanalyze blank to confirm detections. If detects confirm, re-prep samples that are not ND or not >10x the blank value.	Analyst	Accuracy/Laboratory Contamination	No analytes detected > LOQ or >1/10 the amount measured in any sample or 1/10 the regulatory limit, whichever is greater
MS	1 per 10 samples	47-143% Recovery	Flag outliers	Analyst	Accuracy/Bias	Results within acceptance limits
LCS	1 per prep batch of up to 20 samples	47-143% Recovery	Correct problem, reprepare and reanalyze the LCS and all sample associated	Analyst	Accuracy/Bias	Results within acceptance limits
Duplicate	1 per 10 samples	RPD ≤ 20%	Flag data	Analyst	Precision	Results within acceptance limits

QAPP Worksheet #28-7: Analytical Quality Control and Corrective Action

Matrix: Soil
Analytical Group: Cation Exchange Capacity
Analytical Method/SOP: SW-846 Method 9081 and Method 6010B SOP CC-ATM-M020

QC Sample	Number/ Frequency	Method/SOP Acceptance Criteria	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator	Project-Specific MPC
Method blank	One per digestion batch of up to 20 samples	No detections > reporting limit	Rerun once in a new tube. If >RL, re-digest and reanalyze samples.	Lab Manager / Analyst	Accuracy/Laboratory Contamination	<RL
Lab Duplicate	10% of project samples	RPD ≤ 20%	Flag the data.	Lab Manager / Analyst	Precision	RPD ≤ 20%

QAPP Worksheet #28-8: Analytical Quality Control and Corrective Action

Matrix: Soil
Analytical Group: Anion Exchange Capacity
Analytical Method/SOP: SOP AEC

QC Sample	Number/ Frequency	Method/SOP Acceptance Criteria	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator	Project-Specific MPC
Method blank	One per digestion batch of up to 20 samples	<0.05 parts per million	Address issue and re-run blank until acceptable result is achieved, prior to analyzing samples.	Lab Manager / Analyst	Accuracy/Laboratory Contamination	<RL
Check Soil	One per digestion batch of up to 20 samples	Within 10%	Address issue and re-run check soil until acceptable result is achieved, prior to analyzing samples.	Lab Manager / Analyst	Accuracy	Within 5%
Lab Duplicate	10% of project samples	Within 10%	Flag the data.	Lab Manager / Analyst	Precision	RPD ≤ 20%

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QAPP Worksheet #29: Project Documents and Records

Sample Collection and Field Records			
Record	**Generation**	**Verification**	**Storage location**
Field logbook or data collection sheets	Field Personnel	Task Manager	Project File
Chain-of-Custody Forms	Field Personnel	Task Manager	Project File
Shipping Records	Field Personnel	Task Manager	Project File
Daily Quality Control Reports	EA Task Manager	EA Project Manager, CQCS	Project File
Log of Daily Notice Field Activity	EA Task Manager	EA Project Manager, CQCS	Project File
Deviations/Field Change Request Forms or notifications[1]	Field Personnel	Task Manager with concurrence from project team	Project File
Corrective Action Reports	Project Manager	CQCS	Project File/Reports
Correspondence	Field Personnel	Task/Project Manager	Project File

Laboratory Records			
Record	**Generation**	**Verification**	**Storage Location**
Laboratory sample receipt logs	Laboratory check-in staff	EA Database Administrator	Laboratory Files
Chain-of-Custody Forms	Laboratory check-in staff	EA Database Administrator/Project Chemist	Project File/Reports
Instrument Maintenance and Calibration Logs	Laboratory Analyst	Laboratory QA Manager	Laboratory Files
Sample Preparation Analysis Worksheets/Logs	Laboratory Analyst	Laboratory QA Manager	Laboratory Files
Chromatograms/raw data	Laboratory Analyst	Laboratory QA Manager	Project File/Reports
Sample and QC Sample Results	Laboratory Analyst	Lab QA Manager/EA Project Chemist	Project File/Reports
Correspondence	Laboratory Staff	EA Project Chemist	Project File

Project Assessments			
Record	**Generation**	**Verification**	**Storage Location**
Phase IIa Data Validation Checklist	EA Project Chemist	EA Database Administrator	Project File/Reports
Data Validation Report	Data Validator	EA Project Chemist	Project File/Reports
Corrective Action Documentation	EA Task Manager/ Project Chemist	EA Project Manager, CQCS	Project File
Independent Technical Review Certification	Technical Reviewer	EA Task Manager	Project File
Inspection Checklists	EA Task Manager	EA Project Manager	Project File

[1] Deviations/Field Change Requests may be caused by utilities, changes to site conditions, or accessibility issues and these changes may be required without advance warning while the sampling team is in the field sampling. The EA Team will discuss Deviations/Field Change Requests with the ANG installation personnel and make every effort to discuss with USACE and NGB/A4VR POCs prior to implementing changes in the field.

Project Assessments			
Record	**Generation**	**Verification**	**Storage Location**
Non-Conformance Form	EA Project Manager	EA Program Manager	Project File

Laboratory Data Deliverable					
Record	**Drinking Water**	**Groundwater**	**Surface Water**	**Soil**	**Sediment**
Narrative	X	X	X	X	X
Chain-of-Custody Forms	X	X	X	X	X
Summary Results	X	X	X	X	X
QC Results	X	X	X	X	X
Level IV Data Package	X	X	X	X	X
EQuIS and ERPIMS Electronic Data Deliverables	X	X	X	X	X

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

This worksheet is used to document responsibilities for conducting project assessments, responding to assessment findings, and implementing corrective action. Appropriately scheduled assessments allow management to implement corrective action in a timely manner, thereby correcting non-conformances and minimizing their impact on DQOs/Project Quality Objectives.

Assessments:

Assessment Type	Responsible Party and Organization	Frequency	Estimated Dates	Assessment Deliverable	Deliverable Due Date
Project Manager Review	Project Manager/ EA	Monthly (for field efforts that are longer than 1 month)	TBD	Email documenting findings	7 days after assessment
Review of Chain-of-Custody forms	Data Manager / EA	Daily	TBD	Email documenting findings	Within 24 hours
Laboratory Data Assessment (validation)	Data Validator	Once	TBD	Validation report	Within 1 month after receipt of data
Daily Quality Control Audits	Field Sampling Team Leader/ EA	Daily	TBD	Daily QC Report	Within 24 hours
Field Technical System Audits (TSA)	Field Sampling Team Leader/ EA	Daily	TBD	Email/ Daily QC Report	7 days after assessment
Field Performance Audits	Project Manager/ EA or representative	Weekly	TBD	Email/ Daily QC Report	7 days after assessment
Laboratory	Laboratory QA Manager	Per QA Manual	TBD	Email	Determined internally

Assessment Response and Corrective Action:

Assessment Type	Person(s) Responsible for Responding to Assessment Findings	Nature of Corrective Action Response Documentation	Timeframe for Response	Person(s) Responsible for Identifying and Implementing Corrective Action	Person(s) Responsible for Monitoring Effectiveness of Corrective Action
Project Manager Review	Field Sampling Team Leader/ EA	Daily QC Report/ Email	24 hours after notification	Field Sampling Team Leader/ EA	Project Manager/ EA
Review of chain-of-custody forms	Field Sampling Team Leader/ EA	Daily QC Report/ Email	24 hours after notification	Field Sampling Team Leader/ EA	Project Chemist/ E
Laboratory Data Assessment (validation)	Project Chemist/ EA	Email	Up to 1 Week after notification	Laboratory QA Manager	Project Chemist/ EA
Daily Quality Control Audits	Field Sampling Team Leader/ EA	Daily QC Report/ Email	24 hours after notification	Field Sampling Team Leader/ EA	QA Officer/ EA
Field Technical System Audits	Field Sampling Team Leader/ EA	Daily QC Report/ Email	24 hours after notification	Field Sampling Team Leader/ EA	QA Officer/ EA
Field Performance Audits	Field Sampling Team Leader/ EA	Daily QC Report/ Email	24 hours after notification	Field Sampling Team Leader/ EA	Project Manager/ EA
Laboratory	Laboratory Analysts	Email to file	Immediate correction – written documentation due within 1 week	Laboratory QA Manager	Laboratory PM

QAPP Worksheet #34: Data Verification and Validation Inputs

This worksheet is used to list the inputs that will be used during data verification, validation, and usability assessment. Inputs include all requirements documents (e.g., contracts, SOPs, planning documents), field records (both hard-copy and electronic), and interim and final reports. Data verification is a completeness check that all specified activities involved in data collection and processing have been completed and documented and that the necessary records (objective evidence) are available to proceed to data validation. Data validation is the evaluation of conformance to stated requirements.

Data Verification and Validation Inputs for Sampling

Item	Description	Verification (completeness)	Validation (conformance to specifications)
Planning Documents/Records			
1	Approved planning documents (i.e., QAPP)	**X**	
2	Contract	**X**	
3	Field SOPs	**X**	
4	Laboratory SOPs	**X**	
Field Records			
5	Field Logbooks/Field Forms	**X**	**X**
6	Equipment Calibration Records	**X**	**X**
7	Chain-of-Custody Forms	**X**	**X**
8	Sampling Diagrams/Surveys	**X**	**X**
9	Daily Field Log	**X**	**X**
10	Relevant Correspondence	**X**	**X**
11	Change Orders/Deviations	**X**	**X**
12	Field Corrective Action Reports	**X**	**X**
Analytical Data Package			
13	Cover Sheet (laboratory identifying information)	**X**	**X**
14	Case Narrative	**X**	**X**
15	Internal Laboratory Chain-of-Custody Records	**X**	**X**
16	Sample Receipt Records	**X**	**X**
17	Sample Chronology (i.e., dates and times of receipt, preparation, and analysis)	**X**	**X**
18	Communication Records	**X**	**X**
19	Project-Specific Proficiency Test Sample Results (if required)	**X**	**X**
20	LOD/LOQ Establishment and Verification	**X**	**X**
21	Standards Traceability	**X**	**X**
22	Instrument Calibration Records	**X**	**X**
23	Definition of Laboratory Qualifiers	**X**	**X**
24	Results Reporting Forms	**X**	**X**
25	QC Sample Results	**X**	**X**
26	Corrective Action Reports	**X**	**As Necessary**
27	Raw Data	**X**	**X**
28	Electronic Data Deliverable	**X**	**X**

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QAPP Worksheet #35: Data Verification Procedures

This worksheet documents procedures that will be used to verify project data. Data verification is a completeness check to confirm that all required activities were conducted, all specified records are present, and the contents of the records are complete. The referenced EA SOPs are provided in Appendix A.

Records Reviewed	Requirement Documents	Process Description	Frequency	Responsible Person
Field logbooks	EA SOP 05	Verify that records are present and complete for each day of field activities. Verify that all planned samples including field QC samples were collected and that sample collection locations are documented. Verify that meteorological data were provided for each day of field activities. Verify that changes/exceptions are documented and were reported in accordance with requirements. Verify that any required field monitoring was performed, and results are documented.	Daily End of Activity	EA Task Manager EA PM
Chain-of-custody forms	EA SOP 12	Verify the completeness of chain-of-custody records. Examine entries for consistency with the field logbook. Check that appropriate methods and sample preservation have been recorded. Verify that the required volume of sample has been collected. Verify that all required signatures and dates are present. Check for transcription errors.	Daily End of Activity	EA Field Team EA Program Chemist or designee
Laboratory Deliverable	QAPP	Verify that the laboratory deliverable contains all records specified in the QAPP. Check sample receipt records to ensure sample condition upon receipt was noted, and any missing/broken sample containers were noted and reported according to plan. Compare the data package with the chain of custody forms to verify that results were provided for all collected samples. Review the narrative to ensure all QC exceptions are described. Check for evidence that any required notifications were provided to project personnel as specified in the QAPP. Verify that necessary signatures and dates are present.	Before release Upon receipt	Lab QA Manager EA Program Chemist or designee
Electronic data	QAPP	Electronic laboratory data and field data.	Daily	EA Database Administrator/EA PM
Daily and Weekly QC Report	QAPP, Quality Control Plan	All QC reports are complete for each field day/week.	Daily/Weekly	EA Task Manager

Records Reviewed	Requirement Documents	Process Description	Frequency	Responsible Person
Audit Reports, CA Reports	QAPP	Verify that all planned audits were conducted. Examine audit reports. For any deficiencies noted, verify that CA was implemented according to plan.	As required	CQCS

QAPP Worksheet #36: Data Validation Procedures

The PFAS data for groundwater, surface water, soil, and sediment will be validated to a Stage 2B (90%) or Stage 4 (10%) standard, including DoD QSM Version 5.3 (or more recent) Table B-15 requirements. Samples for Stage 4 validation will be selected from those samples with elevated PFAS concentrations, relative to other project samples. PFAS data generated by the mobile laboratory and other chemical data will undergo Stage 2A validation. Grain size and permeability data will undergo data verification for completeness and compliance to project objectives. Data collected for IDW characterization will not undergo data validation.

Data Validator: Laboratory Data Consultants

Analytical Group/Method:	PFAS
Data deliverable requirements:	EQuIS and ERPIMS Electronic Data Deliverables and Stage 4 PDF Data Package
Analytical specifications:	Worksheet #28, SOPs (Worksheet #23)
Measurement performance criteria:	Worksheet #12
Percent of data packages to be validated:	100 percent
Percent of raw data reviewed:	10 percent
Percent of results to be recalculated:	10 percent
Validation procedure:	DoD *General Data Validation Guidelines*; DoD Data Validation Guidelines Module 3: Data Validation Procedure for Per- and Polyfluoroalkyl Substances Analysis by QSM Version 5.3 (or more recent), Table B-15
Validation code:	90% S2BVM, 10% S4VM
Electronic validation program/version:	NA

Data Validator: EA

Analytical Group/Method:	PFAS screening, TOC, pH, and anion and cation exchange capacity
Data deliverable requirements:	EQuIS and ERPIMS Electronic Data Deliverables and PDF Data Package including QC data
Analytical specifications:	Worksheet #28, SOPs (Worksheet #23)
Measurement performance criteria:	Worksheet #12
Percent of data packages to be validated:	100 percent
Percent of raw data reviewed:	0 percent
Percent of results to be recalculated:	0 percent
Validation procedure:	DoD *General Data Validation Guidelines*
Validation code:	S2AVM
Electronic validation program/version:	NA

The following qualifiers will be used to indicate QC deficiencies and will be defined in the data tables:

Qualifier	Definition
U	The analyte was not detected and was reported as less than the LOD or as defined by the customer. The LOD has been adjusted for any dilution or concentration of the sample.
J	The reported result was an estimated value with an unknown bias.
J+	The result was an estimated quantity, but the result may be biased high.
J-	The result was an estimated quantity, but the result may be biased low.
UJ	The analyte was not detected and was reported as less than the LOD or as defined by the customer. However, the associated numerical value is approximate.
X	The sample results (including non-detects) were affected by serious deficiencies in the ability to analyze the sample and to meet published method and project quality control criteria. The presence or absence of the analyte cannot be substantiated by the data provided. Acceptance or rejection of the data should be decided by the project team (which should include a project chemist), but exclusion of the data is recommended.

QAPP Worksheet #37: Data 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 (Worksheets #35 and #36).

Identify personnel (organization and position/title) responsible for participating in the data usability assessment:

- Project Manager: Cybil Boss
- CQCS: Frank Barranco
- Program Chemist: Samantha Saalfield
- Data Validator: Pei Geng (Laboratory Data Consultants)
- USACE Project Manager: Rich Anderson
- Other USACE Omaha District PDT members, as appropriate
- NGB/A4VR Restoration Program Managers: Keith Freihofer (Joe Foss Field) and Bill Myer (Truax Field and Volk Field)

PFAS data generated by the mobile laboratory (Pace) will undergo data verification for completeness and compliance to the QAPP. The purposes of this data set will be to support field sampling design and decisions on a real-time basis. The data usability will be determined through the verification process and performed as data are made available.

A third-party data validation will be performed by Laboratory Data Consultants on the PFAS data generated by Eurofins. If any data are X-qualified (recommended for exclusion) during validation, EA will coordinate with the data usability assessment team to determine whether these data should be rejected or qualified as estimated. A determination will be made prior to submission of the Draft RI Report.

Subsequent to validation, a data usability assessment will be performed and will include the following:

- Step 1
  - Review the project's objectives and sampling design.
    - Review the key outputs defined during systematic planning (i.e., Project Quality Objectives or DQOs and MPC) 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. Look for patterns, trends, and anomalies.
    - Review deviations from planned activities (e.g., number and locations of samples, damaged samples, and SOP deviations) and determine their impacts on the data usability. Assess data quality indicators including precision, accuracy,

representativeness, completeness, comparability, and sensitivity, as described in detail below. Evaluate implications of unacceptable QC sample results.

- Step 3
  - Verify the assumptions of the selected statistical method.
    - 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 soil 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 corrective actions. Discuss data quality indicators. Assess the performance of the sampling design and Identify limitations on data use. Update the conceptual site model and document conclusions. Prepare the data usability summary report which can be in the form of text and/or a table.

Summary of Data Quality Indicators

The data usability assessment will include a summary of whether the data achieved the project DQOs, as well as a data quality and usability statement. A description of each data quality indicator is found under each parameter heading below. Precision, accuracy/bias, representativeness, comparability, and completeness, as well as sensitivity, are the data quality indicators used to validate and assess the data produced during the project. Each data quality indicator 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. Specific data quality indicators and their specific measurement performance criteria to be evaluated for data usability are presented on Worksheet #12, Worksheet #15, Worksheet #19&30, Worksheet #24, and Worksheet #28.

To measure and control the quality of analyses, certain QA parameters are defined and utilized in data analysis activities. These QA parameters are defined below. The assigned subcontract laboratory will generally follow the QA/QC criteria specified in the applicable EPA method.

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, percent difference, or range, in either absolute or relative terms. QC measures for precision include field duplicates, laboratory duplicates, MSDs, and analytical replicates.

To meet the needs of the data users, project data must meet the measurement performance criteria for precision specified in UFP-QAPP Worksheets #12 and #28 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 will be in accordance with the UFP-QAPP Manual, Section 2.6.2.1 (EPA 2005a).

Duplicate precision is stated in terms of RPD or absolute difference between two measurements. Measurement of precision is dependent upon sampling technique and analytical method. Field duplicate and laboratory duplicate samples will be used to measure precision for project samples. Both sampling and analysis will be as consistent as possible. For a pair of measurements, RPD (or absolute difference) will be used, as presented below:

$$\text{RPD (\%)} = \frac{|D_1 - D_2|}{\frac{(D_1 + D_2)}{2}} \times 100$$

where: D_1 and D_2 = the two replicate values.

RPD will meet QA requirements listed in this UFP-QAPP and the DoD QSM.

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. If data validation reports indicate that analytical imprecision exists for a particular data set or sample delivery group, then the impact of that imprecision on usability will be considered prior to use.

Analytical 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 MS, LCS, equipment blanks, and surrogates. In order to meet the needs of the data users, project data must meet the measurement performance criteria for accuracy/bias specified in UFP-QAPP Worksheets #12 and #28. The process for calculating accuracy/bias will be in accordance with the UFP-QAPP Manual, Section 2.6.2.2.

Sources of error include the sampling process, field contamination, preservation, handling, shipping, sample matrix, sample preparation, and analysis technique. Analytical accuracy will be assessed through surrogate spike, MS, laboratory control and/or quality check samples, where applicable. In general, accuracy is measured in terms of percent recovery (%R):

$$\%\mathrm{R} = \frac{(\mathrm{SSR} - \mathrm{SR})}{\mathrm{SA}} \times 100$$

where: SSR = spike sample result
SR = sample result
SA = spike added to spiking matrix

Percent recoveries will meet the QA requirements listed in the RPD will meet QA requirements listed in this UFP-QAPP and the DoD QSM.

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. Representativeness is a qualitative parameter that is dependent upon the proper design and implementation of the sampling program and proper laboratory protocol. The process for calculation representativeness will be in accordance with the UFP-QAPP Manual, Section 2.6.2.4.

The sampling protocol created for this project was designed to provide data representative of site conditions. During the development of the sampling protocol, consideration was given to the past history of the site, existing analytical data, physical setting, and processes. representativeness will be satisfied by determining that the UFP-QAPP is followed, proper sampling techniques, preservation, and handling are used, proper analytical procedures are followed, and holding times for the samples are not exceeded in the laboratory.

This UFP-QAPP discusses how the QA/QC activities (review of sampling design and SOPs, field sampling technical systems audits, split sampling, and analysis audits, etc.) and QC sample data will be reviewed to assess sample representativeness. For samples collected, if field duplicate precision checks indicate potential spatial variability, additional scoping meetings and subsequent sampling may be needed in order to collect data that are more representative of the site.

Completeness

Completeness is a measure of the amount of valid data obtained from a measurement system compared with the amount that was planned to be obtained. In order to meet the needs of the data users, project data must meet the measurement performance criteria for data completeness specified in UFP-QAPP Worksheets #12.

A completeness check will be done on the data generated by the laboratory. The completeness criterion for this project is 100% for each analyte/matrix, particularly for PFOA/PFOS/PFBS. Completeness will be calculated for each analyte in each matrix (UFP-QAPP Manual Section 2.6.2.6). For each target analyte in each matrix, completeness will be calculated as the number of valid (usable) data points for the target analyte in samples of the subject matrix, divided by the total number of samples of the subject matrix analyzed for the target analyte.

Following the completion of the analytical testing, the percent completeness for each target analyte in each matrix will be calculated by the following equation:

$$\text{Completeness (\%)} = \frac{\text{number of usable data}}{\text{number of samples collected for each parameter analyzed}} \times 100$$

The completeness acceptance criterion for samples collected in the field will be 100% of the quantity of samples planned for collection in the UFP-QAPP. Corrective action may be implemented to re-collect samples where necessary and possible (e.g., modifying a planned sample location, sample jars broken during shipment). Laboratory notification of sample receipt and conditions will be used to evaluate, as soon as possible, whether any problems during sample shipment would necessitate recollection of samples.

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.

The extent to which existing and planned analytical data will be comparable depends on the similarity of sampling and analytical methods. The procedures used to obtain the planned analytical data are expected to provide comparable data. The procedures used will be EPA methodologies or other standard test methods, which are well recognized and commonly used for environmental investigations.

Desired Method Sensitivity

Sensitivity is the capability of a test method or instrument to discriminate between measurement responses representing different levels (e.g., concentrations) of a variable of interest. Examples of QC measures for determining sensitivity include laboratory fortified blanks, a method detection limit study, and calibration standards at the quantitation limit. To meet the needs of the data users, project data must meet the measurement performance criteria for sensitivity specified in Worksheet #12 and SLs specified in Worksheet #15 of this UFP-QAPP.

Depending upon the use of the data and the type of test parameter, specific QLs will be required. Worksheet #15 lists the SLs for the chemical parameters of interest for this work. The analytical methods used for this project should have sensitivities below these criteria.

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Appendix A

Field Standard Operating Procedures (SOPs)

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APPENDIX A
FIELD STANDARD OPERATING PROCEDURES (SOPs)

TABLE OF CONTENTS

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6332106 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 1
August 2021

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CONTENTS

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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 NO. ___________
SAMPLE LOCATION/SITE ID ____________________________
DATE: ____/____/____ TIME: _____:_____
ANALYTES: METALS VOC EXPLOSIVES ORGANICS PFAS
OTHER
FILTERED: [NO] [YES]
PRESERVATIVE: [NONE] [HNO_3] [OTHER ______]
SAMPLER: ____________________

1. MATERIALS

The following materials may be required:

- Sample label
- Indelible marker (Note: Sharpies® are acceptable for PFAS sampling)

2. PROCEDURE

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

2.1 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
- 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) (Note: Filtered samples will *not* be used for PFAS analysis)
- Preservatives (water samples only)
- Sampler Name(s)

2.2 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.

2.3 RECORD INFORMATION

Record the sample number and designated sampling point in the field records (loose leaf paper or other non-waterproof field book) 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 (LDPE or glass containers are prohibited for PFAS analysis).
- Whether the sample is a quality assurance sample (split, duplicate, matrix spike/matrix spike duplicate, or blank).

2.3.1 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 shall 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.

3. MAINTENANCE

Not applicable.

4. 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.

5. REFERENCES

Not applicable.

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6332106 Standard Operating Procedure No. 002
for
Chain-of-Custody Form

Prepared by

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Revision 1
August 2021

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CONTENTS

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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. An example form is provided as Figure SOP002-1 (EA's standard electronic chain-of-custody form. Other formats with similar levels of detail are acceptable.

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.

1. MATERIALS

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

2. 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.

3. MAINTENANCE

Not applicable.

4. PRECAUTIONS

None.

5. 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.

Figure

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Figure PFAS SOP002-1 EA Chain-of-Custody Form

Company Name:

Project Manager or Contact:

Phone:

Project No.

Dept.: Task:

Project Name:

Sample Storage Location:

P.O. No.:

Page of

Report No.:

Parameters/Method Numbers for Analysis

Chain-of-Custody Record

EA Laboratories
231 Schilling Circle
Hunt Valley, MD 21031
Telephone: (410) 584-7000

Report Deliverables:
1 2 3 4 D E

EDD: Yes/No

DUE TO CLIENT: _________

Date	Time	Water	Soil	Sample Identification 19 Characters	**No. of Containers**														**EA Labs Accession Number**	Remarks
				XXXXXXXXXXXXXXXXXXX																**LPM**:
				XXXXXXXXXXXXXXXXXXX																
				XXXXXXXXXXXXXXXXXXX																
				XXXXXXXXXXXXXXXXXXX																
				XXXXXXXXXXXXXXXXXXX																
				XXXXXXXXXXXXXXXXXXX																
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Company Name:

Project Manager or Contact:

Phone:

Project No.

Dept.: Task:

Project Name:

Sample Storage Location:

P.O. No.:

Page of

Report No.:

Parameters/Method Numbers for Analysis

Chain-of-Custody Record

EA Laboratories
231 Schilling Circle
Hunt Valley, MD 21031
Telephone: (410) 584-7000

Report Deliverables:
1 2 3 4 D E

EDD: Yes/No

DUE TO CLIENT: _________

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

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.

6332106 Standard Operating Procedure No. 003
for
Subsurface Utility Clearance

Prepared by

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Revision 1
August 2021

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CONTENTS

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SCOPE AND APPLICATION

1.1 PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to prevent injury to workers and damage to subsurface structures (including tanks, pipelines, water lines, gas lines, electrical service, etc.) during ground disturbance activities (including drilling, augering, sampling, use of direct-push technologies, excavation, trenching, concrete coring or removal, fence post installation, grading, or other similar subsurface operations).

1.2 LIMITATIONS

The procedures set forth in this document are general guidance, but may not be entirely applicable to particular sites based on the site-specific considerations. The Project Manager is responsible for making a site-specific evaluation of each site to determine how subsurface utility clearance procedures should be utilized or modified. If safety or other site-specific considerations require a modified or different procedure, the Project Manager should review the modified procedure with the Business Unit Director, Profit Center Manager, or Senior Technical Reviewer. Evaluation support of modified procedures may be provided by the Corporate Health and Safety Director or the Lead Construction Quality Engineer.

Special considerations may be required for utility location activities at complex or challenging project sites (underwater utilities, hazardous waste sites, etc.). Additional subsurface utility clearance procedures should be added as appropriate for difficult sites. When health and safety risks to workers or potential utility damage cannot be effectively managed through utility location, clearance, and protection measures, the Project Manager must consider the modification of ground disturbance activities (e.g., establishing a safe offset from high-risk utilities). In these cases, detailed coordination with the client and/or regulatory staff is likely required.

1.3 SCOPE

This SOP provides minimum guidance for subsurface utility clearance activities, which must be followed prior to and during ground disturbance activities at EA project sites. Even after completing the subsurface utility clearance activities required in this SOP, all ground disturbance activities should proceed with due caution.

Deviations from this SOP may be provided on an exception basis for specific situations, such as underground storage tank systems removals, verified aboveground/overhead services/lines, undeveloped land/idle facilities, shallow groundwater conditions, soil stability, or well construction quality assurance/quality control concerns, etc.

EA or its subcontractors are responsible for, and shall ensure that, all ground disturbance activities are completed safely, without incident, and in accordance with applicable federal, state, and local regulations.

This SOP shall not override any site-specific or consultant/contractor procedures that are more stringent or provide a greater degree of safety or protection of health or the environment.

2. PROCEDURES

The EA Project Manager or his/her designee must complete the Subsurface Utility Clearance Checklist (Attachment A) in conjunction with the following procedures. The checklist must be completed before initiating any ground disturbance activities. The completed checklist must be submitted to the appropriate team individuals, subcontractors, and/or the client and included in the project files.

2.1 SAFETY

A Health and Safety Plan must be available onsite and followed by all contractors and subcontractors.

Work areas should be defined and secured with safety cones, safety tape, construction fence, other barriers, or signs as appropriate.

Site work permits must be obtained as required by site procedures. Based on site conditions or classification, the use of intrinsically safe equipment may be required.

To ensure the safety of all onsite personnel and subsurface structure integrity, consideration should be given to de-energizing and locking out selected site utilities or temporarily shutting down a portion of or the entire facility.

2.2 SUBSURFACE UTILITY LOCATION ACTIVITIES

To gather all relevant information about potential subsurface structures prior to ground disturbance activities, the project team should pursue multiple lines of evidence on the type, location, depth, size, material of construction, and status (active/abandoned) of all utilities within and near the area planned for ground disturbance activities. A minimum of three lines of evidence should be obtained and documented; however, additional lines of evidence should be secured when possible. Lines of evidence may include the following:

- Historical Site Information
- Public Utility Mark-Out (One Call – 811)
- Private Utility Mark-Out
- Site Inspection
- Client/Facility Interviews and Coordination.

2.2.1 Historical Site Information

The most recent as-built drawings and/or site plans (including underground storage tank, product, and vent lines) should be obtained, as available.

NOTE: As-built drawings may not accurately depict the locations and depths of improvements and subsurface structures and should, therefore, not be **solely** relied upon.

EA should obtain any other site information such as easements, rights-of-way, historical plot plans, fire insurance plans, tank (dip) charts, previous site investigations, soil surveys, boring logs, and aerial photographs, etc. as relevant to the planned ground disturbance activities. Where applicable, EA should also contact contract personnel who may have historical site knowledge.

2.2.2 Public and Private Utility Mark-Outs

EA must ensure that a thorough mark-out at the site is completed to locate electrical, gas, telephone, water, sewer, low voltage electric lines, product delivery pipelines, fiber optic, and all other subsurface utilities/services.

- Where available, public utility companies must be contacted to identify subsurface utilities. (This can be accomplished through the One-Call system in most instances.) Attachment B provides a brochure for the 811 Utility Locate Call Center.

- In addition, where available and warranted by site conditions, a private utility/pipeline mark-out company should be contracted to perform an electronic subsurface survey to identify the presence of suspected hazardous or critical subsurface utilities and structures. In some cases, this is necessary to confirm public utility mark-outs in the vicinity of planned ground disturbance activities.

EA will review all available site plan subsurface information with the private mark-out company to assist in locating utilities and other subsurface structures.

NOTE: Mark-outs may not accurately depict the exact locations of improvements and subsurface structures and should, therefore, not be **solely** relied upon.

Where possible, EA personnel are encouraged to be onsite at the time of subsurface mark-outs. This is to ensure accuracy and understanding of subsurface utility structures identified and provides an opportunity to exchange information with mark-out company personnel regarding planned work activities.

Subsurface utility structures should be marked throughout the entire work area(s) with adequate materials (e.g., site conditions may require paint and tape/flags). Ground disturbance activities must be started within 30 days of mark-out, unless local ordinances specify a shorter time period.

If activities are not started within required time period or markings have faded, mark-outs must be redone.

EA personnel will record time and date of mark-out request and list all companies contacted by the service and confirmation number. This information should be available for review onsite and checked off after visual confirmation of markings.

2.2.3 Site Inspection

To compare the site plan to actual conditions based on information gathered in other lines of evidence, a site inspection should be performed to identify potential signs of subsurface utilities. These signs may include:

- Signage identifying subsurface utilities
- Asphalt patching or paving scars
- Pull boxes, junction boxes, valve box covers, or manhole covers
- Sewer drains and clean-out traps
- Meters and light poles
- Piping or conduit on the walls or roofs of buildings
- Linear ground depressions
- Markings from previous utility mark-out efforts
- Other utilities including fire hydrants, on/below grade electrical transformers, splice cages, sprinkler systems, steam lines (including insulated tanks that may indicate steam lines), and cathodic protection on lines/tanks.

EA will document all findings and update the site plan with this information. In some regions, it may be more effective and efficient to conduct the site inspection at the same time the contractor performing the ground disturbance activity is mobilized to the site. The site inspection may include others as determined by the consultant/contractor and the Project Manager.

2.2.4 Client/Facility Interviews and Coordination

Knowledgeable client and facility staff familiar with site utilities should be interviewed to obtain information and documentation on potential subsurface utility locations, depth, etc. Results of these interviews should be documented and included with the Subsurface Utility Clearance Checklist. On third party sites, close coordination with the site owner's representatives for mark-outs, review of as-builts, and other information reviews should be conducted prior to any ground disturbance work. Project Managers are encouraged to provide updated as-built information to the client.

EA will review the selected ground disturbance locations with the client. EA will not proceed with the subsurface activities until the plan has been discussed with the client. During execution of the project, if subsurface activities are required outside of the area previously approved by the client, EA will submit these changes to the client for approval prior to execution.

2.2.5 Ground Disturbance Activity Sequence

When practical, EA will plan ground disturbance activities starting at the point farthest from the location of suspected underground improvements. This is done to determine the natural subsurface conditions and to allow EA site personnel to recognize fill conditions.

Experience has shown that the following warning signs may indicate the presence of a subsurface structure:

- Warning tape (typically indicative of underground services).
- Pea gravel/sand/non-indigenous material (typically indicative of tanks or lines).
- Red concrete (typically indicative of electrical duct banks).
- The abrupt absence of soil recovery in a hand auger. This could indicate pea gravel or sand that has spilled out of the auger. This may not be indicative in areas where native soil conditions typically result in poor hand auger recoveries.
- Any unexpected departure from the native soil or backfill conditions as established by prior onsite digging.

If any of these conditions is encountered by EA site personnel, digging should stop and the client should be contacted.

3. UTILITY PROTECTION MEASURES DURING GROUND DISTURBANCE ACTIVITIES

After mobilization, but prior to the primary ground disturbance activities, the physical location of subsurface utilities should be cleared and verified whenever possible and practical. The clearance method used to clear and verify the subsurface utilities should be compatible with the inherent associated risk given the type of facility/property, subsurface utility material of construction, utility depth, soil stratigraphy, and the location of the ground disturbance activity, such that required delineation is obtained. It should be noted that in areas where there is paving, sufficient paving should be removed to allow clear visibility of the subsurface conditions during clearance activities. The following is a list of potential clearance methods that may be used on a job site:

- Vacuum digging
- Probing
- Hand digging
- Hand augering
- Post-hole digging.

EA personnel will evaluate the potential for electrical shock or fire/explosion for each subsurface disturbance project and will evaluate as necessary the use of non-conductive or non-sparking tools (i.e., fiberglass hand shovels, and thick electrically insulating rubber grips on hand augers or probes). The potential need for the use of non-conductive materials, electrical safety insulated gloves, and footwear will also be evaluated on a case-by-case basis.

For drilling, direct-push technology, fence post installation, or other borehole installation, the area to be delineated will exceed the diameter of the largest tool to be advanced and sufficiently allow for visual inspection of any obstructions encountered.

3.1 SUBSURFACE CLEARANCE PROCEDURES FOR TRENCHING/ EXCAVATION ACTIVITIES

For trenching and excavation activities, appropriate subsurface clearance methods should be conducted along the length and width of the excavation at a frequency sufficient to ensure adequate precautions have been applied to the entire work area. The frequency and density of investigations will be based on site knowledge, potential hazards, and risks of the work area to surrounding locations.

Whenever subsurface structures are exposed, EA will cease work and mark the area (e.g., flags, stakes, cross bracing) to ensure the integrity of these exposed structures is maintained during subsequent trenching/excavation/backfilling.

During ground disturbance activities, EA and its subcontractors should consider the use of spotters to monitor the excavation for signs of subsurface utilities (pipes, conduits, cables, bedding material, warning tape, tracing wire, soil material changes, etc.) to provide early warning in the event unknown subsurface utilities are encountered. The decision to use spotters should be based on the risk of encountering unknown subsurface utilities, utility hazards associated potential unknown utilities that could be encountered (electrical, natural gas, etc.), and the physical and environmental hazards to have a spotter in proximity to the excavation. Spotters, if used, should be briefed on the potential physical and utility hazards that may be present at the site and the signs of subsurface utilities that they should be monitoring for during ground disturbance activities.

Uniform color codes for marking of underground facilities are provided in Attachment C.

Attachment A

Subsurface Utility Clearance Checklist

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SUBSURFACE UTILITY CLEARANCE CHECKLIST

Site Identification: ______________________

Project Consultant/Contractor: ______________________

Section 1: Safety, Preparation Tasks, and Mark-Outs

Activity	**Yes**	**No**	**N/A**	**Comments including Justification if Response Is No or Not Applicable**
Health and Safety Plan is available, and all contractors and subcontractors are familiar with it.				
All applicable local, state, and federal permits have been obtained.				
Site access/permission has been secured.				
Most recent as-built drawings and/or site plans (including underground storage tank, product, and vent lines) obtained.				
Reviewed site information to identify subsurface structures relevant to planned site activities (easements, rights-of-way, historical plot plans, fire insurance plans, tank dip charts, previous site investigations, soil surveys, boring logs, aerial photographs, etc.).				
Utility mark-outs have been performed by public utility company(s). Mark-outs clear/visible.				
Subsurface structure mark-outs performed by private mark-out company. Mark-outs clear/visible.				
Additional Activities: Were dig locations reviewed with site representative?				

Section 2: Initial Site Visit and Selecting Ground Disturbance Locations

Activity	**Yes**	**No**	**N/A**	**Comments, including Justification if Response Is No or Not Applicable**
Location of all aboveground indicators of subsurface utilities/services that may be leading to or from buildings within the planned work area has been identified.				
Location of utility mark-outs by all utility companies previously contacted has been identified within required time period.				
Location of all subsurface structure mark-outs by private mark-out company has been identified within required time period.				
Location of area lights/signs and associated subsurface lines identified.				
Location of all phones and associated subsurface lines identified.				
Location of all drains and associated interconnecting lines identified.				
Location of all electrical junction boxes and associated interconnecting lines identified				
Location of all natural gas meters or connections and all interconnecting lines identified				

Completed by: ______________________
Name

Signature: ______________________ ____________
Company Date

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Attachment B

811 Utility Locate Brochures

(Note: Brochures included in electronic copy only)

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Attachment C

Uniform Color Codes for Marking of Underground Facilities

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APWA UNIFORM COLOR CODE

WHITE - Proposed Excavation

PINK - Temporary Survey Markings

RED - Electric Power Lines, Cables, Conduit and Lighting Cables

YELLOW - Gas, Oil, Steam, Petroleum or Gaseous Materials

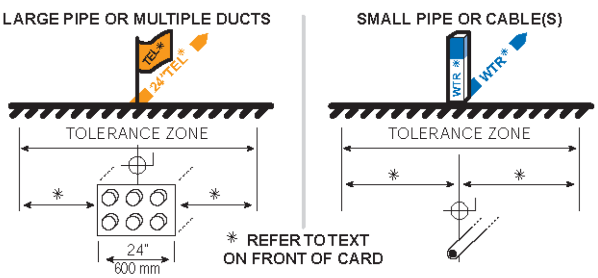
ORANGE - Communication, Alarm or Signal Lines, Cables or Conduit

BLUE - Potable Water

PURPLE - Reclaimed Water, Irrigation and Slurry Lines

GREEN - Sewers and Drain Lines

TYPICAL MARKING



Customize with your center's phone and address information

GUIDELINES FOR UNIFORM TEMPORARY MARKING OF UNDERGROUND FACILITIES

This marking guide provides for universal use and understanding of the temporary marking of subsurface facilities to prevent accidents and damage or service interruption by contractors, excavators, utility companies, municipalities or any others working on or near underground facilities.

ONE-CALL SYSTEMS
The One-Call damage prevention system shall be contacted prior to excavation.

PROPOSED EXCAVATION
Use white marks to show the location, route or boundary of proposed excavation. Surface marks on roadways do not exceed 1.5" by 18" (40 mm by 450 mm). The facility color and facility owner identity may be added to white flags or stakes.

USE OF TEMPORARY MARKING
Use color-coded surface marks (i.e., paint or chalk) to indicate the location or route of active and out-of-service buried lines. To increase visibility, color coded vertical markers (i.e., stakes or flags) should supplement surface marks. Marks and markers indicate the name, initials or logo of the company that owns or operates the line, and width of the facility if it is greater than 2" (50 mm). Marks placed by other than line owner/operator or its agent indicate the identity of the designating firm. Multiple lines in joint trench are marked in tandem. If the surface over the buried line is to be removed, supplementary offset markings are used. Offset markings are on a uniform alignment and clearly indicate the actual facility is a specific distance away.

TOLERANCE ZONE
Any excavation within the tolerance zone is performed with non-powered hand tools or non-invasive method until the marked facility is exposed. The width of the tolerance zone may be specified in law or code. If not, a tolerance zone including the width of the facility plus 18" (450 mm) measured horizontally from each side of the facility is recommended.

ADOPT UNIFORM COLOR CODE
The American Public Works Association encourages public agencies, utilities, contractors, other associations, manufacturers and all others involved in excavation to adopt the APWA Uniform Color Code, using ANSI standard Z535.1 Safety Colors for temporary marking and facility identification.

Rev. 4/99

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6332106 Standard Operating Procedure No. 004
for
Sample Packing and Shipping

Prepared by

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

Revision 1
August 2021

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CONTENTS

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1. SCOPE AND APPLICATION

The purpose of this Standard Operating Procedure (SOP) is to delineate protocols for the packing and shipping of environmental samples to the laboratory for analysis. Additional requirements are applicable when shipping samples under the U.S. Environmental Protection Agency's Superfund Contract Laboratory Program.

NOTE: Samples collected from process wastewater streams, drums, bulk storage tanks, soil, sediment, or water samples from areas suspected of being highly contaminated could require shipment as dangerous goods; procedures for shipping of such samples are not covered in this SOP.

2. MATERIALS

The following materials may be required:

- Clear tape
- Custody seals
- Ice
- Packing material
- Plastic garbage bags
- Sample documentation
- Waterproof coolers (hard plastic)
- Zip-seal plastic bags

3. PROCEDURE

Refer to SOP Numbers (Nos.) 001, 002, 016, and 039 as applicable.

Samples will be placed in clean, bubble-wrap lined sample coolers with double-bagged ice immediately after collection to ensure proper preservation. Most sample analyses require that the sample material is maintained at 2-6 degrees Celsius (°C). It is also important to ensure that sample containers are maintained at all times at the temperature required by the analytical method used to analyze the sample media; as such, samples should be retained in a chilled cooler during the inventory, quality control, and packaging process.

Check cap tightness outside of each sample container. Verify that information on sample labels is correct and matches chain-of-custody forms. Ensure that both waterproof labels and indelible ink are used to label sample containers. Wrap breakable sample containers in bubble wrap. Enclose each sample in a clear zip-seal plastic bag.

Prepare cooler for shipping. Empty any water that has accumulated in coolers from melting ice. Securely seal all valves and/or drain holes in the shipping container, both inside and out, with duct tape to prevent leakage in the event of sample container breakage or melting ice.

Place several layers of bubble wrap on top of absorbent material and line the cooler sidewalls with bubble wrap. Line cooler with open garbage bag.

Prepare sample containers for shipping as follows:

- ***Glass Containers***—Wrap each glass sample container in bubble wrap or closed cell foam sheets. It is acceptable to package up to three 40-milliliter vials in one bubble wrap bag that is usually provided by the analytical laboratory. Enclose sample containers in a clear zip-seal plastic bag. (Note: Glass containers are not allowed when sampling for PFAS constituents.)

- ***Polyethylene Containers***—Place sample containers in clear zip-seal bags.

- ***Zip-Seal Bags***—Double-bag the samples to ensure that moisture will not reach the label.

Place all the sample containers upright inside garbage bag. Do not stack glass containers or lay them on their sides. Add additional bubble wrap between and around sample containers as needed to ensure containers do not shift during transport. If a second garbage bag was used, tie the (inner) garbage bag to isolate samples.

Double bag and seal loose, fresh ice to prevent melting ice from soaking the packing material. Fill gallon-size or larger zip-seal bags with fresh ice about two-thirds full and squeeze excess air out of the bags before sealing. Turn bag upside down and place in a second zip-seal bag, also removing excess air. Prepare sufficient bags to cover sample containers and ensure that the proper temperature (2-6° C) is maintained during transport.

Place ice on top of sample containers. Ensure that packing material does not insulate samples from ice. Do not use loose ice in sample coolers. Do not use bagged ice as packing material between or around sample bottles. Tie the garbage bag ensuring that the cooler lid will close securely.

Place a temperature blank into the cooler. The temperature blank consists of a plastic bottle containing either potable or deionized water. Temperature blanks are typically provided by the analytical laboratory. If temperature blanks are not provided, field staff must add a clean container filled with deionized water; ensure the cap is tight and container is labeled before placing in cooler.

If aqueous volatile organic analyte samples are being submitted, ensure a trip blank sample set is placed in each cooler containing volatile organic analyte samples. Trip blanks are used to check for contamination of volatile organic compound samples during handling, storage, and shipment from field to laboratory. The trip blanks consist of volatile organic analyte vials filled with deionized water and are typically provided by the analytical laboratory. Ensure that the trip blank samples and analyses are included on the chain-of-custody record.

Make copies of sample documentation (chain-of-custody forms or other field records) and retain in field files for record. Enclose the original field documentation forms in a waterproof plastic bag and tape the bag to the underside of the cooler lid. If more than one cooler is being used, each cooler will have its own documentation.

Seal coolers with signed and dated custody seals such that if the coolers were opened, the custody seals would be broken. Place clear tape over the custody seals to prevent damage to the seals.

Tape the cooler shut with packing tape over the hinges and custody seals. Tape should be wrapped around the cooler a minimum of five times. Ship all samples via overnight delivery on the same day they are collected if possible. Project-specific shipping requirements (e.g., Saturday delivery, communication with the receiving laboratory, etc.) should be discussed with the sample manager or project manager during project planning.

After samples are packaged within shipping containers, place shipping labels clearly on the outside of the container; clearly mark the number of containers in the shipment on the shipping label. Mark each cooler as "1 of 2," "2 of 2," etc.

4. MAINTENANCE

Not applicable.

5. PRECAUTIONS

The project manager and field team leader are responsible for determining if samples collected during a specific field investigation meet the definitions for dangerous goods. If a sample meets or is suspected to meet the definition of "dangerous goods" per the Dangerous Goods Regulation of the International Air Transport Association, then that sample must be handled according to the instructions given for that material. Dangerous goods must be prepared for shipping only by personnel trained and certified by International Air Transport Association in dangerous goods shipment.

6. REFERENCES

Not applicable.

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6332106 Standard Operating Procedure No. 005 for Field Decontamination

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Revision 1
August 2021

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CONTENTS

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1. SCOPE AND APPLICATION

All personnel or equipment involved in intrusive sampling, or that enter a hazardous waste site, must be thoroughly decontaminated prior to leaving the site to minimize the spread of contamination and prevent adverse health effects. This Standard Operating Procedure (SOP) describes the normal decontamination of sampling equipment and site personnel. Specific projects and programs may have additional decontamination requirements. Refer to the planning document(s) for additional site-specific requirements.

As a good practice, sampling at a site should be conducted moving from least to most impacted locations to minimize the potential for cross-contamination. It is advisable to use disposable tools and personal protective equipment to the extent possible such that decontamination is not necessary. If disposable equipment cannot be used, all attempts will be made to minimize the need for decontamination by using dedicated equipment when practical.

1.1 MATERIALS

The following materials may be required:

0.01 normal (N) hydrochloric acid	Concentrated, anionic detergent (Liquinox or Alconox; compatible with sampling for PFAS constituents)
0.10 N nitric acid	Plastic garbage bags
Aluminum foil or clean plastic sheeting	Plastic sheeting, buckets, etc. to collect washwater and rinsates
Approved water (deionized, potable, etc.)	Pressure sprayer, spray bottles, brushes, laboratory wipes, disposable cloth (shop towel or similar)
Laboratory-supplied per- and polyfluoroalkyl substances (PFAS)-free water[(a)]	Reagent grade alcohol[(b)]

a. For the purpose of this SOP, PFAS-free water is considered equivalent to "deionized ultra-filtered water," "reagent-grade distilled water," and "deionized organic-free water." The end product is water that is pure with no spurious ions or organics (including PFAS) to contaminate the sample. The water is supplied by the laboratory.
b. For the purpose of this SOP, the term "reagent grade alcohol" refers to either pesticide grade isopropanol or reagent grade methanol.

1.2 PROCEDURE

All reusable (non-dedicated) equipment that contacts or could potentially contact environmental samples shall be decontaminated prior to use at a site, between sampling locations, and at the completion of sampling events before leaving the site. Decontamination procedures are conducted in the Contaminant Reduction Zone, which may or may not be contiguous to the Exclusion Zone. The Contaminant Reduction Zone should be located on a level, preferably paved surface, either in an area upwind of the investigation/sampling area or in an area believed to be free of surface contamination. Care must be employed when moving contaminated tools and equipment to the Contaminant Reduction Zone to prevent the spread of contamination.

Specially designated and properly built decontamination pads may be built at a centralized location to accommodate larger pieces of equipment. The pads are built such that any water produced during the decontamination process can be contained and pumped into investigative-derived waste holding containers (i.e., frac tank, 55-gallon drum, etc.) for waste profiling and disposal.

For other field equipment, the Contaminant Reduction Zone may be a mobile decontamination station set up in the vicinity of the Exclusion Zone or sampling location. Plastic sheeting will be used to create a clean surface for the sampling and decontamination equipment to be placed upon.

1.2.1 Sample Bottles

At the completion of each sampling activity, the exterior surfaces of the sample bottles must be decontaminated as follows:

- Ensure the bottle lids are on tight.
- Wipe the outside of the bottle with a paper towel to remove gross contamination.

1.2.2 Personnel Decontamination

Review the Health and Safety Plan for the appropriate decontamination of site personnel and reusable personal protective equipment, such as protective suits used at highly contaminated sites, respirators, safety boots, safety glasses, etc. Decontamination will be conducted in a designated Contaminant Reduction Zone as per the Health and Safety Plan and the general decontamination procedures outlined further in this SOP.

1.2.3 Non-Dedicated Equipment

Reasonable attempts will be made to minimize the need for decontamination by using dedicated equipment when practical.

All reusable (non-dedicated) equipment that contacts or could potentially contact environmental samples shall be decontaminated prior to use at a site, between sampling locations, and at the completion of sampling events before leaving the site. Decontamination shall be conducted at a central decontamination station (i.e., decontamination pad) or at the sampling location.

Decontamination stations should be located on a level, preferably paved surface, either in an area upwind of the investigation area or in an area believed to be free of surface contamination. Plastic sheeting will be used to create a clean surface for the sampling and decontamination equipment to be placed upon.

Used decontamination solutions will be disposed of properly according to the site-specific Health and Safety Plan or applicable planning documents.

1.2.3.1 Field Monitoring and Testing Equipment

Water quality meters and temperature, pH, conductivity, redox, and dissolved oxygen probes will be cleaned per the manufacturer's instructions. If no such specifications exist, remove gross contamination and triple rinse probe with PFAS-free water. If downhole probes are used, wipe the wetted portion of the cable with a clean laboratory wipe or disposable cloth (shop towel or similar) that has been soaked with PFAS-compatible detergent solution to remove gross contamination and rinse with approved water.

Electronic water level indicators, weighted tapes, measuring tapes transducers, level loggers, etc. will be decontaminated after each use as follows:

- Wipe the wetted or contaminated portion of the tape or cable and the probe with a clean laboratory wipe or disposable cloth (shop towel or similar) that has been soaked with PFAS-compatible detergent solution to remove gross contamination. Rinse cloth in the solution and continue wiping until tape or cable is clean.

- Wipe with a second wipe or cloth or rinse with HPLC-grade water to remove soap residue.

- Dry tape with a third cloth (or laboratory wipe) and rewind into case or on spool, or re-coil tape.

Other field monitoring or measuring equipment such as beakers and graduated cylinders used to measure flow rates; flow-through cells used for monitoring water quality parameters; piezometers used to determine water levels; packers, mechanical slug device, and downhole equipment used during aquifer (hydraulic) testing; etc. will be decontaminated by washing with a non-phosphate laboratory detergent solution, followed by approved water and HPLC-grade water rinse.

1.2.3.2 Bladder Pumps

Non-dedicated bladder pumps with disposable bladders will be decontaminated as follows:

- Disconnect tubing from pump.

- Completely disassemble the pump, being careful to note the initial position of and retain any springs and loose ball checks.

- Discard the pump bladder.

- Clean all parts in the same manner as provided in Section 1.2.3.1.

- Install a new PFAS-compatible bladder and reassemble pump.

- Store pump in a clean, dedicated polyvinyl chloride (for PFAS sampling) storage container.

1.2.3.3 Grundfos Redi-Flow® or Similar Submersible Pumps

Non-dedicated Grundfos Redi-Flow® and similar pumps will be disassembled and decontaminated per the manufacturer's instructions on an as-needed basis (i.e., where high concentrations and an elevated risk of cross-contamination exist). Due to the challenges associated with pump decontamination, if possible, consider designating one pump for sampling in highly contaminated areas and a second pump for sampling non-impacted areas or areas with lower contaminant concentrations. In most cases, the pumps will be decontaminated following the procedures below.

The pump and support cable/electrical wires that come in contact with water will be decontaminated via pumping as detailed below. To avoid electrical shock, always disconnect power from the pump when handling the pump body during decontamination procedures.

- Disconnect sample tubing from pump.

- Decontaminate the wetted portion of the cable/electrical wires by washing with non-phosphate laboratory detergent solution, followed by approved water and HPLC-grade water rinse. Coil cable/electrical wires on spools or clean plastic sheeting.

- Scrub the exterior of the pump to remove gross (visible) contamination, using appropriate brush(es), approved water, and PFAS-compatible detergent solution.

- Transfer pump to rinse bucket filled with approved water. Rinse by pumping no less than nine volumes or a minimum of 5 minutes of approved water.

- Rinse pump exterior with reagent grade alcohol.

- Rinse pump exterior with PFAS-free water.

- Rinse pump exterior with 0.10 N nitric acid solution

- Rinse pump exterior with HPLC-grade water.

- Allow pump to air dry.

- Wrap pump in aluminum foil or clean plastic sheeting, or store in a clean, dedicated polyvinyl chloride storage container.

- Prior to reusing pump, rinse exterior again with HPLC-grade water.

1.2.3.4 Other Liquid Sampling Equipment

Other sampling equipment used to collect surface water, groundwater, non-aqueous phase liquid (NAPL), or other liquid samples includes but is not limited to PFAS-compatible bailers, dip samplers (whether bucket, long-handled, or short-handled), discrete interval stainless-steel samplers, ball check valves and foot valves, and labware (i.e., beakers, graduated cylinders, vials, and other containers that are used to hold samples for field measurements/screening and water chemistry). This equipment will be decontaminated after each use as follows:

- Discard all ropes, tubing, etc. used in sampling in a properly marked sealable container, or as directed by the Health and Safety Plan. NOTE: No tubing is to be used in conjunction with a bailer in collecting samples.
- Wash sampling equipment with non-phosphate laboratory detergent and approved water solution using appropriate brush(es), laboratory wipes, or disposable cloth (shop towel or similar) to remove gross (visible) contamination.
- Rinse with approved water.
- Rinse with reagent grade alcohol.
- Rinse with HPLC-grade water.
- Rinse with 0.10 N nitric acid solution using a spray bottle. This rinse may be eliminated if inorganic compounds such as metals are not being sampled/are not a contaminant of concern.
- Rinse with HPLC-grade water.
- Allow equipment to air dry. If sampling equipment has just been used for purging and is being decontaminated prior to sampling, do not air dry. Double rinse with HPLC-grade water and proceed to collect samples.
- Wrap equipment in clean plastic sheeting, or store in a clean, dedicated polyvinyl chloride storage container.
- Rinse equipment with HPLC-grade water immediately prior to re-use.

1.2.3.5 Solid Materials Samplers

Solid materials samplers include soil and sediment sampling probes, augers, trowels, shovels, sludge samplers, and other sampling equipment (e.g., core tubes, grab samples, core catchers, core liners, scoops, spoons, etc.), which will be decontaminated as follows:

- Scrub the sampler to remove gross (visible) contamination, using appropriate brush(es), approved water, and non-phosphate laboratory detergent (steam cleaning may be substituted for detergent scrub).

- Rinse off PFAS-compatible detergent with approved water.

- Rinse sampler with reagent grade alcohol.

- Rinse sampler with HPLC-grade water.

- For non-metallic samplers only, rinse sampler with 0.10 N nitric acid solution.

- For non-metallic samplers only, rinse sampler with HPLC-grade water.

- Allow sampler to air dry.

- Wrap sampler in aluminum foil or clean plastic sheeting, or store in a new zip-seal bag (size permitting) or clean, dedicated polyvinyl chloride or PTFE storage container.

- Rinse sampler with HPLC-grade water immediately prior to re-use.

For larger sediment sampling equipment, if sediment can be collected from the interior of a sampling device and away from potentially contaminated surfaces of the sampler, a site water rinse may be sufficient between stations. A site water rinse may also be sufficient for vessel surfaces between sample locations. However, all tools and equipment coming into contact with the sample should be decontaminated in accordance with the procedures above. Wash water from decontamination activities should be collected and disposed of properly.

1.2.3.6 Other Sampling and Measurement Probes

Soil (or sediment) gas sampling probes will be decontaminated as solids sampling devices.

1.2.3.7 Drilling Rigs, Sediment Sampling Vessels, and Other Heavy Equipment

All drilling rigs, sediment sampling vessels, and associated equipment such as augers, drill casing, rods, samplers, tools, recirculation tank, and water tank (inside and out) will be decontaminated prior to site entry after over-the-road mobilization and immediately upon departure from a site after drilling a hole. Supplementary cleaning will be performed prior to site entry when there is a likelihood that contamination has accumulated on tires and as spatter or dust on the way from one site to the next.

- Place contaminated equipment in an enclosure (i.e., existing wash pad, decontamination pad, etc.) designed to contain all decontamination residues (water, sludge, etc.).

- Steam clean equipment until all dirt, mud, grease, asphaltic, bituminous, or other encrusting coating materials (with the exception of manufacturer-applied paint) have been removed.

- Water used will be taken from an approved source.

- Containerize decontamination fluids in 55-gallon drums; sample; characterize; and, based on sample results, dispose of all decontamination residues properly.

Other heavy equipment includes use of backhoes, excavators, skid steers, etc. If heavy equipment is utilized during field activities (i.e., a backhoe for test pitting), the bucket should not come in contact with soil to be sampled. If the bucket contacts the soil to be sampled, then it should be decontaminated between sample locations, following the same procedures as listed above for a drill rig.

1.2.3.8 Ice Chests and Reusable Shipping Containers

Scrub exterior/interior with approved brush and Liquinox (or Alconox) detergent. Rinse off detergent with approved water. Let air dry and properly store until re-use.

NOTE: If container/ice chest is severely contaminated, clean as thoroughly as possible, render unusable, and properly dispose of.

2. PRECAUTIONS

Segregate all waste streams as specified in the sampling documents and store investigation-derived waste properly. Dispose of all wash water, rinse water, rinsates, and other sampling wastes (tubing, plastic sheeting, etc.) in properly marked, sealable containers, or as directed by the Health and Safety Plan or applicable planning documents.

Once a piece of equipment has been decontaminated, be careful to keep it in such condition until needed.

3. REFERENCES

Site-specific Health and Safety Plan and/or applicable planning documents.

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6332106 Standard Operating Procedure No. 007
for
Surface Water Sampling

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Revision: 1
August 2021

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1. SCOPE AND APPLICATION

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

2. MATERIALS

The following materials may be required:

Nitrile gloves	Sample bottles
Cooler with ice	Short-handled dip sampler (PFAS-compatible or stainless steel)
Long-handled dip sampler (PFAS-compatible or stainless steel)	Peristaltic pump
Disposable peristaltic head tubing	Disposable non-Teflon tubing

3. PROCEDURE

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

Sampling should be performed deliberately and methodically to minimize disturbance of bottom sediments, yet as quickly as possible to ensure a representative sample. If wading in a stream, sample upstream at the sampling location to prevent disturbance of the stream bottom from impacting the sample. A new pair of nitrile gloves must be worn for each different sampling location. Surface water must be collected by inserting a capped sampling container (polypropylene or HDPE) with the opening pointing down to avoid the collection of surface films. At the time of container opening, the container must be more than 10 centimeter (cm) from the sediment bed and more than 10 cm below the surface water level and as close to the center of the channel as possible, where practicable. Point the container up to fill so that gloved hands, sample container, and sampler are downstream of where sample is being collected. For PFAS-analysis, only HDPE containers will be used and no filtering of samples will be completed.

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

- Remove the cap from the sample bottle.

- Dip a sample of surface water using the sampler.

- Tilt sample bottle and gently pour sample from sampler into the bottle. Allow the sample to trickle down the side of the bottle. Avoid aerating the sample.

- Add preservative as required. Replace cap, and place in cooler immediately.

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

- Cut a length of Teflon® tubing to the depth of sampling specified by the client or project-specific Sampling and Analysis Plan. Teflon® is prohibited when sampling for PFAS, and materials compatible for PFAS sampling (i.e., HDPE or silicone) should be used.

- Insert one end of the tubing into the intake hose on the peristaltic pump.

- Place a stainless steel weight on the tubing and lower to the specified depth;

- Cut a length of tubing and insert into the output (out-flow) hose on the peristaltic pump.

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

- Fill the required sample containers.

4. MAINTENANCE

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

5. PRECAUTIONS

The following precautions should be taken:

- Avoid disturbing bottom sediments.

- Consult the Health and Safety Plan prior to collecting any samples for personal protective equipment such as dermal and respiratory protection and personal flotation devices when sampling in or near deep water or from boats.

- Always decontaminate the sampling and filtration equipment, and change gloves between sampling locations to minimize the risk of cross-contamination.

6. REFERENCES

None.

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6332106 Standard Operating Procedure No. 010
for
Water Level and Well Depth Measurements

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Revision 1
August 2021

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1. SCOPE AND APPLICATION

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

2. MATERIALS

The following materials may be required:

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

3. PROCEDURE

3.1 PRELIMINARY STEPS

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

When planning on measuring depth to water at a site where product may be present in wells, the wells should be segregated between potentially contaminated and not contaminated categories. The sequence of well gauging should be established to minimize the potential of cross contamination by generally gauging clean wells first.

Ensure that the electronic sounding device is working prior to mobilization by submerging the probe in a container of potable or deionized water. Keep the indicator probe in its protective case when not in use. Locate the well and verify its position on the site map. Record on the applicable field form(s) or in the field logbook (no waterproof cover for PFAS sampling; utilize loose paper) whether positive identification was obtained, including the well number/identification and any identifying marks, codes, or tags contained on the well casing or protective casing.

3.2 WELL HEADSPACE SCREENING

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

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

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

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

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

3.3 WELL ASSESSMENT

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

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

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

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

3.4 LIQUID LEVEL AND WELL DEPTH MEASUREMENTS

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

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

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

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

3.4.1 Non-Aqueous Phase Liquid Level Measurements

Always perform NAPL checks for the following conditions:

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

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

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

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

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

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

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

- Continue lowering the probe until the base of the well is encountered. Measure the depth of the well as detailed in Section 3.4.3.

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

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

3.4.2 Water Level Measurements

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

- Upon removing the well cap, ensure that enough time (a couple of minutes) has passed for the air pressure in the well to have equalized with atmospheric pressure.
- Turn the water level meter and test the alarm and liquid indication light. Adjust the sensitivity scale as needed.
- Remove the water level indicator probe from the case, and slowly lower the probe and cable into the well, allowing the cable reel to unwind. Continue lowering until the alarm sounds and the liquid indication light comes on. Very slowly, raise and lower the probe until the point is reached where the alarm just sounds. Record the depth to water.
- Slowly raise the probe and wipe the wetted portion of the tape (if any) with a clean laboratory wipe or disposable cloth (shop towel or similar) that has been soaked with non-phosphate laboratory detergent solution to remove gross contamination.
- Decontaminate the measuring tape and probe between well locations as detailed in SOP No. 005 to minimize the potential of cross contamination.

3.4.3 Well Depth Measurements

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

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

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

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

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

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

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

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

3.5 TRANSDUCERS AND DATALOGGERS

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

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

3.5.1 Transducers Deployment

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

Measure and record the depth to water and well depth using an electronic sounding device as detailed in Sections 3.4.2 and 3.4.3. Slowly lower the transducer into the well until it is below the lowest possible piezometric level (typically 2-3 feet below the water table). Attach the cable grip to the well protective casing and/or tape the cable to the casing to prevent the transducer from falling further.

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

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

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

3.5.2 Transducer Data Recording and Manipulation

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

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

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

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

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

3.5.3 Transducer Retrieval

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

4. SPECIAL CONSIDERATIONS

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

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

5. CALIBRATION

No calibration is required. However, the marked tapes of the instruments described in this SOP may stretch, especially when depth of the wells is great. If more than one instrument is used at a site during the same gauging event, consider comparing the markings of the tapes on all instruments by stretching them on clean plastic sheeting to the anticipated length to be used. If the delta is known between the tapes, corrections of the measurements can be done at the time data are processed.

6. PRECAUTIONS

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

7. REFERENCES

Not applicable.

6332106 Standard Operating Procedure No. 013
for
Collection of Monitoring Well Samples

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Revision: 1
August 2021

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1. SCOPE AND APPLICATION

The purpose of this Standard Operating Procedure (SOP) is to delineate protocols for the collection of groundwater samples from monitoring wells.

2. MATERIALS

The following materials may be required:

0.45-µM filters	Polyvinyl chloride bailer (for purging only)
Bladder pump (dedicated to one well only or designed for decontamination)	Sample bottles and labels
Conductivity meter	Stainless steel bailer (for purging and sampling)
Dissolved oxygen meter	Submersible pump and hose (for purging only)
Generator	Thermometer (optional)[1]
Logbook or book of field parameter forms	Transparent bailer with a double check valve
Peristaltic pump with tubing for filtering samples	Turbidity meter
pH meter with oxidation-reduction potential probe	Poly or Teflon® and/or Teflon® lined tubing **(PTFE or Teflon® should not be used when sampling for PFCs/PFAS)**
Photoionization detector organic vapor analyzer.	Variable speed, low flow submersible pump (e.g., Grundfos MP1 groundwater sampling pump) (for purging and sampling)
Variable speed peristaltic pump	Peristaltic head tubing
Plastic sheeting	Water level indicator
Polypropylene rope	Interface probe

NOTES:
µM = Micrometer(s).
L = Liter.
mL = Millimeter.
PFAS = Per- and polyfluoroalkyl substances.
PFC = Perfluorinated compound.
PTFE = Polytetrafluoroethelyne.
VOC = Volatile organic compound.
PTFE bailer with PTFE-coated stainless steel cable, double check valve top, and controlled flow bottom discharge attachment[2] for VOC sampling (40-mL vials), and top discharge attachment for collecting larger samples (1-L bottles) (for purging and sampling)

3. PROCEDURE

3.1 GENERAL

Groundwater sampling will follow these general steps:

- Arrive onsite

1. Temperature compensation and measurement capabilities are generally available as integral functions of pH meters and conductivity meters. If this is the case, a separate thermometer is not required.
2. Although use of a controlled flow bottom discharge valve is historically preferred, use of such a device can cause aeration of the sample.

- Set up apparatus (generators, pumps, etc.)
- Glove
- Organic vapor check, water level, and well depth measurements
- Sample non-aqueous phase liquids (NAPLs) (as required)
- Begin purge procedure
    - — If using bailer to purge and sample, see Section 3.6
    - — If using pump to purge and bailer to sample, see Section 3.7
    - — If using bladder or low-flow pump to purge and sample, see Section 3.8
- Decontaminate/re-glove
- Take samples
    - — If with bailer, see Section 3.6
    - — If with bladder or low flow pumps, see Section 3.8
- Decontaminate/dispose of wastes, move equipment to next site.

NOTE: Sampling monitoring wells for PFAS analysis have specific requirements that must be followed. Review SOP No. 073 and the project-specific planning documents prior to planning or conducting any sampling for PFAS.

3.2 GENERAL RULES FOR GROUNDWATER FIELD PARAMETER LOGBOOK

Use only one site or installation per logbook (non-waterproof cover or loose-leaf sheets must be used when sampling for PFAS constituents), and only one sampling location per page or form (if using pre-printed forms). The same logbook may be used for more than one sampling event. The first five pages will be reserved for index, general notes, etc. Sign and date each entry. The last five pages will be reserved for recording calibration data for the pH, temperature, turbidity, oxidation-reduction potential, dissolved oxygen, and conductivity meters. Use the page number or a separately recorded "Cal Reference Number" to refer to each calibration.

As appropriate, insert the cardboard flap under the form being filled out so that writing does not go through to the pages below. As appropriate, fill in the forms from front to back of the logbook, tearing out the white copy for each sample when the sample has been collected. This copy goes in the cooler with the sample, directly to the laboratory. The original copy must be torn out before you write on the back of the duplicate form. As appropriate, duplicate copies, index pages, and calibration sheets remain intact.

Reference SOP No. 016 for additional procedures and requirements for the use and maintenance of field logbooks for sampling.

3.3 GROUNDWATER SAMPLING GENERAL RULES

Groundwater samples will be collected from the least contaminated wells first, progressing to the most contaminated[3]. Upon arrival at the well site, immediately set up and organize the purging, sampling, and filtration equipment. If needed, due to muddy or contaminated ground, remoteness from sampling vehicle, and/or for placement of hose(s) and/or power cord if a pump is used, place clean plastic sheeting at, or around the well, to serve as a clean staging area for purging and sampling equipment, as conditions warrant. Care must be exercised not to step on plastic sheeting. If the well is remote from the sampling vehicle, set up the filtration equipment and place rope, wrapped bailer, and pre-labeled sample containers on the plastic sheet from the well. When a pump is to be used, situate the portable generator on level ground approximately 15 feet (ft) away from and downwind from the well. All generator maintenance (oil and fueling) is to be performed offsite. If the hose(s) and/or power cord of the pump are not on a reel, place the pump with its hose and power cord on the plastic sheeting downhill from the well.

Check well headspace for organic vapor, which may pose a health and safety hazard and indicate the presence of NAPL. Measure depth(s) to and thickness(es) of NAPL(s) as appropriate. Measure the depth to water and depth of well. From the water depth, well diameter, sand pack length, etc., calculate the equivalent volume (1 EV) of water in the well.

$$1\ \text{EV} = \text{volume in casing} + \text{volume in saturated sand pack}$$

Therefore, if the water table lies below the top of the sandpack, use the following equation:

$$1\ \text{EV} = (\pi R_w^2 h_w) + (0.30\pi(R_s^2 - R_w^2)h_w) * (0.0043)$$

If the water table lies above the top of the sandpack use this equation:

$$1\ \text{EV} = [(\pi R_w^2 h_w) + (0.30\pi(R_s^2 - R_w^2)h_s)] * (0.0043)$$

where

R_s = Radius of sandpack in inches
R_w = Radius of well casing in inches
h_s = Height of sandpack in inches
h_w = Water depth in inches
0.0043 gallons (gal)/inch (in.)^3
Assumed filter pack porosity = 30 percent.

3. First round samples are to be collected from upgradient wells first, moving to downgradient wells under the assumption that upgradient wells will be less contaminated than downgradient wells. Results of first round analysis may mandate a change in sampling sequence.

Samples will always be collected in order of decreasing volatility (i.e., the samples to be analyzed for the volatile constituents should be collected first). Deliver the VOC sample to the vial by allowing the water to trickle down the inside wall of the vial at a rate no greater than approximately 100 mL/minute. Other samples may be delivered at a faster rate. Sampling rates will at no time exceed 1 L/minute. Procedures for each class of samples are contained in the site-specific Quality Assurance Project Plan.

When collecting samples for volatile analysis, care should be taken to prevent analyte loss by volatilization. The following procedures should be adhered to when collecting these samples:

- Avoid excessive aeration and agitation of sample.
- Fill vial so that a reverse meniscus is present by adjusting the flow rate from the sampling device.
- Place septum on vial so that the PTFE side is in contact with the sample. After the cap is on the bottle, check for air bubbles in the sample. If air bubbles are present, properly dispose of that sample and recollect the sample in the same vial or a new vial if prepreserved.
- Make sure vial is labeled and immediately transfer the vial to the cooler with ice.

Filtered and unfiltered samples will be taken for inorganics (metals) analyses, as appropriate. The samples will be filtered through an in-line 0.45-µM filter (preferred method), or by gravity through a 0.45-µM membrane placed in a filter funnel. Use forceps to place the membrane into the funnel and pour sample through funnel until appropriate volumes have been filtered. Note that no filter will be used when sampling for PFAS constituents.

If necessary, due to slow filtering, a peristaltic pump may be used to filter the sample through an in-line filter. Connect the pump to the generator, and attach tygon tubing to the bottom discharge valve on the bailer. Start pump and collect sample from the end of the in-line filter directly into the proper container, preserved, and placed in the cooler. Filtered samples will be preserved in the field with acid to a pH of less than 2. Make sure sample bottle is labeled and the cap is on tightly. Then place in cooler with ice immediately.

— OR —

If a low flow pump is used collect the samples, filtered samples will be taken by installing a 0.45-µM filter in-line and pumping the water through the filter (note that no filter will be used when sampling for PFAS constituents). Collect sample from the end of the in-line filter directly into the proper container, preserved, and placed in the cooler. If a flow-through cell is used to measure water quality parameters, collect samples before flow-through cell. Filtered samples will be preserved in the field with acid to a pH of less than 2. Make sure sample bottle is labeled and the cap is on tightly. Then place in cooler with ice immediately.

Unfiltered samples will be collected by slowly pouring the sample water into the appropriate sample container, being careful not to agitate or cause bubbles to form. Do not overfill bottles. Make sure sample bottle is labeled and the cap is on tightly, then place the sample in cooler with ice immediately.

All samples will be delivered to the laboratory as soon as possible. If possible, samples will be shipped on the same day as they are collected. If samples must be retained due to weekend sampling (Friday through Sunday), the laboratory will be notified as to the time sensitive nature of the samples.

3.4 SAMPLING OF NON-AQUEOUS PHASE LIQUIDS

If NAPLs are detected in the well, a sample from all layers must be collected prior to any purging activities. NAPLs may be indicated by the presence of volatiles in the well headspace, and confirmed by the oil/water interface probe.

Collecting light non-aqueous phase liquid (LNAPL) will be accomplished using a transparent bailer with a double check valve. This bailer will be slowly lowered until the bottom of the bailer is 1-2 in. below the LNAPL-water interface, then slowly withdrawn. Verify that the interface was sampled by visual inspection of the bailer contents through the side of the bailer. Measure the thickness of the LNAPL in the bailer and note in the Field Logbook. Sample for laboratory analysis. An additional field verification may be performed by decanting the remainder of the contents of the bailer into a glass jar, adding a hydrophobic dye such as Sudan IV, or Redoil, shaking the sample and looking for coloration of NAPL. Alternate field tests are: examine the sample under ultraviolet light (many fluoresce), or allow the sample to stand overnight, and examine for interface and/or volatiles in the headspace the following day. Refer to the following sections on purging and sample collection for setup and general operation.

Collecting dense non-aqueous phase liquids (DNAPLs) will be accomplished using a transparent bailer with a double check valve. The bailer must be lowered very slowly to the bottom of the well and raised slowly out of the well in a controlled fashion. Sample for analysis as above. The same field check described above may be employed for DNAPL. Refer to the following sections on purging and sample collection for set up and general operation.

If NAPLs are present in the well, **and** a low-flow pump is to be used for purging and sampling, the well will be allowed to re-equilibrate prior to purging and sampling. This will be accomplished by allowing the well to stand undisturbed for at least 8 hours prior to purging and sample collection.

3.5 WELL PURGING GENERAL RULES

Water within the casing of a well will stagnate, de-gas, lose volatiles, possibly precipitate metals due to changes in redox potential, and may react with the screen and/or casing material. It is, therefore, necessary to purge a sufficient volume of this stagnant water from the well and/or casing to ensure that a representative sample of formation water can be obtained. Traditionally, the volume of water to be purged was arbitrarily set at 3-5 equivalent volumes. Recent advances in sampling technologies have caused a re-thinking of such arbitrary purge volumes. It is, for this reason, that monitoring of select chemical and physical properties of the sample medium will be used instead of strict volumes to determine when a representative sample may be taken from a well.

Acceptable purge/sampling devices include: bailers, high-discharge submersible pumps (purge only), and variable speed, low-flow pumps that include both submersible pumps (purge and sample) and dedicated bladder pumps (purge and sampling). It is recommended to purge and sample at similar rates with one type device per well. An acceptable exception to this general rule is to use a high-discharge submersible pump to purge a deep, fast-recharging well, and a bailer to sample the same well.

Peristaltic, gas-lift, and centrifugal pumps can cause volatilization, produce high pressure differentials, and result in variability in the analysis of some analytes of interest. For this reason, these pumps should be used with caution and flow rate slowed to minimize volatilization.

To prevent groundwater from cascading down the sides of the screen into an open hole, thereby aerating the sample, purge rates will closely match recharge rates. If the static water level is within the casing, the initial purge rates may be set high enough to lower the water level to the top of the screen, then reduced to maintain that level and identify the well's recharge rate.

Purging will be accomplished with either a submersible pump, a low-flow (submersible or bladder) pump, or bailer. The choice of bailer or pump will be based on depth to water table, volume to be purged, and permeability of the aquifer. If the well recharges rapidly and/or has greater than 20 gal (estimated EV) to be purged, water may be removed with a submersible pump or a low-flow pump. If the well recharges slowly and/or has less than 20 gal to be purged, water will be removed with a bailer or a low-flow pump.

Purging will be accomplished with as minimal disturbance to the surrounding formation as possible.

Purge water will be containerized onsite until analysis of samples is completed. Based on sample results, accumulated purge water will be properly disposed of.

If the water level is within the screened interval and the well recharge rate is less than 0.1 L/minute, purge the well using a low-flow pump as follows:

1. Draw the water down to within 1 ft of the top of the pump.

2. Allow the well to recover.

3. Check and record field parameters.

4. Repeat Steps 1 through 3 then collect samples for metals analysis only[4].

5. Note the event in the Field Logbook, and report the problem to the Project Manager. If this extremely low recharge problem consistently occurs in a given well, the well may be considered for re-development and/or replacement.

6. If adjacent wells have elevated VOC levels, additional soil gas surveys will be considered in the vicinity of the low recharge well to help determine the need for replacement.

3.6 PURGING AND SAMPLING WITH BAILERS

Bailers may be used for both purging and sampling wells if: (1) the well recharge rate is less than 4 L/minute, (2) depth to the water table is less than 50 ft, and (4) less than 20 gal are to be purged (5 EV < 20 gal)[5].

When purging with a bailer, either a polyvinyl chloride, PFAS-comptabiel, or stainless steel bailer may be used. The bailer will be attached to either a spool of stainless steel cable or polypropylene rope. If using cable, attach it to the bailer using stainless steel cable clamps. Thoroughly decontaminate the cable after each use, prior to rewinding cable onto spool. Cable clamps and raw cable ends may serve to trap contamination. Exercise particular caution in decontaminating these areas. If using rope, attach the rope to the bailer using a bowline knot, dispense the needed length (a few feet more than the well depth), and cut the remainder away; then, at the end opposite the bailer, make a slip knot and place it around the well casing or protective posts to prevent losing the bailer and rope down the well. The polypropylene rope will be not reused; it will be properly disposed of. Either type of bailer will be repeatedly lowered gently into the well until it fills with water, is removed, and the water discharged into an appropriate container until purging is complete. Care must be taken not to unduly agitate the water, as this tends to aerate the sample, increase turbidity, makes stabilization of required parameters difficult to achieve, and generally prolongs purging.

After purging 2 EV, obtain a sample of groundwater and measure the following stabilization parameters: temperature, conductivity, pH, turbidity, redox potential (Eh), and dissolved oxygen level at each successive half-well volume. When three of these stabilization parameters are in agreement within approximately 10 percent in three consecutive half-well volume samples,

4. Analyte losses due to volatilization in a drained well are too high for valid VOC sampling (McAlary and Barker 1987).
5. These numbers are based on the following assumptions: (1) In purging, it is preferable to remove water at approximately the recharge rate; (2) 4 L/minute is estimated as the approximate maximum rate at which water can be removed with a bailer from depths of 20-50 ft; and (3) 20 gal is estimated to be at the limit of the sampler's endurance, at which point fatigue and sloppiness of technique begin.

sufficient water has been purged from the well. The results of these tests should be recorded in the sampling logbook. Should these parameters not reach agreement, no more than five well volumes will be purged.

Immediately upon completion of purging, collect samples for laboratory analysis using a PTFE bailer on a PTFE-coated stainless steel cable. The bailer will be equipped with double check valve top and controlled flow bottom discharge attachments for VOC sampling (40-mL vials), and top discharge attachment for collecting larger samples (1-L bottles).

Slowly, so as not to agitate the water, lower the bailer into the well, using a spool of PTFE-coated cable. Allow bailer to fill, withdraw smoothly. Refill bailer as needed.

If the controlled flow bottom discharge attachment is used for VOC sampling, attach it to the bottom of the bailer. Using the stopcock valve on the bailer to control the flow, and fill sample vials as described above in Section 3.3.

Remove check valve top and pour unfiltered sample into inorganics sample bottles.

Collect filtered samples as described in Section 3.3. Decontaminate bailer and cable.

3.7 PURGING WITH PUMP, SAMPLING WITH BAILER

If the recharge rate of the well is greater than 30 L/minute, or the water level is deeper than 50 ft, or more than 20 gal of purge water will be generated (5 EV > 20 gal), then purging and sampling may be accomplished using a submersible pump/bailer combination.

When purging with a pump, gradually lower the intake until it is submerged within the screened interval. Lower an electronic water level probe to the top of the screen (as determined from completion records) to the monitor water level, start pump, and slowly lower the pump as the water level continues to fall. Care should be exercised to lower the water column to the top of the screened interval (water level probe will stop beeping) but not below the top of the screen if possible. This will ensure that the stagnant layer has been removed, but should minimize the detrimental effects of over pumping the well. Secure hose(s) and/or power cord to casing and place discharge hose into the proper container, downhill and as far away from the well as possible. Determine and record the discharge rate.

Discharge rate = volume of container/time to fill container

The discharge rate will be established at approximately equal to or just greater than the well's recharge rate (determined from well development). If well development records are incomplete, recharge rate can be determined by monitoring the rise/fall of the water level within the casing as one purges the well. If the water level is static at a given pumping rate, but fluctuates up or down as pumping rate is decreased or increased, the pumping rate at which the water level is static is the recharge rate.

After purging 2 EV, obtain a sample of groundwater and measure the following stabilization parameters: temperature, conductivity, pH, turbidity, redox potential (Eh), and dissolved oxygen level at each successive half-well volume. When three of these stabilization parameters are in agreement within approximately 10 percent in three consecutive half-well volume samples, sufficient water has been purged from the well. The results of these tests should be recorded in the sampling logbook. Should these parameters not reach agreement, no more than five well volumes will be purged.

Immediately upon completion of purging, collect samples for laboratory analysis using a PTFE bailer on a PTFE-coated stainless steel cable. The bailer will be equipped with a double check valve top and controlled flow bottom discharge attachments for VOC sampling (40-mL vials), and top discharge attachment for collecting larger samples (1-L bottles). Filtration of metals samples will be accomplished using either an in-line filter attached to the bottom of the bailer, or a funnel and appropriate filter (Section 3.3).

Slowly, so as not to agitate the water, lower the bailer into the well, using a spool of PTFE-coated cable. Allow bailer to fill, withdraw smoothly, and fill sample containers as described in Section 3.6. Decontaminate bailer and cable in and decontaminate pump.

3.8 PURGING AND SAMPLING WITH LOW-FLOW PUMP

To obtain representative samples, subsurface disturbances should be kept to a minimum, thereby preventing sample alteration due to sampling actions. The reasoning behind the use of low-flow pumps to purge and sample monitoring wells is that these pumps minimize physical disturbance (turbulence) at the sampling point and chemical changes (aeration) in the medium. For these reasons, the low-flow pump is the preferred method for both purging and sampling in most cases. For the purposes of this SOP, "low-flow pumps" are defined as either dedicated bladder pumps or variable speed submersible pumps. Practical operational flow rates for these sampling devices range from 0.1 to 30 L/minute.

Low-flow pumps may be used for purging and sampling any well having recharge greater than 0.1 L/minute, which is the practical lower limit of pump performance. Below that pumping rate, pump inefficiencies and/or overheating may alter the physical and chemical properties of the sample. If the pump is continuously operated at sampling rates higher than the well recharge rate, the water level will be lowered in the well, possibly allowing aeration of the sample that is unacceptable sampling procedure. Low-flow pumps are suitable for sampling wells with recharge rates lower than 0.1 L/minute if precautions are taken to avoid aeration of the sample.

Low flow submersible pumps will be used as follows:

- Lower the pump into the well, slowly so as not to agitate the water, until the pump is at the mid-point of the screened interval or the mid-point of the water column if the static water table lies below the top of the screen.[6]

- Attach the pump's umbilical cord (which will consist of power cord and sampling tubing) to the protective casing, or lock the cord spool so that the pump cannot move vertically in the well during sampling.

- Lower the water level probe into the well behind the pump until it just touches water. This will allow the sampler to monitor the water level while purging and sampling, and prevent the inadvertent drying of the well.

- Begin purging at the pump's lowest setting, then gradually increase rate[7] until the pumping rate matches the aquifer recharge rate. **If the water level is above the top of the screen**, the pumping rate may be allowed to slightly exceed recharge rate, lowering the water level to no less than 1 ft above the screen, then reduced until it matches recharge rate and purging continued. **If the water level is below the top of the screen**, always keep the purge rate lower than well's recharge rate.

- Monitor stabilization parameters listed in Section 3.6 beginning immediately, using an in-line monitoring system. Record parameters regularly, at a rate of one set of parameters per each 1-3 liters of water removed from the well. When these parameters stabilize to within 10 percent over three consecutive readings, reduce[8] flow rate to 0.1 L/minute (if needed) and begin collecting VOC samples directly from the discharge line.

- If the well recharges at a rate less than 0.1 L/minute, purge until the water level is even with the top of the screen, allow the well to recover, and sample immediately.

- Remove and decontaminate water level probe and pump.

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6. This assumes a 10-ft screened interval. If the screened interval is greater than 10 ft, multiple samples should be taken as follows (if prescribed in the planning documents):
   - If the screen is 10-12 ft, sample the canter of the water column, as outlined above.
   - If the screen is longer than 12 ft, and the water column is 10 ft or less, sample the center of the water column.
   - If the screen is longer than 12 ft, and the water column fills the screen, or extends above the screen, sample at 1/3 and 2/3 the height of the water column, or about every 6 ft.
7. Some sources indicate that the pumping rate should not exceed 1 L/minute, with 0.5 L/minute being preferable. The optimal purge rate is highly aquifer dependent and may range from less than 0.5 L/minute to greater than 10 L/minute. The purge rate for a given well will, therefore, be a field decision, based on well development, purge, and sampling records rather than SOP mandate.
8. Sampling should occur at the same rate as purging as long as aeration of sample does not occur.

4. MAINTENANCE

Refer to manufacturer's requirements for maintenance of pumps and generators.

5. PRECAUTIONS

Refer to the site-specific Health and Safety Plan for appropriate personal protective equipment.

6. REFERENCES

McAlary, T.A. and J.F. Barker. 1987. Volatilization Losses of Organics During Groundwater Sampling From Low Permeability Materials, in Groundwater Monitoring Review. Fall.

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6332106 Standard Operating Procedure No. 016
for
Field Logbooks and Surface Water, Groundwater, and Soil/Sediment Field Checklists

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Revision 1
August 2021

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CONTENTS

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1. SCOPE AND APPLICATION

The purpose of this Standard Operating Procedure (SOP) is to delineate protocols for completion of field logbooks and completion of field forms used to record surface water, groundwater, soil/sediment sampling information, instrument calibration data, and data from hydrologic testing. Acceptable field logbooks are bound, unprinted books such as a surveyor's field logbook, or a Federal Supply Service Number (No.) 7530-00-222-3525 record book (or equivalent); or they may be company-proprietary, pre-printed forms bound into a field logbook. When sampling for PFAS constituents, non-waterproof materials should be used such as loose-leaf paper. Example forms are provided herein. Alternate, equivalent forms are acceptable.

2. MATERIALS

The following material may be required: field logbook, indelible ink pen, and field checklists documented in Sections 3.1 through 3.7.

3. PROCEDURE

All information pertinent to a field survey or sampling effort will be recorded in a bound logbook. Each page/form will be consecutively numbered, dated, and signed. All entries will be made in indelible ink, and all corrections will consist of line-out deletions that are initialed and dated. The person making the correction will provide a brief explanation for the change. Entries are factual only. No personal opinions should be entered.

There should be no blank lines on a page. A single blank line or a partial blank line (i.e., at the end of a paragraph) should be lined to the end of the page. If only part of a page is used, the remainder of the page should have an "X" drawn across it. The bottom of each page must be signed and dated by the field personnel entering the information.

At a minimum, entries in the field logbook will include but not be limited to the following:

- Date.
- Project number and project name.
- Name and address of field contact.
- Identification of sample crew members.
- Documentation should include model numbers of equipment used (e.g., data loggers, drilling rigs) and calibration (if applicable). Each day's entry should begin with time onsite, who is onsite (including observers other than the sampling crew), brief description of what work will be performed that day and how, and the weather.

- If samples are being taken in or near tidal waters, the time of high and low tide for the site should be determined from local gauges or tables and recorded.

- References such as maps of the sampling site.

- Times of key daily milestones should be entered (e.g., time borings began, times personnel arrived and left site, times subcontractors arrived and left site, etc.). Time should be recorded in the left-hand margin on the page in military time.

- Sample-specific information:

  — Unique, sequential field sample number

  — Purpose of sampling

  — Location, description, and log of photographs of each sampling point

  — Details of the sample site (e.g., elevation of the casing, casing diameter and depth, integrity of the casing, etc.)

  — Documentation of procedures for preparation of reagents or supplies that become an integral part of the sample (e.g., filters and absorbing reagents)

  — Type of media of sample (e.g., groundwater, surface water, soil, sediment, and product)

  — Suspected waste composition

  — Number and volume of sample taken

  — Sampling methodology, including distinction between grab and composite sample

  — Sample preservation

  — Date and time of collection

  — Collector's sample identification number(s)

  — Sample shipment (e.g., name of the laboratory and cartage agent: Federal Express, United Parcel Service, etc.)

  — Field observations (e.g., oily sheen on groundwater sample, incidental odors, soil color, grain size, plasticity, moisture content, layering, Unified Soil Classification System classification, etc.)

— Any field measurements made (e.g., pH, conductivity, explosivity, water depth, organic vapor analyzer readings, etc.)

— Signature and date by the personnel responsible for observations

— Decontamination procedures.

Sampling situations vary widely. No general rules can specify the extent of information that must be entered in a field logbook. However, records should contain sufficient information so that someone can reconstruct the sampling activity without relying on the sampler's memory. Further, the project work plan or field sampling plan should be reviewed to identify additional specific information or requirements that should be included in the field logbook.

The Project Manager will keep a master list of all field logbooks assigned to the Sampling Team Leaders. One field logbook kept by the Project Manager will be a master site log of daily activities and will contain the list of field logbooks assigned to Sampling Team Leaders.

Project name and number should be clearly marked on the outside cover using indelible ink. If more than one field logbook exists for the project, then the number of the field logbook should also be clearly marked on the outside cover.

Field checklists associated with the collection of soil, sediment, surface water, and groundwater are shown in Figures SOP016-1 through SOP016-9 and described in Sections 3.1 through 3.7. The details described above for completion of the field logbook should be completed even though these field checklists have been completed, and the field checklists noted in the field logbook. While the importance of the use of field logbooks is emphasized in this SOP, it is acknowledged that alternate documentation approaches may be necessary (e.g., higher reliance on documentation forms, use of electronic tablets) for a variety of client and project-specific reasons. It is essential the team establish clear expectations for the use of field logbooks during project planning and document any differences from this SOP in the project-specific variance form.

3.1 SOIL/SEDIMENT FIELD CHECKLISTS (REQUIRES FIGURES PFAS SOP016-1 AND PFAS SOP016-3)

3.1.1 Field Parameter Form (Items on Figures PFAS SOP016-1 and PFAS SOP016-2)

1. HIGH CONCENTRATION EXPECTED?: Answer "Yes" or "No."

2. HIGH HAZARD?: Answer "Yes" or "No."

3. SITE: Record the complete name of the site.

4. AREA: Record the area designation of the sample site.

5. INST CODE: Record the 2-letter installation code appropriate for the installation or site. Correct abbreviations can be found on Pages 3-6 of the Installation Restoration Data Management System (IRDMS) User's Guide for chemical data entry.

6. FILE NAME: Record "CSO" for a soil sample or "CSE" for a sediment sample.

7. SITE TYPE: Record the abbreviation appropriate for where the sample was taken. Correct abbreviations can be found on Pages 18-21 of the IRDMS User's Guide for chemical data entry. This entry must match the Site Type on the map file form.

8. SITE ID: Record a code up to 10 characters or numbers that is unique to the site.

9. FIELD SAMPLE NUMBER: Record a code specific for the sample.

10. DATE: Enter the date the sample was taken.

11. TIME: Enter the time (12-hour or 24-hour clock acceptable as long as internally consistent) the sample was taken.

12. AM PM: Circle "AM" or "PM" to designate morning or afternoon (12-hour clock).

13. SAMPLE PROG: Record "GQA" (Groundwater Quality Assessment) or other appropriate sample program.

14. DEPTH (TOP): Record the total depth sampled.

15. DEPTH INTERVAL: Record the intervals at which the plug will be sampled.

16. UNITS: Record the units of depth (feet, meters)

17. SAMPLE MEASUREMENTS: Check the appropriate sampling method.

18. CHK: Check off each container released to a laboratory.

19. ANALYSIS: Record the type of analysis to be performed on each sample container.

20. SAMPLE CONTAINER: Record the sample container type and size.

21. NO.: Record the number of containers.

22. REMARKS: Record any remarks about the sample

23. TOTAL NUMBER OF CONTAINERS FOR SAMPLE: Record the total number of containers.

24. SITE DESCRIPTION: Describe the location where the sample was collected.

25. SAMPLE FORM: Record the form of the sample (i.e., clay, loam, etc.) using The Unified Soil Classification System.

26. COLOR: Record the color of the sample as determined from standard Munsell Color Charts.

27. ODOR: Record the odor of the sample or "none." See SOP No. 001 Section 5.

28. PID (HNu): Record the measured photoionization detector (PID) (HNu) values.

29. UNUSUAL FEATURES: Record anything unusual about the site or sample.

30. WEATHER/TEMPERATURE: Record the weather and temperature.

31. SAMPLER: Record your name.

3.1.2 Map File Form (Figure PFAS SOP016-3)

1. The map file logbook form will be located on the reverse of the field parameter logbook form, or on an adjoining page of the field logbook (if level book is used).

2. SITE ID: Record the Site ID from the field parameter form.

3. POINTER: Record the field sample number for the sample being pointed to.

4. DESCRIPTION/MEASUREMENTS: Describe the location where the sample was taken, along with distances to landmarks.

5. SKETCH/DIMENSIONS: Diagram the surroundings and record the distances to landmarks.

6. MAP REFERENCE: Record which U.S. Geological Survey Quad Map references the site.

7. COORDINATE DEFINITION: Write the compass directions the X- and Y-Coordinates of the map run.

8. COORDINATE SYSTEM: Write "UTM" (Universal Transverse Mercator).

9. SOURCE: Record the 1-digit code representing the Map Reference.

10. ACCURACY: Give units (e.g., write "1-M" for 1 meter).

11. X-COORDINATE: Record the X-Coordinate of the sample site location.

12. Y-COORDINATE: Record the Y-Coordinate of the sample site location.

13. UNITS: Record the unit's map sections are measured in.

14. ELEVATION REFERENCE: Record whether topography was determined from a map or a topographical survey.

15. ELEVATION SOURCE: Record the 1-digit code representing the elevation reference.

16. ACCURACY: Record the accuracy of the map or survey providing the topographical information.

17. ELEVATION: Record the elevation of the sampling site.

18. UNITS: Write the units in which the elevation is recorded.

19. SAMPLER: Write your name.

3.2 SURFACE WATER FIELD CHECKLISTS (REQUIRES FIGURES PFAS SOP016-2 AND PFAS SOP016-3)

3.2.1 Field Parameter Form (Items Unique to Figure SOP016-3)

1. CAL REF: Record the calibration reference for the pH meter.

2. pH: Record the pH of the sample.

3. TEMP: Record the temperature of the sample in degrees Celsius.

4. COND: Record the conductivity of the water.

5. For all other sections, see Section 3.2.1.

3.3 GROUNDWATER SAMPLING FIELD CHECKLISTS (REQUIRES FIGURES PFAS SOP016-2, PFAS SOP016-3, AND PFAS SOP016-4)

3.3.1 Field Parameter Form (Items on Figure PFAS SOP016-4)

1. WELL NO. OR ID: Record the abbreviation appropriate for where the sample was taken. Correct abbreviations can be found on Pages 18-21 of the IRDMS User's Guide for chemical data entry.

2. SAMPLE NO.: Record the reference number of the sample.

3. WELL/SITE DESCRIPTION: Describe the location where the sample was taken, along with distances to landmarks.

4. X-COORD and Y-COORD: Record the survey coordinates for the sampling site.

5. ELEV: Record the elevation where the sample was taken.

6. UNITS: Record the units the elevation was recorded in.

7. DATE: Record the date in the form MM/DD/YY.

8. TIME: Record the time, including a designation of AM or PM.

9. AIR TEMP.: Record the air temperature, including a designation of C or F (Celsius or Fahrenheit).

10. WELL DEPTH: Record the depth of the well in feet and inches.

11. CASING HT.: Record the height of the casing in feet and inches.

12. WATER DEPTH: Record the depth (underground) of the water in feet and inches.

13. WELL DIAMETER: Record the diameter of the well in inches.

14. WATER COLUMN HEIGHT: Record the height of the water column in feet and inches.

15. SANDPACK DIAM.: Record the diameter of the sandpack. Generally, this will be the same as the bore diameter.

16. EQUIVALENT VOLUME OF STANDING WATER: Use one of the following equations, to determine one equivalent volume (EV):

    1 EV = Volume in casing + volume in saturated sand pack. Or to restate:

    $$1 \text{ EV} = (BR_w^2 h_w + 0.30B(R_s^2 - R_w^2)h_s) * (0.0043)$$

    where

    R_s = Radius of sandpack in inches
    R_w = Radius of well casing in inches
    h_s = Height of sandpack in inches
    h_w = Water depth in inches

    0.0043 = gal/in.^{3}
    and filter pack porosity is assumed as 30 percent

— OR —

Volume in casing = (0.0043 gal/in.^{3})(B)(12 in./ft)(R_c^2)(W_h)

where

R_c = Radius of casing in inches
W_h = Water column height in feet

Vol. in sandpack = (0.0043 gal/in.^{3})(B)(12 in./ft)(R_b^2 - R_c^2)(W_h)(0.30)

(if W_h is less than the length of the sandpack),

— PLUS —

Vol. in sandpack = (0.0043 gal/in.^{3})(B)(12 in./ft)(R_b^2 - R_c^2)(S_h)(0.30)

(if W_h is greater than the length of the sandpack).

where

R_b = Radius of the borehole
S_h = Length of the sandpack.

Show this calculation in the comments section.

17. VOLUME OF BAILER OR PUMP RATE: Record bailer volume or pump rate.

18. TOTAL NUMBER OF BAILERS OR PUMP TIME: Record the number of bailers required to remove 3 equivalent volumes (EV) of water from the well or the total purge time and volume as applicable.

19. WELL WENT DRY? Write “YES” OR “NO.”

20. NUMBER OF BAILERS OR PUMP TIME: Record the number of bailers or pump time which made the well go dry.

21. VOLUME REMOVED: Record the volume of water (gal) removed before the well went dry.

22. RECOVERY TIME: Record the time required for the well to refill.

23. PURGE AGAIN?: Answer “YES” or “NO.”

24. TOTAL VOL. REMOVED: Record the total volume of water (in gal) removed from the well.

25. CAL REF.: Record the calibration reference for the pH meter.

26. TIME: Record time started (INITIAL T[0]), 2 times DURING the sampling and the time sampling ended (FINAL).

27. pH: Record the pH at start of sampling (INITIAL), twice DURING the sampling and at the end of sampling (FINAL).

28. TEMP: Record the water temperature (Celsius) at the start of sampling, twice DURING the sampling, and at the end of sampling (FINAL).

29. COND: Record the conductivity of the water at the start of sampling, twice DURING the sampling, and at the end of sampling (FINAL).

30. D.O.: Record the dissolved oxygen level in the water at the start of sampling, twice DURING the sampling, and at the end of sampling (FINAL).

31. TURBIDITY: Record the readings from the turbidity meter (nephelometer) and units at the start of sampling, twice DURING the sampling, and at the end of sampling (FINAL).

32. ORD: Record the oxidation/reduction (RedOx) potential of the water sample at the start of sampling, twice DURING the sampling, and at the end of sampling (FINAL).

33. HEAD SPACE: Record any positive readings from organic vapor meter reading taken in well headspace prior to sampling.

34. NAPL: Record the presence and thickness of any non-aqueous phase liquids (light or dense)

35. COMMENTS: Record any pertinent information not already covered in the form.

36. SIGNATURE: Sign the form.

3.4 FIELD CALIBRATION FORMS (MAINTAINED AS A SEPARATE LOGBOOK, OR INCORPORATED INTO SAMPLING LOGBOOKS)

3.4.1 Items on Figure PFAS SOP016-5

1. Record time and date of calibration. Note whether 12- or 24-hour clock was used.

2. Record calibration standard reference number.

3. Record meter I.D. number

4. Record initial instrument reading, recalibration reading (if necessary), and final calibration reading on appropriate line.

5. Record value of reference standard (as required).

6. COMMENTS: Record any pertinent information not already covered on form.

7. SIGNATURE: Sign form.

3.5 GROUNDWATER HYDROLOGY TESTS CHECKLISTS (MUST INCLUDE FIGURES PFAS SOP016-6 AND PFAS SOP016-7 AND/OR PFAS SOP016-8 OR PFAS SOP016-9)

3.5.1 Field Permeability Test Data Sheet (Items on Figures PFAS SOP016-6)

1. CONTRACTOR: Organization performing the test.

2. SEQ. #: Enter page number of this set of forms (page # of #).

3. PROJECT NAME: Record the name assigned by the contractor's organization to the project.

4. PROJECT NO.: Record the contractor assigned project number or the contract number.

5. LOCATION: Specific location

6. CLIENT: Agency or company with the contract under which the work is being performed.

7. FIELD PARTY CHIEF: Printed name of the person responsible for this particular field test.

8. WELL #: Record the well number as it appears on the well completion tag, affixed to the protector casing or well completion records.

9. TEST TYPE: Short description of the type of test to be performed.

10. RISING/FALLING HEAD WITH SLUG: Check if the test involved the insertion/removal of and inert object.

11. RISING/FALLING HEAD WITHOUT SLUG: Check if the test involved the addition/removal of a quantity of water.

12. START DATE: Date on which the test was begun.

13. CLOCK TIME: Time each datum (depth to groundwater level) is collected. Note whether 12- or 24-hour clock was used.

14. ELAPSED TIME: Time since the last datum was collected.

15. DEPTH TO GWL (ft): Depth to the top of the groundwater table (Groundwater Level) as measured by manual methods.

16. REC. (ft): Water level as reported by transducer/datalogger (this is the depth of water above the transducer.

17. TIME: Time the discharge rate check was begun (addition or removal of water method). Note whether 12- or 24-hour clock was used.

18. FLOW METER (Addition or removal of water method): The amount of water added or removed as registered by the flowmeter, in gal of liters.

19. DISCHARGE RATE: Flowmeter reading divided by time interval (gal/min or liters/min).

20. SIGNATURE: The person completing this form must sign the form at the end of the test.

21. DATE: Date the form was signed.

3.5.2 Groundwater Levels – Single Well (Items on Figure PFAS SOP016-7)

1. CONTRACTOR: Organization performing the test.

2. SEQ. #: Enter page number of this set of forms (page # of #).

3. PROJECT NO.: Record the contractor assigned project number or the contract number.

4. WELL #: Record the well number as it appears on the well completion tag, affixed to the protector casing or well completion records.

5. PROJECT NAME: Record the name assigned by the contractor's organization to the project.

6. LOCATION: Specific location.

7. FIELD PARTY CHIEF: Printed name of the person responsible for this particular field test.

8. CLIENT: Agency with the contract under which the work is being performed.

Well Data

9. STICKUP: Enter the length of well casing extending above the average ground surface at the base of the protective casing.

10. MEASURED UP(+)/DOWN(-) FROM: Describe the starting point for the previous measurement.

11. MP ELEVATION: Enter the elevation of the measuring point here. NOTE: This datum may require reference to tables and/or maps and may be added after completing the day's fieldwork.

12. DATUM = MSL OR: Is the datum for the previous elevation Mean Sea Level? If not, what? Also tell whether it was derived from a map elevation (write "MAP") or survey data (write "SURVEY").

13. MEASURING POINT DESCRIPTION: Describe the point used as the origin for all down-hole (water table) measurements. NOTE: Remedial investigation wells are required to have a permanently marked reference (measuring) point (refer to SOP No. 019).

14. REMARKS: Record any pertinent observations about the site/well conditions not specifically required in the preceding.

15. DATE: Date of each water level reading

16. TIME: Time of each water level reading. Note whether 12- or 24-hour clock was used.

17. ELAPSED TIME: Time since test was begun.

18. DEPTH TO WATER: Measured depth to the groundwater table.

19. WATER ELEVATION: Elevation of the top of the groundwater table (use datum listed above).

20. MEAS. METH.: Method used to measure the water level in the well (see abbreviation key at the bottom of the data sheet).

21. TAPE NO.: The unique identification number of the traceable standard tape used to calibrate the measuring device.

22. WELL STATUS: Condition of the well at the time of measuring (see abbreviation key at the bottom of the data sheet).

23. REMARKS: Any additional pertinent comments not specifically required above.

24. INITIALS: Initials of person completing this data entry.

25. ABBREVIATION KEYS: Self-explanatory.

26. SIGNATURE: The person completing this form must sign the form at the end of the test.

27. DATE: Date the form was signed.

3.5.3 Groundwater Levels – Single Well (Items on Figure PFAS SOP016-8)

1. CONTRACTOR: Organization performing the test.

2. SEQ. #: Enter page number of this set of forms (page # of #).

3. PROJECT NO.: Record the contractor assigned project number or the contract number.

4. WELL #: Record the well number as it appears on the well completion tag, affixed to the protector casing or well completion records.

5. PROJECT NAME: Record the name assigned by the contractor's organization to the project.

6. LOCATION: Specific location.

7. FIELD PARTY CHIEF: Printed name of the person responsible for this particular field test.

8. CLIENT: Agency with the contract under which the work is being performed.

Well Data

9. STICKUP: Enter the length of well casing extending above the average ground surface at the base of the protective casing.

10. MEASURED UP(+)/DOWN(-) FROM: Describe the starting point for the previous measurement.

11. MP ELEVATION: Enter the elevation of the measuring point here. NOTE: This datum may require reference to tables and/or maps and may be added after completing the day's fieldwork.

12. DATUM = MSL OR: Is the datum for the previous elevation Mean Sea Level? If not, what? Also tell whether it was derived from a map elevation (write "MAP") or survey data (write "SURVEY").

13. MEASURING POINT DESCRIPTION: Describe the point used as the origin for all down-hole (water table) measurements. NOTE: All Rhode Island wells are required to have a permanently marked reference (measuring) point (refer to SOP No. 019).

14. REMARKS: Record any pertinent observations about the site/well conditions not specifically required in the preceding.

15. DATALOGGER: This section is record of pertinent datalogger information.

16. MANUFACTURER: Record the manufacturer/brand name as stated on the datalogger.

17. MODEL: Enter the model number of the datalogger.

18. S/N: Enter the serial number of this datalogger.

19. TAG PROGRAMMED IN LOGGER: What is the identifier used in the datalogger's program to indicate that this unit was used to record a given data set?

20. TRANSDUCER: This section is a listing of pertinent information about the transducer used.

21. MANUFACTURER: Record the manufacturer/brand name as stated on the transducer.

22. MODEL: Enter the model number of the transducer.

23. S/N: Enter the serial number of this transducer.

24. INPUT/UNITS: What are the units this transducer uses?

25. RANGE: Record the pressure or depth range over which this transducer is certified.

Calibration

26. PRESSURE RATING: This is taken from the manufacturer's specifications for a given transducer. (Usually in psi, or kpa).

27. "SUBMERGENCE = ___ (V) / (MV)": Record the voltage returned by the transducer at a given depth of submergence. Indicate whether the reading is in volts (v), or millivolts (mv).

28. VOLUME WATER ADDED/REMOVED: (Applicable if inert object insertion/removal method was not employed.) Record the volume of water added to or removed from the well.

29. DISCHARGE RATE: If z (above) is filled, enter the rate at which this water was added or removed.

30. INITIAL WATER LEVEL (ft): Enter the water level in the well at the beginning of the test.

31. PRESSURE TRANSDUCER SUBMERGENCE: Record the depth to which the transducer is submerged at the beginning of the test and the depth to the transducer at the end if the test. All depths will be recorded to the nearest 0.01 ft.

32. TIME: Record the time the test is begun and ended. Note whether 12- or 24-hour clock was used.

33. OBSERVED CHANGES IN ADJACENT WELLS: Note any changes in water levels in nearby wells.

34. RESULTS RECORDED ON DISKETTE #: Tracking number of the diskette on which these data are archived.

35. DISKETTE FILE NAME: Name of the file(s).

36. SIGNATURE: The person completing this form must sign the form at the end of the test

37. DATE: Date the form was signed.

3.6 GROUNDWATER LEVELS – MULTIPLE WELLS (ITEMS ON FIGURE PFAS SOP016-9)

1. CONTRACTOR: Organization performing the test.

2. SEQ. #: Enter page number of this set of forms (page # of #).

3. PROJECT NO.: Record the contractor assigned project number or the contract number.

4. PROJECT NAME: Record the name assigned by the contractor's organization to the project.

5. LOCATION: Specific location.

6. FIELD PARTY CHIEF: Printed name of the person responsible for this particular field test.

7. CLIENT: Agency with the contract under which the work is being performed.

8. REMARKS: Any pertinent observations not specifically required above.

9. WELL: Record the well number as it appears on the well completion tag, affixed to the protector casing or well completion records.

10. DATE: Date this measurement was made.

11. TIME: Time this measurement was made. Note whether 12- or 24-hour clock was used.

12. DEPTH TO WATER: Depth from MP to top of groundwater table.

13. STICKUP: Enter the length of well casing extending above the average ground surface at the base of the protective casing.

14. MP ELEV.: Enter the elevation of the measuring point here. NOTE: This datum may require reference to tables and/or maps and may be added after completing the day's fieldwork.

15. MEAS. METH.: Method used to measure the water level in the well (see abbreviation key at the bottom of the data sheet).

16. REMARKS/MP: Describe the location and nature of the measuring point.

17. INITIALS: Initials of the person completing this form.

18. ABBREVIATION KEYS: Self-explanatory.

19. SIGNATURE: The person completing this form must sign the form at the end of the test.

20. DATE: Date the form was signed.

3.7 GROUNDWATER LEVELS – DATALOGGERS

1. CONTRACTOR: Organization performing the test.

2. SEQ. #: Enter page number of this set of forms (page # of #).

3. PROJECT NO.: Record the contractor assigned project number or the contract number.

4. WELL #: Record the well number as it appears on the well completion tag, affixed to the protector casing or well completion records.

5. PROJECT NAME: Record the name assigned by the contractor's organization to the project.

6. LOCATION: Specific location.

7. FIELD PARTY CHIEF: Printed name of the person responsible for this particular field test.

8. CLIENT: Agency with the contract under which the work is being performed.

Well Data

9. STICKUP: Enter the length of well casing extending above the average ground surface at the base of the protective casing.

10. MEASURED UP(+)/DOWN(-) FROM: Describe the starting point for the previous measurement.

11. MP ELEVATION: Enter the elevation of the measuring point here. NOTE: This datum may require reference to tables and/or maps and may be added after completing the day's fieldwork.

12. DATUM = MSL OR: Is the datum for the previous elevation Mean Sea Level? If not, what? Also tell whether it was derived from a map elevation (write "MAP") or survey data (write "SURVEY").

13. MEASURING POINT DESCRIPTION: Describe the point used as the origin for all down-hole (water table) measurements. NOTE: All Rhode Island wells are required to have a permanently marked reference (measuring) point (refer to SOP No. 019, Section 3.4).

14. REMARKS: Record any pertinent observations about the site/well conditions not specifically required in the preceding.

Datalogger (This section is a record of pertinent datalogger information)

15. MANUFACTURER: Record the manufacturer/brand name as stated on the datalogger.

16. MODEL: Enter the model number of the datalogger.

17. S/N: Enter the serial number of this datalogger.

18. TAG PROGRAMMED IN LOGGER: What is the identifier used in the datalogger's program to indicate that this unit was used to record a given data set?

Transducer (This section is a listing of pertinent information about the transducer used)

19. MANUFACTURER: Record the manufacturer/brand name as stated on the transducer.

20. MODEL: Enter the model number of the transducer.

21. S/N: Enter the serial number of this transducer.

22. INPUT/UNITS: What are the units this transducer uses?

23. RANGE: Record the pressure or depth range over which this transducer is certified.

Calibration

24. PRESSURE RATING: This is taken from the manufacturer's specifications for a given transducer (usually in psi, or kpa).

25. "SUBMERGENCE = ___ (V) / (MV)": Record the voltage returned by the transducer at a given depth of submergence. Indicate whether the reading is in volts (v), or millivolts (mv).

26. DATE: Date of each water level reading

27. TIME: Time of each water level reading. Note whether 12- or 24-hour clock was used.

28. LOGGING TIME INTERVAL: Time since test was begun.

29. WL FEET BELOW MP: Measured depth to the groundwater table from measuring point.

30. SUBMERGENCE: Depth of water above the transducer.

31. MEAS.METHOD: What device/method was used to measure the water level.

32. TAPE NO.: Record the tape identification number.

33. TRANSDUCER MOVED?: Was the transducer moved since the last water level reading?

34. REMARKS: Any pertinent remarks not otherwise specified.

35. INITIALS:

Data Transfer to Diskette

36. DATE: Date data were archived onto diskette.

37. TIME: Time stamp the computer assigns the data file.

38. FILE NAME: Name assigned the data file.

39. SOFTWARE USED FOR TRANSFER: Any special software, or computer operating system used to write the files to diskette. NOTE: If a "shareware" archiver which compresses files was used, and the archived file is not self-extracting, a copy of the unarchive program should be copied onto the diskette also.

40. OUTPUT FORMAT: What is the format of the output file? (DOS, UNIX, Binary, Compressed?)

41. INITIALS: Initials of the person who copied the data to diskette.

42. ABBREVIATION KEY: Self-explanatory.

4. MAINTENANCE

Not applicable.

5. PRECAUTIONS

None.

6. REFERENCES

None.

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Figures

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FIGURE PFAS SOP016-1
FIELD PARAMETER LOGBOOK
SOIL AND SEDIMENT SAMPLES

HIGH CONCENTRATION EXPECTED? HIGH HAZARD?

INSTALLATION/SITE ________________________________ AREA ___________________

INST CODE FILE NAME ____

SITE TYPE SITE ID
FIELD SAMPLE NUMBER

DATE (MM/DD/YY) / / TIME AM PM SAMPLE PROG.

DEPTH (TOP) DEPTH INTERVAL UNIT _____________

SAMPLING METHOD:

SPLIT SPOON AUGER SHELBY TUBE SCOOP OTHER

CHK	ANALYSIS	SAMPLE CONTAINER	NO.	REMARKS

TOTAL NUMBER OF CONTAINERS FOR SAMPLE

DESCRIPTION OF SITE AND SAMPLE CONDITIONS

SITE DESCRIPTION:____
SAMPLE FORM ______________________ COLOR _____________ ODOR _____________
PID (HNu) _______________________ UNUSUAL FEATURES _______________________

WEATHER/TEMPERATURE
SAMPLER

HIGH CONCENTRATION EXPECTED? HIGH HAZARD?

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FIGURE PFAS SOP016-2
FIELD PARAMETER LOGBOOK
GROUNDWATER AND SURFACE WATER SAMPLES

INSTALLATION/SITE AREA
INST CODE FILE NAME SITE TYPE
SITE ID FIELD SAMPLE NUMBER
DATE (MM/DD/YY) / / TIME AM PM SAMPLE PROG.
DEPTH (TOP) DEPTH INTERVAL UNITS

SAMPLING MEASUREMENTS
CAL REF. pH TEMPERATURE C CONDUCTIVITY OTHER

CHK	ANALYSIS	SAMPLE CONTAINER	NO.	REMARKS

TOTAL NUMBER OF CONTAINERS FOR SAMPLE

DESCRIPTION OF SITE AND SAMPLE CONDITIONS
SITE DESCRIPTION
SAMPLING METHOD
SAMPLE FORM COLOR ODOR
PID (HNu)
UNUSUAL FEATURES
WEATHER/TEMPERATURE ____________________ SAMPLER ________________

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FIGURE PFAS SOP016-3
MAP FILE LOGBOOK

SITE ID POINTER ____________________
DESCRIPTION/MEASUREMENTS
SKETCH/DIMENSIONS:

MAP REFERENCE
COORDINATE DEFINITION (X is Y is)
COORDINATE SYSTEM SOURCE ACCURACY
X-COORDINATE Y-COORDINATE UNITS
ELEVATION REFERENCE
ELEVATION SOURCE ACCURACY ELEVATION
UNITS

SAMPLER

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FIGURE PFAS SOP016-4
MAP FILE AND PURGING LOGBOOK
GROUNDWATER SAMPLES

WELL COORD. OR ID SAMPLE NO.______________
WELL/SITE
DESCRIPTION____

____
X-COORD. Y-COORD. _______________ ELEV. UNITS
DATE ____/____/____ TIME AIR TEMP.

WELL DEPTH _________ ft _________ in. CASING HT. _________ ft _______ in.
WATER DEPTH __________ ft _________ in. WELL DIAMETER __________ in.
WATER COLUMN HEIGHT _________ ft _________ in. SANDPACK DIAM. ________ in.
EQUIVALENT VOLUME OF STANDING WATER ____________ (gal) (L)
VOLUME OF BAILER ___________ (gal) (L) or PUMP RATE ___________ (gpm) (lpm)
TOTAL NO. OF BAILERS (5 EV)___________ or PUMP TIME ___________ MIN.
WELL WENT DRY? [Yes] [No] NUM. OF BAILERS ________ or PUMP TIME_______MIN
VOL. REMOVED __________ (gal) (L) RECOVERY TIME __________ MIN
PURGE AGAIN? [Yes] [No] TOTAL VOL. REMOVED __________ (gal) (L)

Date and Time	Quantity Removed	Time Required	pH	Cond	Temp	ORD	Turb	DO	Character of water (color/ clarity/odor/partic.)
(before)									
(during)									
(during)									
(during									
(after)									

COMMENTS:____
____
____
____

____
SIGNATURE

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FIGURE PFAS SOP016-5
FIELD CALIBRATION: pH, CONDUCTIVITY, TEMPERATURE, TURBIDITY, OXIDATION-REDUCTION POTENTIAL, AND DISSOLVED OXYGEN METERS

INITIAL CALIBRATION	FINAL CALIBRATION
DATE:	DATE:
TIME:	TIME:

pH METER CALIBRATION

CALIBRATION STANDARD REFERENCE NO: _______________

METER ID ______________________________

pH STANDARD	INITIAL READING	RECALIB. READING	FINAL READING
7.0			
10.0			
4.0			

CONDUCTIVITY METER CALIBRATION

CALIBRATION STANDARD REFERENCE NO: _______________

METER ID _________________

COND. STANDARD	INITIAL READING	RECALIB. READING	FINAL READING

TEMPERATURE METER CALIBRATION

METER ID ________________

TEMP. STANDARD	INITIAL READING	RECALIB. READING	FINAL READING
ICE WATER			
BOILING WATER			
OTHER			

FIGURE PFAS SOP016-5 *(continued)*

TURBIDITY METER CALIBRATION

CALIBRATION STANDARD REFERENCE NO: _______________

METER ID ________________

STANDARD	INITIAL READING	RECALIB. READING	FINAL READING

ORD METER CALIBRATION

CALIBRATION STANDARD REFERENCE NO: _______________

METER ID ________________

STANDARD	INITIAL READING	RECALIB. READING	FINAL READING

DISSOLVED OXYGEN METER CALIBRATION

CALIBRATION STANDARD REFERENCE NO: _______________

METER ID ____________________________

STANDARD	INITIAL READING	RECALIB. READING	FINAL READING

COMMENTS:____

____

____

____

____

SIGNATURE

FIGURE PFAS SOP016-6
FIELD PERMEABILITY TEST DATA SHEET

Contractor: **Seq. #** /

Project Name:				Project #:						
Location:				Client:						
Party Chief:				Contractor:						
Observation Well:										
Test Type: Rising/Falling Head w/Slug				Rising/Falling Head w/out Slug						
Start Date:								Discharge Rate		
Clock Time	**Elapsed Time (min)**	**Depth to GWL (ft)**	**Rec (ft)**	**Clock Time**	**Elapsed Time**	**Depth to GWL (ft)**	**Rec (ft)**	**Time**	**Flow Meter**	**Discharge Rate**

Signature: ________________________ **Date:** ______________

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FIGURE PFAS SOP016-7
GROUNDWATER LEVELS – SINGLE WELL

Contractor: **Seq. #** /

Project No.:
Project Name:
Field Party Chief:

WELL DATA:

Stickup: (ft)
MP Elevation:

Well No.: Site: Area:

up (+)/down (-) from: Datum = MSL or:

Measuring Point Description:

Datalogger:
Manufacturer: Model: S/N:
Tag No. Programmed in Logger:

Transducer: Manufacturer: Model: S/N:
Input/Units: Range:

Calibration:
Pressure Rating:
0 ft submergence = (v) / (mv) ft submergence = (v) / (mv)

Volume Water Added/Removed:
Discharge Rate:
Initial Water Level (ft):

Pressure Transducer Submergence
Initial (ft): Final(ft): Time:Start: End:
Observed Changes in Adjacent Wells:

Results Recorded on Diskette #:
Diskette File Name:

Signature: ____ **Date:** ______________________

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FIGURE PFAS SOP016-8
GROUNDWATER LEVELS – MULTIPLE WELLS

Contractor: **Seq. #** /

Project No.:
Project Name:
Field Party Chief:

WELL DATA:

Stickup: (ft)
MP Elevation:
Measuring Point Description:
Remarks:
Well No.:
Site: Area: up (+)/down (-) from:
Datum = MSL or:

Date	Time	Elapsed Time	Depth to Water	Water Elevation	Meas. Meth.	Tape No.	Well Status	Remarks	Initials

Measurement Method:
A = Airline
C = Chalk and tape
E = Electric tape
T = Tape with popper
X = Other (describe in remarks)

Well Status:
D = Dry
F = Flowing
P = Pumping
RP = Recently pumped
NP = Nearby well pumping
NRP = Nearby well recently
X = Obstructed

Signature: ______________________________ **Date:** ____________________

FIGURE PFAS SOP016-8 *(continued)*

Contractor: **Seq. #** /

Project No.:
Project Name: Location:
Field Party Chief: Client:

Well	Date	Time	Depth to Water	Stickup	MP Elev.	Meas. Meth.	Tape No.	Remarks/MP	Initials

Measurement Method:
A = Airline
C = Chalk and tape
E = Electric tape
T = Tape with popper
X = Other (describe in remarks)

Well Status:
D = Dry
F = Flowing
P = Pumping
RP = Recently pumped
NP = Nearby well pumping
NRP = Nearby well recently
X = Obstructed

FIGURE PFAS SOP016-9
GROUNDWATER LEVELS DATALOGGERS

Contractor
Project No.: **Well No.:**
Project Name: **Site:**
Field Party Chief: **Area:**

WELL DATA: Stickup: **(ft)** **up (+)/down (-) from:**
MP Elevation: **Datum = MSL or:**

Measuring Point Description:
Remarks:

Datalogger:
Manufacturer: Model: S/N:
Tag No. Programmed in Logger:
Transducer: Manufacturer: Model: S/N:
Input/Units: Range:
Calibration: Pressure Rating:
0 ft submergence = (v) / (mv) ft submergence = (v)

Logging	Date	Time	Logging Time Interval	WL, ft Below MP	Submergence (logger reading)	Meas. Method	Tape No.	Well Status	Transducer Moved	Remarks	Initials
Start											
Stop											
Start											
Stop											

Data Transfer to Disk

Date	Time	File Name	Software Used for Transfer	Output Format	Initials

Measurement Method:
A = Airline
C = Chalk and tape
E = Electric tape
T = Tape with popper
X = Other (describe in remarks)

Well Status:
D = Dry
F = Flowing
P = Pumping
RP = Recently
NP = Nearby well pumping
NRP = Nearby well recently pumped
X = Obstructed

Signature **Date**

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6332106 Standard Operating Procedure No. 019
for
Monitoring Well Installation

Prepared by

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Revision 1
August 2021

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CONTENTS

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1. SCOPE AND APPLICATION

The installation approach and details for monitoring wells are driven by the existing conditions at the project site and state and local regulatory requirements. The project team should carefully address these considerations as they may require some deviations for procedures described in this Standard Operating Procedure (SOP). State and local regulatory requirements supersede the guidance prescribed herein. The purpose of this SOP is to delineate the quality control measures required to ensure the accurate installation of monitoring wells. The applicable site-specific Work Plan should be consulted for specific installation instructions. The term "monitoring wells," as used herein, is defined to denote any environmental sampling well. An example Well Construction Log Form is provided in Attachment A. Alternate, equivalent forms are acceptable.

2. MATERIALS

2.1 DRILLING EQUIPMENT

The following drilling equipment may be required:

- Appropriately sized drill adequately equipped with augers, bits, drill stem, etc.
- Source of approved water
- Water level indicator
- Weighted steel tape measure
- Photoionization detector: RAE® Systems MiniRAE 3000 (or equivalent)
- Lower explosive limit – oxygen monitor
- Steel drums for intrusion-derived wastes (drill cuttings, contaminated personal protective equipment, decontamination solutions, etc.)
- Heavy plastic sheeting
- High temperature, high pressure sprayer and water obtained from approved source for decontaminating drilling equipment
- Sorbent pads and/or log.

2.2 WELL INSTALLATION MATERIALS[1]

The following well installation materials may be required:

- Well screen:[2]

  — Polyvinyl chloride (PVC): Johnson (or equivalent); PVC 0.010 slot; Schedule 40; flush-threaded (leak-proof) joints; PVC complies with ASTM International (ASTM) D2665, D1784, and F480; free of ink markings; and cleaned and prepackaged by manufacturer.

  — Stainless steel: Johnson (or equivalent); stainless steel 0.010 slot; 304 stainless steel[3]; ASTM F480 flush threads; cleaned, wrapped, and heat sealed by manufacturer.

- Riser pipe:

  — PVC: Johnson (or equivalent); STD; PVC; Schedule 40; flush-threaded (leak-proof) joints; PVC complies with ASTM, D1784, and F480; free of ink markings; and cleaned and prepackaged by manufacturer.

  — Stainless steel: Johnson (or equivalent); Schedule 5; 304 stainless steel; ASTM Type A312 material; 4-inch (in.) diameter; cleaned, wrapped, and heat sealed by manufacturer.

- Plugs/caps: Johnson (or equivalent); standard PVC or stainless steel.

- Filter pack: Morie, 100 well gravel (or equivalent). NOTE: Final gradation may vary as a function of the gradation of the formation.[2]

- Fine Silica or Ottawa sand (or equivalent).

- Bentonite seal: BAROID, bentonite pellets (3/8-in. diameter).

- Cement: Type II Portland cement (table below).

1. Technical information on all installed materials (screens, riser pipe, filter pack, bentonite, cement, etc.) and representative samples of the proposed filter pack, bentonite powder, and bentonite pellets will be supplied to the Project Manager.
2. Well screen slot size and filter pack gradation will be determined from sieve analysis of aquifer materials. Screen and casing material type will be determined based on field tests of groundwater chemistry and contaminants.
3. Unless the sum of Cl-, F-, and Br- is >1,000 parts per million (ppm), in which case Type 316 should be used.

Cement Type	Special Characteristics	Recommended Usage
I	No special properties	General use as grout mix or cement plug (if sulfates <250 ppm), surface pad.
IA	Air-entraining Type I (Note that air entrainment properties can be achieved by chemical admixtures)	Air entrainment gives cement greater freeze-thaw resistance. Recommended for surface pads.
II	Moderate sulfate resistance, low heat of hydration	General use as grout mix or cement plug where groundwater sulfate >250 ppm and <1,500 ppm, surface pad.
IIA	Air-entraining Type II	See Type IA.
III	High early strength, high heat of hydration	Elevated temperature can damage well casing and fracture grout/cement plugs. NOT RECOMMENDED.
IIIA	Air-entraining Type III	NOT RECOMMENDED.
IV	Low heat of hydration	General use as grout mix or cement plug preferred type for well abandonment to ensure intact grout/cement plug.
V	High sulfate resistance	Use when groundwater sulfate levels >1,500 ppm.
NOTE: ppm = Part per million.		

- Bentonite powder: Baroid, Aquagel Gold Seal.
- Steel protective casing: Brainard-Kilman (or equivalent) zinc-plated steel, lockable, painted.[4]
- Geotextile: Milrafi (or equivalent); GTF 130; non-woven; 4 ounces.
- Coarse (blanket) gravel: Crushed stone aggregate.
- Containers for purged water, as required.
- Submersible pump or bailer of appropriate capacity, and surge block sized to fit well.
- Hach DREL 2000 portable laboratory (or equivalent).
- Conductivity, pH, oxidation-reduction potential (ORP), turbidity, dissolved oxygen, and temperature meters.
- Water level meter or interface probe
- Protective steel covers.

4. All painted components (protector casing, steel bollards/pickets) will be painted high-visibility orange and allowed to dry completely prior to being brought onsite.

- Portland Type IA cement (see previous table) alone, or as part of concrete mix for surface pad.

- Steel posts (bollards/pickets), painted (see footnote).

2.3 DOCUMENTATION

The following documents may be required by field staff supervising the installation of monitoring wells:

- Copy of appropriate Work Plan
- Copy of approved Health and Safety Plan
- Copies of well and excavation permits
- Boring log forms
- Well completion diagram form
- Well development form.

2.4 GEOLOGIST'S PERSONAL EQUIPMENT

The following equipment may be required for the geologist:

- 10 times magnifying hand lens
- Unified Soil Classification System chart
- Munsell soil color chart
- Sieve set (Keck model SS-81 or equivalent)
- Personal protective equipment as required by the Health and Safety Plan.

3. PROCEDURE

3.1 MATERIALS APPROVAL

Water sources for drilling, grouting, sealing, filter placement, well installation, and equipment decontamination must be approved by the Project Manager prior to arrival of the drilling equipment. Information required for the water source includes: water source, manufacturer/owner, address and telephone number, type of treatment and filtration prior to tap, time of access, cost per gallon (if applicable), dates and results associated with all available chemical analyses over the past 2 years, and name and address of the analytical laboratory (if applicable).

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

Granular filter pack material must be approved by the Project Manager prior to drilling. A 1-pint representative sample must be supplied to the Project Manager. Information required includes: lithology, grain size distribution, brand name, source, processing method, and slot size of intended screen.

Screen and casing materials must be approved by the Project Manager prior to drilling. Materials for deep wells must have adequate strength to prevent collapse or damage. A collapsed well is an expensive and time-consuming mistake.

Portland Type II cement will be used for grout (see previous table).

3.2 DRILLING

The objective of the selected drilling technique is to ensure that the drilling method provides representative data while minimizing: (1) subsurface contamination, (2) cross-contamination of aquifers, and (3) drilling costs. The preferred drilling method for shallow (<100 feet [ft]) well installation is hollow-stem auger, although direct-push and sonic methods can also be considered, and other methods can be approved as conditions warrant. The method used at a specific site will be proposed in the work plan and evaluated by the Project Manager.

If the design depth of the well is >100 ft, other rotary drilling methods (mud rotary, air rotary, air rotary with downhole hammer, dual-tube reverse rotary, etc.) may be used to install wells. The following drilling fluids and methods are approved in the order listed: (1) rotary drilling with water from an approved source as drilling fluid (clays from the formations will tend to thicken the fluid and coat the walls of the borehole and this is acceptable); (2) rotary drilling with water as a fluid, advancing a temporary casing with the bit to maintain an open hole; and (3) mud rotary using water with additives as drill fluid. Due to the potential for aquifer contamination and plugging, mud rotary drilling is not recommended for monitoring wells. If, however, "running sands" are encountered and the aquifer is expected to have a relatively high flow rate, then mud rotary is considered an approved method. Pure sodium bentonite is the only approved additive. Mud rotary drilling must be halted at the last aquitard above the target aquifer. Casing must be set, all bentonite-bearing fluids flushed from the hole and drill rig, and drilling may be resumed using water only as the drill fluid until the target depth is reached. Rotary drilling with air is useful and efficient in bedrock drilling and is typically done with no additions to the air stream; however, additives (e.g., foam) can be considered if conditions warrant.

A site geologist will be present during all well drilling and installation activities and will fully characterize all tasks performed in support of these activities into the monitoring well logbook. The site geologist will be responsible at only one operating rig for: (1) logging of samples, (2) monitoring of drilling operations, (3) recording of water losses/gains and groundwater data, (4) preparing the boring logs and well diagrams, and (5) recording the well installation procedures of the rig. The site geologist will have onsite sufficient equipment in operable condition to perform efficiently his/her duties as outlined in the contractual documents. Items in the possession of each site geologist will include: (1) the approved Health and Safety Plan; (2) this SOP; (3) a hand lens (10 times); (4) a standard color chart; (5) grain-size chart;

(6) a weighted (with steel or iron) steel tape long enough to measure the deepest well, heavy enough to reach that depth, and small enough to fit readily within the annulus between the well and drill casing; and (7) a water level measuring device, preferably electrical.

Only anti-seizing compounds that are environmentally safe (i.e., commercial products for environmental drilling projects or solid vegetable shortening [e.g., Crisco®]) may be used on downhole drilling equipment. Compounds containing either lead or copper will not be allowed. In addition, polychlorinated biphenyls will not be permitted in hydraulic fluids or other fluids used in the drilling rig, pumps, and field equipment/vehicles.

Surface runoff or other fluids will not be allowed to enter any boring or well during or after drilling/construction. Steps in the form of grading or sandbagging can be taken to ensure that runoff is directed away from the borehole.

Antifreeze used to keep equipment from freezing will not contain rust inhibitors and sealants. Antifreeze is prohibited in areas in contact with drilling fluid. The ground surface at the well site will be protected from possible coolant, fuel, and hydraulic fluid spills and/or leakage by placement of plastic sheeting with raised edges; and draining into a lined catch basin large enough to contain spills and/or leakage from motors, radiators, or vehicle tanks. Sorbent pillows will be placed to catch obvious leaks from the drill rig. Sorbent logs may be used instead of, or in conjunction with, a lined catch basin to contain spills.

An accurate measurement of the water level will be made upon encountering water in the borehole and later upon stabilization (levels will have less usefulness during mud rotary drilling). Levels will be periodically checked throughout the course of drilling. Any unusual change in the water level in the hole (i.e., a sudden rise of a few inches may indicate artesian pressure in a confined aquifer) will be the basis for cessation of drilling. The geologist will immediately contact the Project Manager[5]. Particular attention for such water level changes will be given after penetrating any clay or silt bed, regardless of thickness, which has the potential to act as a confining layer.

Anticipated depths of wells are given in well-specific work plans. In case the previously defined criteria have not been met before the depth range for a given hole is reached, the geologist will stop the drilling and confer with the Project Manager. The current boring conditions (depth, nature of the stratigraphic unit, and water table depth) will be compared to those of other wells nearby to decide to continue drilling or terminate and complete the well.

If the well is to be installed in the surficial aquifer, drilling will be terminated before penetrating the basal aquitard. The basal aquitard is defined as the first 2 ft-thick clay below the water table, or below 5 ft in the case of a shallow aquifer.

If the well is to be installed in a lower, confined aquifer:

5. The contract technical oversight will also be contacted for guidance.

- Penetrations of aquifers located lower than the water table aquifer will be limited to avoid cross-contamination.

- Placement of new upper confined aquifer wells will be initially limited to those areas where contamination has been confirmed.

- The location of upper confined aquifer wells will be based upon the findings of the water table aquifer investigation. Areas of known contamination will be targeted for installing upper confined aquifer wells for the purposes of delineating vertical contamination.

- Where possible, upper-confined aquifer wells will be located such that they afford triangulation with other wells within the same aquifer to allow for a determination of groundwater flow direction.

- Some upper-confined aquifer wells will be installed approximately 10-15 ft from water table wells to enable the accurate assessment of vertical hydraulic gradients. If the direction of groundwater flow is known, wells within a group will be located sidegradient of each other.

- The boring will be advanced until the base of the surficial aquifer is reached (Section 3.2).

- An outer surface casing will be set 2-5 ft into the confining layer to minimize the potential for cross-contamination from the unconfined aquifer during drilling activities.

- The surface casing will be driven into the confining bed and grouted into place. Grout will be tremied into the annulus around the outside of the casing to within 5 ft of the ground surface. A grout plug at least 2 ft thick will be tremied into the bottom of the surface casing. The grout will be permitted to cure for 24 hours. All drilling fluids within the surface casing will then be removed, and the casing will be flushed with clean potable water.

- The drilling equipment will be decontaminated, a smaller bit or auger selected, and the hole will be continued through the grout plug into the confined aquifer.

- If deeper aquifers are to be screened, repeat preceding steps until total depth is reached.

If dense non-aqueous phase liquid (DNAPL) contamination is detected during drilling, the well will be terminated and completed at the base of the aquifer as described in Section 3.4. Drilling will not continue through the confining unit.

3.3 LOGGING

All borings for monitoring wells will be logged by a geologist. Logs will be recorded in a field logbook (not waterproof for investigations related to PFAS constituents) and/or a boring log. If the information is recorded in a logbook, it will be transferred to boring log forms on a daily basis. Field notes are to include, at a minimum:

- Boring number
- Material description (as discussed below)
- Weather conditions
- Evidence of contamination
- Water conditions (including measured water levels)
- Daily drilling footage and quantities (for billing purposes)
- Notations on man-placed materials
- Drilling method and borehole diameter
- Any deviations from established field plans
- Blow counts for standard penetration tests
- Core and split-spoon recoveries.

Material description for soil samples must include:

- Classification
- Unified Soil Classification System symbol
- Secondary components and estimated percentages
- Color
- Plasticity
- Consistency
- Density
- Moisture content
- Texture/fabric/bedding and orientation
- Grain angularity
- Depositional environment and formation
- Incidental odors
- Photoionization detector reading(s)
- Staining.

A typical boring log entry will include: (1) Munsell color, (2) moisture content, (3) primary components, (4) secondary components, (5) Unified Soil Classification System symbol, and (6) other attributes (density, consistency, and others from the list above). The relative proportions of secondary components will be described with descriptive terms: trace (less than 5 percent), few (6-15 percent), little (16-30 percent), some (31-49 percent), and (36-50 percent).

Material description for rock samples must include:

- Classification

- Lithologic characteristics
- Bedding/banding characteristics
- Color
- Hardness
- Degree of cementation
- Texture
- Structure and orientation
- Degree of weathering
- Solution or void conditions
- Primary and secondary permeability
- Sample recovery
- Incidental odors
- Photoionization detector reading(s)
- Staining.

3.4 WELL CONSTRUCTION AND INSTALLATION

3.4.1 General

After the borehole is drilled and logged, the hole will be backfilled as required for proper screen placement. The integrity of the aquitard will be restored by placing a bentonite plug of an appropriate thickness, either to the top of the aquitard (normal well installation) or to within 0.3 ft of the top of the aquitard (DNAPL well). Aquifer fill will be clean filter pack.

The installation of monitoring wells in uncased or partially cased holes will begin within 12 hours of completion of drilling or, if the hole is to be logged, within 12 hours of well logging, and within 48 hours for holes fully cased with temporary drill casings. Once installation has begun, work will continue until the well has been grouted and the drill casing has been removed.

The construction of each well will be depicted as built in a well construction diagram. The diagram will be attached to the boring log and will graphically denote:

- Borehole depth
- Screen location and length
- Joint location
- Granular filter pack
- Seal
- Grout
- Cave-in
- Centralizers
- Height of riser
- Protective casing detail.
- Water level on the construction date

3.4.2 Well Casing and Screen Installation

Assemble appropriate decontaminated lengths of pipe and screen. Make sure these are clean and free of grease, soil, and residue. Lower each section of pipe and screen into the borehole, one at a time, screwing each section securely into the section below it. No grease, lubricant, polytetrafluoroethelyne tape, or glue may be used in joining the pipe and screen sections. If a well extends below 50 ft, centralizers will be installed at 50 ft and every 50 ft thereafter except within screened interval and bentonite seal. Centralizer material will be PVC, polytetrafluoroethelyne, or stainless steel. Determination of centralizer material will be based on the same criteria as screen and casing selection.

Normal screen placement for the water table (surficial) aquifer will extend from 2 ft above the static water level to no more than 6 in. from the bottom of the hole or backfill material, whichever is applicable. The bottom of the screen will rest no more than 6 in. from the bottom of the hole or backfill material, whichever is applicable.

NOTE: The end cap in DNAPL wells will rest on the bottom of the hole, or bentonite backfill if applicable (Section 3.2).

Screen placement for a confined aquifer well will normally be at the top of the confined aquifer.

Screen lengths will not normally exceed 10 ft. If it appears advantageous in a given situation (e.g., to screen an entire aquifer that is thicker than 10 ft), approval must be sought on a case-by-case basis from the appropriate regulatory agency. Otherwise, wells will be screened as follows:

Thickness of Aquifer	Action
<10 ft	Screen entire aquifer
>10 ft <30 ft	Screen top 10 ft; consider vertically nested well cluster
>30 ft	Install vertically nested well cluster

Plastic well screens, casings, and fittings will conform to National Sanitation Foundation Standard 14 or ASTM equivalent for potable water usage. These materials will bear the appropriate rating logo. If the logos are not present, a written statement from the manufacturer/supplier stating that the materials contain the appropriate rating must be obtained. Material used will be new and essentially chemically inert to the site environment.

Well screen and casing should be inert with respect to the groundwater; therefore, the selection of screen and casing material will be based on select field tests of aquifer chemistry and potential contaminants. The screen will be capped without sediment trap or DNAPL sampling cup, and lowered into the hole. The well casing will be pre-cut to extend 2-2.5 ft above ground surface. Prior to placement of the last piece of well casing, a notch or other permanent reference point will be cut, filed, or scribed into the top edge of the casing.

Screen slot size will be appropriately sized to retain 90-100 percent of the filter pack material, the size of which will be determined by sieve analysis of formational material.

Stainless steel screens will be used in DNAPL wells. The formation grain size will be multiplied by the higher factor (6) to determine filter pack grain size. This will ensure that the filter pack is sufficiently coarse to permit DNAPL to pass freely from the formation into the coarser filter pack, then into the open well (Cohen and Mercer 1993).

DNAPL sampling cups are prohibited. The well screen will be capped and set 0.3 ft (0.5 ft maximum) into the top of the confining bed and rest on the bottom of the hole or bentonite backfill (if used). No sand will be placed below the screen.

3.4.3 Filter Sand Installation

Place the appropriate filter pack. Monitor the rise within the annulus with a weighted tape to assure that bridging is not occurring. After the filter pack is in place, wait 3-5 minutes for the material to settle, tamp and level with a capped PVC pipe, and check its depth with a weighted steel tape.

Filter pack material will be placed, lightly tamped, and leveled. Filter pack will extend from the bottom of the hole to a height of 1-2 ft above the top of the screen. The filter pack will be capped with a minimum of 1 ft of fine (e.g., Ottawa-type) sand to prevent the bentonite seal (placed as pellets) from infiltrating the filter pack. If the bentonite seal is placed as a slurry, a minimum of 2 ft of fine sand will be required.

If the hole is less than 20 ft deep, the filter pack may be poured into the annulus directly. If the hole is deeper than 20 ft, the filter pack must be tremied into place.

Granular filter packs will be chemically and texturally clean, inert, and siliceous.

Filter pack grain size will be based on formation grain size analysis. The D30 (70 percent retained) sieve size multiplied by a factor of not less than 3 nor greater than 6 will be used to determine the appropriate grain size.

Calculations regarding filter pack volumes will be entered into the field logbook along with any discrepancies between calculated and actual volumes used. If a discrepancy of greater than 10 percent exists between calculated and actual volumes exists, an explanation for the discrepancy will also be entered in the field logbook.

3.4.4 Bentonite Installation

Install the bentonite seal (2- to 5-ft thick) by placing bentonite pellets into the hole gradually. If the well is deeper than 20 ft, a tremie pipe will be used to place either bentonite pellets or slurry. Tamp and level pellets. If the well is within 20 ft deep, tamp with a capped PVC pipe; if >20 ft, tamping may be accomplished with the weighted end of the tape. In either case, check the depth to the top of the seal with a weighted tape as above.

If the bentonite pellets are of poor quality, they may have a tendency to hydrate and swell inside the tremie pipe and bridge. This situation may be solved by the following procedure:

1. Use a different brand of pellets. Different brands may have longer hydration times.

2. Freeze the pellets[6]. Note that this will require a longer wait time to allow proper hydration after the pellets thaw.

3. Place the bentonite seal as a slurry using a side-discharge tremie pipe as though installing grout. Note (Section 3.4) this will require that a minimum of 2 ft of fine sand be placed as a cap on top of the filter pack material.

Wait for the pellets to hydrate and swell. Hydration times will be determined by field test or by manufacturer's instructions. Normally this will be 30-60 minutes. Document the hydration time in the field notebook. If the pellets are above the water level in the hole, add several buckets of clean water to the boring. Document the amount of water added to the hole.

The final depth to the top of the bentonite seal will be measured and recorded.

3.4.5 Grout Installation

Mix an appropriate cement-bentonite grout (described below). Be sure the mixture is thoroughly mixed and as thick as is practicable.

Lower a side discharge tremie pipe into the annulus to the level of the pellet seal.

Pump the grout slurry into the annulus while withdrawing the tremie pipe and temporary casing. Stop the grout fill at 5 ft below the ground surface. Allow to cure for not less than 12 hours. If grout settles more than 6 in., add grout to bring level back up to within 5 ft of ground surface. Place approximately 2 ft of bentonite pellets (minimum 0.5 ft) in annulus. Seat the protective casing in the bentonite seal, allowing no more than 0.2 ft between the top of the well casing and the bottom of the protective casing cap. Fill inner annulus (between well casing and protective casing) with bentonite pellets to the level of the ground surface. Cover bentonite pellets with 1 ft of clean granular material (coarse sand or pea gravel filter pack). Fill the outer annulus (between the protective casing and the borehole) with neat cement. Allow the cement to mound above ground level and finish to slope away from the casing. Lock the cap.

6. Bentonite pellets may be "flash-frozen" by brief immersion in liquid nitrogen (LN2). This can be accomplished by pouring LN2 over a small quantity (0.25-0.5 bucket) of pellets, allowing the LN2 to boil off, then pouring the pellets into the tremie pipe. NOTE: Use of LN2 is an additional jobsite hazard and must be addressed in the contractor's Health and Safety Plan. This contingency must be covered before drilling starts in order to avoid delays in well installation.

– OR –

Continue the grout fill to the ground surface. Seat the protective casing in the grout, allowing no more than 0.2 ft between the top of the well casing and the bottom of the protective casing cap. Lock the cap.

– AND –

Allow the grout slurry to set overnight.

Fill the outer annulus (between the casing and the borehole) with neat cement. Allow the cement to mound above ground level and finish to slope away from the casing.

Grout used in construction will be composed by weight of:

- 20 parts cement (Portland cement, Type II) (see previous table)
- 0.4-1 part (maximum) (2-5 percent) bentonite
- 8 gallons (maximum) of approved water per 94-pound bag of cement.

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

All grout material will be combined in an aboveground container and mechanically blended to produce a thick, lump-free mixture. The mixed grout will be recirculated through the grout pump prior to placement. Grout placement will be performed using a commercially available grout pump and a rigid, side discharge tremie pipe.

The following will be noted in the field logbook: (1) calculations of predicted grout volumes; (2) exact amounts of cement, bentonite, and water used in mixing grout; (3) actual volume of grout placed in the hole; and (4) any discrepancies between calculated and actual volumes used. If a discrepancy of greater than 10 percent exists between calculated and actual volumes exists, an explanation for the discrepancy will also be entered in the field logbook.

Well protective casings will be installed around all monitoring wells on the following day as the initial grout placement around the well. Any annulus formed between the outside of the protective casing and the borehole will be filled to ground surface with cement.

3.4.6 Surface Completion

Cut the riser with a pipe cutter approximately 2-2.5 ft above grade. All pipe cuts MUST be square to ensure that the elevation between the highest and lowest point of the well casing is less than or equal to 0.02 ft. Notch, file, or otherwise permanently scribe a permanent reference point on the top of the casing.

Torches and saws may not be used to cut the riser. Care must be taken that all filings or trimmings cut from the reference point fall outside the riser rather than into the well. **Under no circumstances will a permanent marker or paint pencil be used to mark the reference point**.

The tops of all well casings will be capped with covers composed of materials compatible with the products used in the well installation. Caps may either be vented, or a telescopic fit, constructed to preclude binding to the well casing caused by tightness of fit, unclean surfaces, or weather conditions. In either case, it should be secure enough to preclude the introduction of foreign material into the well yet allow pressure equalization between the well and the atmosphere (e.g., avoid the use of unvented well plugs).

In some locations, safety requirements may mandate that a well be flush-mounted with no stickup. If a flush-mounted well is required at a given location, an internal pressure cap must be used instead of a vented cap to ensure that rainwater cannot pool around the wellhead and enter the well through the cap.

Slope the ground surface away from the casing for a distance of 2 ft, at a rate of no less than 1 in. in 2 ft. Surface this sloping pad with a geotextile mat covered by 6 in. of coarse gravel.

– OR –

Frame and pour a 4-ft square × 6-in. thick (4 ft × 4 ft × 6 in.) concrete pad centered around the protective casing.

– AND –

Set pre-painted protective steel pickets (3 or 4) evenly around and 4 ft out from the well. These pickets will be set into 2 ft deep holes, the holes will then be filled with concrete; and, if the pickets are not capped, they will also be filled with concrete.

3.5 WELL DEVELOPMENT

Well development is the process by which drilling fluids, solids, and other mobile particulates within the vicinity of the newly installed monitoring well have been removed while restoring the aquifer hydraulic conductivity. Development corrects any damage to or clogging of the aquifer caused by drilling, increases the permeability of the aquifer in the vicinity of the well, and stabilizes the formation and filter pack sands around the well screen.

Well development will be initiated after 48 consecutive hours but no longer than 7 calendar days following grouting and/or placement of surface protection.

Two well development techniques, over pumping and surging, will be employed in tandem. Over pumping is simply pumping the well at a rate higher than recharge. Surging is the operation of a plunger-like device (e.g. surge block) up and down within the well casing similar to a piston in a cylinder.

3.5.1 Materials Required

The following materials will be required for well development:

- Well Development Form
- Boring Log and Well Completion Diagram for the well
- Submersible pump or bailer of appropriate capacity, and surge block
- Conductivity, pH, ORP, turbidity, dissolved oxygen, and temperature meters
- Water-level meter or interface probe, as appropriate
- Containers for purged water, if required.

3.5.2 Summary of Procedures and Data Requirements

Pump or bail the well to ensure that water flows into it, and to remove some of the fine materials from the well. Removal of a minimum of one equivalent volume is recommended at this point. The rate of removal should be high enough to stress the well by lowering the water level to approximately half its original level. If well recharge exceeds 15 gallons per minute, the requirement to lower the head will be waived.

Slowly lower a close-fitting surge block into the well until it rests below the static water level, but above the screened interval. (NOTE: This latter is not required in the case of a light non-aqueous phase liquid well.)

Begin a gentle surging motion that will allow any material blocking the screen to break up, go into suspension, and move into the well. Continue surging for 5-10 minutes, remove surge block, and pump or bail the well, rapidly removing at least one equivalent volume.

Repeat previous step at successively lower levels within the well screen until the bottom of the well is reached. Note that development should always begin above, or at the top of, the screen and move progressively downward to prevent the surge block from becoming sand locked in the well casing. As development progresses, successive surging can be more vigorous and of longer duration as long as the amount of sediment in the screen is kept to a minimum.

Development is expected to take at least 2 hours in a small well installed in a clean sand, and may last several days in large wells, or in wells set in silts with low permeabilities.

Development will continue until little or no sediment can be pulled into the well, and target values for parameters listed below are met.

At a minimum, development will remove 3-5 well volumes of water. One development volume is defined as (1) equivalent volume, plus (2) the amount of fluid lost during drilling, plus (3) the volume of water used in filter pack placement.

1. Monitor water quality parameters (turbidity, pH, conductivity, ORP, dissolved oxygen, and temperature) before beginning development procedures, and after removing 2, 2.5, and 3 well volumes of water.

2. If these parameters have stabilized over the three readings, the well will be considered developed.

3. If the parameters have not stabilized after these three readings, continue pumping the well to develop, but stop surging. Monitor the stabilization parameters every half development volume.

4. When the parameters have stabilized over three consecutive readings at half development volume intervals, the well will be considered developed.

All water removed must be disposed of as directed by the Work Plan.

Record all data as required on a Field Record of Well Development Form (Attachment B), which is made a part of the complete well record. These data include:

- Depths and dimensions of the well, casing, and screen obtained from the well diagram.

- Water losses and uses during drilling, obtained from the boring log for the well.

- Depth-to-water measurements.

- Measurements of the following indicator parameters: turbidity, pH, conductivity, ORP, dissolved oxygen, and temperature.

- Target values for the indicator parameters listed above are as follows: pH – stabilize, conductivity – stabilize, ORP – stabilize, dissolved oxygen –- stabilize, temperature – stabilize, and turbidity – 5 nephelometric turbidity units or stabilize. A value is considered to have stabilized when three consecutive readings taken at half development volume intervals are within 10 percent of each other.

- Notes on characteristics of the development water.

- Data on the equipment and technique used for development.

- Estimated recharge rate and rate/quantity of water removal during development.

3.6 TEMPORARY WELLS

Temporary wells typically differ from permanent installations in the following ways: (1) the wells are typically shallow and have small diameters; (2) installation methods tend to be driving, direct-push, but could be any of the rotary methods or sonic; and (3) the wells tend to have limited surface completions with no protective casing, concrete pad, or bollard posts. Keep in mind that temporary wells may still require well permits and perhaps reporting on abandonment. The installation should follow steps to allow for expedited abandonment after a limited timeframe, meaning: (1) the casing should be amenable to pulling or ripping, (2) the borehole should be limited in diameter to expedite filling, and (3) surface disturbance should be minimized to allow for quick site restoration and possible reseeding.

3.7 WELL SURVEY

Newly installed monitoring wells will typically be surveyed by a state-registered surveyor to determine the geographical coordinates and elevations. Typical standards for the survey are surveying the well to vertical accuracy of 0.010 U.S. survey ft using the 1988 North American Vertical Datum and a horizontal accuracy to within 0.10 ft tied to site datum (World Geodetic System 1984 Universal Transverse Mercator Zone 11 North). The elevations for the natural ground surface (not the top of the grout collar) and the highest point on the riser casing rim of the uncapped well casing, and the protective casing for each well will be surveyed. A survey mark will be indicated by a small groove or other permanent marking in the well riser casing.

4. MAINTENANCE

Not applicable.

5. PRECAUTIONS

Refer to the site-specific Health and Safety Plan for discussion of physical and chemical hazards and preventive measures to be used during well installation and development activities.

6. REFERENCES

Cohen, R.M. and J.W. Mercer. 1993. DNAPL Site Evaluation, CRC Press, Inc.

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Attachment A

Well Construction Log Form

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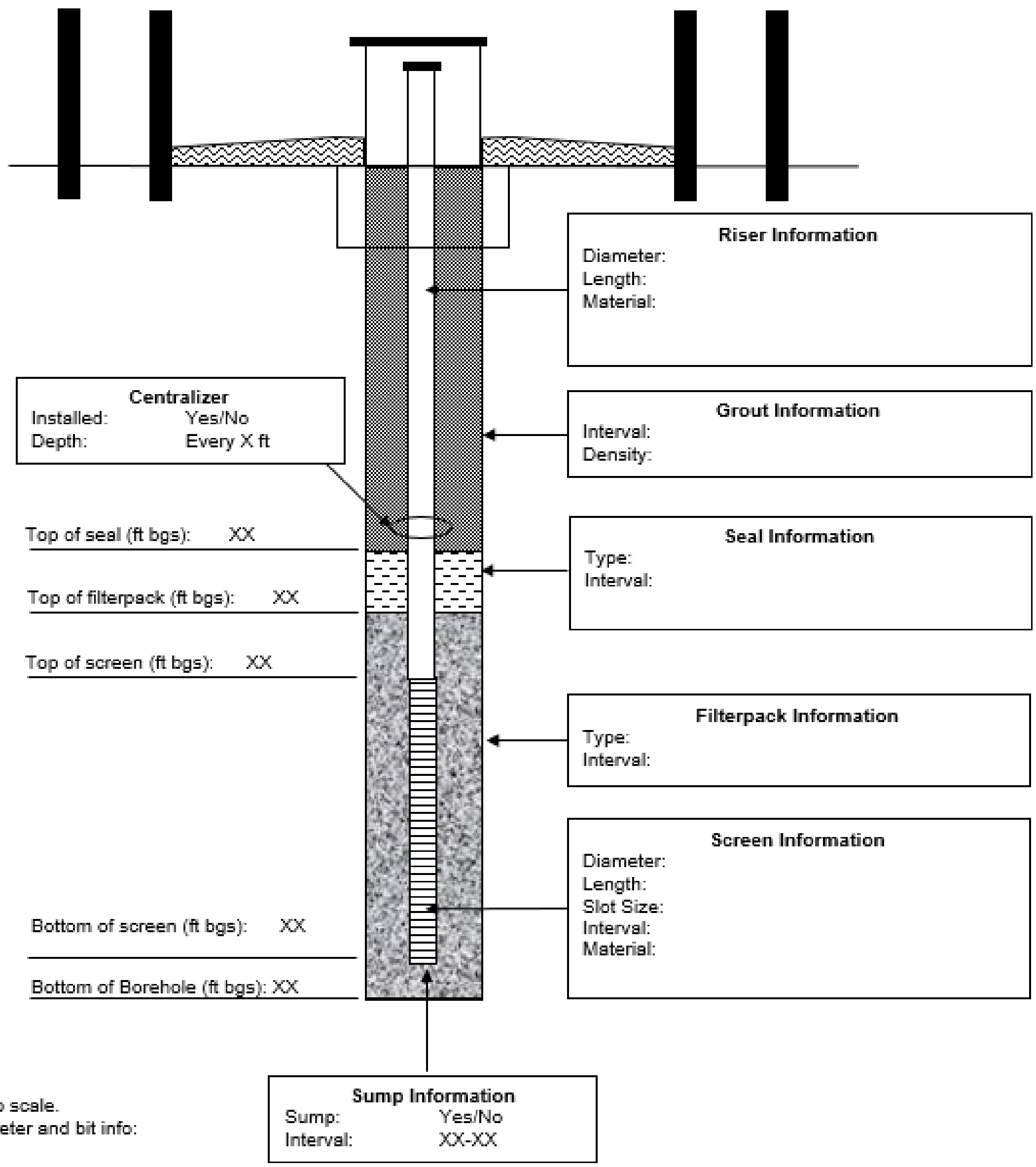
WELL CONSTRUCTION LOG

EA Engineering, Science, and Technology, Inc., PBC	**Monitoring Well ID No.:** [Coordinates] Not Yet Surveyed [Aquifer Type]
Project Name/ Project No.:	
Location:	

All footages indicated are below ground surface (bgs).



Notes:
Features not to scale.
Borehole diameter and bit info:

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Attachment B

Field Record of Well Development Form

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FIELD RECORD OF WELL DEVELOPMENT

Project Name:	Project No:	Date:
EA Personnel:	Development Method:	
Weather/Temperature/Barometric Pressure:		Time:

Well No.:	Well Condition:
Well Diameter:	Measurement Reference:
Well Volume Calculations	
A. Depth To Water (ft):	D. Well Volume/ft:
B. Total Well Depth (ft):	E. Total Well Volume (gal)[C*D]:
C. Water Column Height (ft):	F. Five Well Volumes (gal):

Parameter	Beginning	1 Volume	2 Volumes	3 Volumes	4 Volumes	5 Volumes
Time (min)						
Depth to Water (ft)						
Purge Rate (gpm)						
Volume Purged (gal)						
pH						
Temperature (°F)						
Conductivity (µmhos/cm)						
Dissolved Oxygen						
Turbidity (NTU)						
ORP (mV)						
Parameter	**6 Volumes**	**7 Volumes**	**8 Volumes**	**9 Volumes**	**10 Volumes**	**End**
Time (min)						
Depth to Water (ft)						
Purge Rate (gpm)						
Volume Purged (gal)						
pH						
Temperature (°F)						
Conductivity (µmhos/cm)						
Dissolved Oxygen						
Turbidity (NTU)						
ORP (mV)						

NOTE: NTU = Nephelometric turbidity unit.
ORP = Oxidation-reduction potential.

COMMENTS AND OBSERVATIONS: ____

____

____

____

FIELD RECORD OF WELL DEVELOPMENT

Project Name:	Project No:	Date:
EA Personnel:	Development Method:	
Weather/Temperature/Barometric Pressure:		Time:

Well No.:	Well Condition:
Well Diameter:	Measurement Reference:

Parameter	Beginning	1 Volume	2 Volumes	3 Volumes	4 Volumes	5 Volumes
Time (min)						
Depth to Water (ft)						
Purge Rate (gpm)						
Volume Purged (gal)						
pH						
Temperature (°F)						
Conductivity (µmhos/cm)						
Dissolved Oxygen						
Turbidity (NTU)						
ORP (mV)						

Parameter	6 Volumes	7 Volumes	8 Volumes	9 Volumes	10 Volumes	End
Time (min)						
Depth to Water (ft)						
Purge Rate (gpm)						
Volume Purged (gal)						
pH						
Temperature (°F)						
Conductivity (µmhos/cm)						
Dissolved Oxygen						
Turbidity (NTU)						
ORP (mV)						

6332106 Standard Operating Procedure No. 021
for
Sedimen Sampling

Prepared by

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Revision: 1
August 2021

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CONTENTS

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1. SCOPE AND APPLICATION

This Standard Operating Procedure (SOP) delineates protocols for sampling sediments from streams, rivers, ditches, lakes, ponds, lagoons, and marine and estuarine systems.

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

2. PROCEDURES

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

3. GENERAL PROCEDURES

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

2. Comply with the Health and Safety Plan specifications for proper personal protective equipment (steel-toed boots, safety glasses, hard hats, splash shields, and Tyvek as appropriate and designated in the site-specific Health and Safety Plan). Wear chemically protective gloves when collecting samples appropriate for the potential constituents to be sampled. Complete review of emergency plans and equipment. If sampling from a boat or near waterbodies with depths of 4 feet or more, the sampling team will wear life jackets.

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

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

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

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

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

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

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

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

11. Use the proper equipment and material construction for the analytes of interest.

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

13. Collect samples for volatile organic compound analysis and acid volatile sulfide analysis first. Do not mix such samples before placing them in the sample containers. For composite volatile organic compound and acid volatile sulfide samples, place equal aliquots of each

subsample in the sample container with no headspace. To maintain sample integrity, exposure to oxygen/air should be limited to the extent possible.

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

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

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

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

4. CORERS

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

4.1 EQUIPMENT

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

- Probing equipment for pre-sampling testing for utilities
- Sampling vessel, floating platform (properly equipped and sized barge or boat), and waders and plan for collecting samples by hand (may significantly limit sample depth)

- Winch
- Crane, boom arm or A-frame
- Sediment core sampler (Vibracore, piston tube, Wildco tube sampler, etc.)
- Core liners, core catchers, liner caps, etc.
- Saw, knife, and cutters to open or split core liners
- Sampling vessel
- Propulsion method for sampling vessel or floating platform
- Containers, buckets, and tubs
- Small trays
- Calibration bucket
- Wash box
- Glassware
- Logbook
- Labels
- Coolers
- Spoons
- Water filters
- Gloves for sampling
- Gloves for other sampling activities such as cutting, equipment handling, etc.
- Measuring device
- Decontamination chemicals and de-ionized water.

4.2 PROCEDURE

4.2.1 Manual Sampling

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

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

2. Position downstream of the sample location.

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

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

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

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

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

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

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

4.2.2 Sampling from a Vessel

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

2. Select sediment coring tools of sufficient diameter and length to obtain the needed sample volume and depth of penetration. Depending on the volume of sediment needed, multiple sediment cores may be required. To the extent possible, predetermine the

number of cores required to avoid having to return to a location for additional cores/sample volume.

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

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

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

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

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

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

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

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

11. Cut off any empty core liner to eliminate headspace. Measure core recovery. Acceptable core recoveries may be specified in the work planning documents. Typically, recoveries

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

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

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

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

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

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

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

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

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

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

5. SCOOPS AND SPOONS

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

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

6. DREDGES

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

6.1 PETERSON, VAN VEEN, AND PONAR DREDGES

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

- Open the jaws and place the cross bar into the proper notch.
- Lower the dredge to the bottom in a controlled manner, making sure it settles flat.
- When tension is removed from the line, the cross bar will drop, enabling the dredge to close as the line is pulled upward during retrieval.
- Pull the dredge to the surface. Make sure the jaws are closed and that no sample was lost during retrieval through incomplete closure due to rocks, shells, or other debris; penetration at an angle; or tilting during retrieval. The sampler should not be overfilled such that the sediment surface is touching the top of the sampler. Overlying water should be present indicating minimal leakage; this water should be siphoned off, not decanted, prior to sample processing. The sediment water interface should be intact with no signs of washout or channeling.

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

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

6.2 ECKMAN DREDGE

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

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

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

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

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

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

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

7. REFERENCES

Not applicable.

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6332106 Standard Operating Procedure No. 025
for
Soil Sampling

Prepared by

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Revision 1
August 2021

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SCOPE AND APPLICATION

The purpose of this Standard Operating Procedure is to delineate protocols for sampling surface and subsurface soils. Soil samples give an indication of the area and depth of site contamination, so a representative sample is very important.

1. MATERIALS

The following materials may be required:

Bucket auger or push tube sampler	Split-spoon, Shelby tube, or core barrel sampler
Drill rig and associated equipment	Stainless steel bowl
Personal protective equipment as required by the Health and Safety Plan	Stainless steel spoon, trowel, knife, spatula (as needed)

2. PROCEDURE

2.1 SUBSURFACE SAMPLES

Don personal protective equipment. Collect split-spoon, core barrel, or Shelby Tube samples during drilling. Upon opening sampler, or extruding sample, immediately screen soil for volatile organic compounds using either a photoionization detector or flame ionization detector. The portion of the split-spoon sample that represents slough shall not be sub-sampled. If sampling for volatile organic compounds, determining the area of highest concentration, use a stainless steel knife, trowel, or laboratory spatula to peel and sample this area. Log the sample in the Field Logbook while it is still in the sampler. Peel and transfer the remaining sample in a decontaminated stainless steel bowl. Mix thoroughly with a decontaminated stainless steel spoon or trowel. Place the sample into the required number of sample jars. Preserve samples as required. Discard any remaining sample into the drums being used for collection of cuttings. Decon sampling implements. All borings will be abandoned.

NOTE: If sample recoveries are poor, it may be necessary to composite samples before placing them in jars. In this case, the procedure will be the same, except that two split-spoon samples will be mixed together. Samples for VOCs or SVOCs shall not be homogenized unless specified in the Site-Specific Section of the Scope of Services. The Field Logbook should clearly state that the samples have been composited, which samples were composited, and why the compositing was done.

Samples taken for geotechnical analysis will be undisturbed samples, collected using a thin-walled (Shelby tube) sampler.

2.2 SURFICIAL SOIL SAMPLES

Don personal protective equipment. Remove vegetative mat. Collect a sample from under the vegetative mat with a stainless steel trowel, push tube sampler, or bucket auger. If a representative sample is desired over the depth of a shallow hole or if several shallow samples are to be taken to represent an area, composite as follows:

- As each sample is collected, place a standard volume in a stainless steel bowl.
- After all samples from each hole or area are in the bucket, homogenize the sample thoroughly with a decontaminated stainless steel spoon or spatula.

If no compositing is to occur, place sample directly into the sample jars. Place the leftover soil in the auger borings and holes left by sampling. If necessary, add clean sand to bring the subsampling areas back to original grade. Replace the vegetative mat over the disturbed areas. Samples for volatile organic compounds will not be composited. A separate sample will be taken from a central location of the area being composited and transferred directly from the sampler to the sample container. Preserve samples as required. Decon sampling implements.

3. MAINTENANCE

Not applicable.

4. PRECAUTIONS

Refer to the Health and Safety Plan.

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

5. REFERENCES

ASTM International. Method D1586-84, Penetration Test and Split-Barrel Sampling of Soils.

———. Method D1587-83, Thin Walled Sampling of Soils.

Department of the Army, Office of the Chief of Engineers. 1972. Engineer Manual 1110-2-1907 Soil Sampling. 31 March.

6332106 Standard Operating Procedure No. 028
for
Well and Boring Abandonment

Prepared by

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Revision 1
August 2021

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1. SCOPE AND APPLICATION

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

2. MATERIALS

The following materials may be required:

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

3. PROCEDURE

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

Any casing will be pulled, drilled out, or thoroughly pierced. Using tremie pipe, grout will be placed from the bottom of the hole to within 3 ft of the ground surface, and allowed to settle for 24 hours. The remainder of the hole will be filled with concrete. The surface of the concrete will be mounded, smoothed, and inscribed with "ABD," for abandoned, any assigned well or boring designation, and the date the hole was abandoned. All boring logs, samples, completion records, and abandonment procedures will be included in the records of work on the site or cluster.

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

If the well is not within 10 ft of another monitoring well, or if there are no substantial, continuous sand bodies, and no replacement well is planned within 10 ft of the original well location, then the hole may be grouted from the bottom to the top.

3.1 GROUT

Grout used in construction will be composed by weight of:

- 20 parts cement (Portland cement, Type II or V)
- 0.4-1 part (maximum) (2-5 percent) bentonite
- 8 gal (maximum) approved water per 94-lb bag of cement.

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

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

Grout placement will be performed using a commercially available grout pump and a rigid tremie pipe removal and grouting will be accomplished in stages, aquifer by aquifer, sealing the boring from the bottom to ground surface. This will be accomplished by placing a grout pipe to the bottom and pumping grout through the pipe until undiluted grout reaches the bottom of the next higher section of casing or, for the top-most section, until grout flows from the boring at ground surface. Efforts will be made to grout incrementally as the temporary casing is removed.

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

3.2 BORINGS

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

3.2.1 Shallow Borings not Penetrating Water Table

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

3.2.2 Borings Penetrating the Water Table

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

3.2.3 Deep Stratigraphic Borings

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

3.3 WELLS

The following procedure applies to wells aborted prior to completion and existing wells determined to be ineffective or otherwise in need of closure.

Prior to abandoning any developed well, the proper well licensing body will be provided written notification along with an abandonment plan for that well.

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

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

4. REPLACEMENT WELLS

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

5. PRECAUTIONS

None.

6332106 Standard Operating Procedure No. 034
for
Drum Sampling

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Revision 1
August 2021

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1. SCOPE AND APPLICATION

The purpose of this Standard Operating Procedure is to provide technical guidance on implementing safe and cost-effective response actions at hazardous waste sites containing drums with unknown contents. Container contents are sampled and characterized for disposal, bulking, recycling, segregation, and classification purposes.

These are standard (i.e., typically applicable) operating procedures that may be varied or changed as required, dependent on site conditions, equipment limitations, or limitations imposed by the procedure. In all instances, the ultimate procedures employed should be documented and associated with the final report.

Prior to sampling, drums must be excavated (if necessary), inspected, staged, and opened. Drum excavation must be performed by qualified personnel. Inspection involves the observation and recording of visual qualities of each drum and any characteristics pertinent to classification of the drum's contents. Staging involves the physical grouping of drums according to classifications established during the physical inspection. Opening of closed drums can be performed manually or remotely. Remote drum opening is recommended for worker safety. The most widely used method of sampling a drum involves the use of a glass thief. This method is quick, simple, relatively inexpensive, and requires no decontamination. The contents of a drum can be further characterized by performing various field tests.

If buried drums are suspected, geophysical investigation techniques (i.e., magnetometry or ground penetrating radar) may be employed in an attempt to determine the location and depth of drums. During excavation, the soil must be removed with great caution to minimize the potential for drum rupture.

Until the contents are characterized, sampling personnel should assume that unlabeled drums contain hazardous materials. Labeled drums are frequently mislabeled, especially drums that are reused. Because a drum's label may not accurately describe its contents, extreme caution must be exercised when working with or around drums.

If a drum that contains a liquid cannot be moved without rupture, its contents may be immediately transferred to a sound drum using an appropriate method of transfer based on the type of waste. In any case, preparations should be made to contain the spill (i.e., spill pads, dike, etc.) should one occur.

If a drum is leaking, open, or deteriorated, it must be placed immediately in overpack containers.

The practice of tapping drums to determine their contents is neither safe nor effective and should not be used if the drums are visually overpressurized or if shock-sensitive materials are suspected. A laser thermometer may be effective in order to determine the level of the drum contents via surface temperature differences.

Drums that have been over-pressurized to the extent that the head is swollen several inches above the level of the chime should not be moved. A number of devices have been developed for venting critically swollen drums including, but not limited to, hydraulic and remotely operated drum puncturing tools. Drum venting methods must be selected after careful consideration of potential hazards and in coordination with EA's safety coordinator. Venting should be performed from behind a wall or barricade. Once the pressure has been relieved, the bung can be removed and the drum sampled.

Because there is potential for accidents to occur during handling, particularly initial handling, drums should only be handled if necessary. All personnel should be warned of the hazards prior to handling drums. Overpack drums and an adequate volume of absorbent material should be kept near areas where minor spills may occur. Where major spills may occur, a containment berm adequate to contain the entire volume of liquid in the drums should be constructed before any handling takes place. If drum contents spill, personnel trained in spill response should be used to isolate and contain the spill.

2. MATERIALS

The following materials may be required:

Absorbent material for spills	Glass thieving tubes or composite liquid waste sampler
Bung wrench	Hydraulic drum opener
Chain-of-custody records	Other appropriate sample jars
Coring device	Personal protective equipment
Decontamination materials	Pneumatic devices
Drum deheader (if necessary)	Stainless steel spatula or spoons
Drum opening devices	Uniquely numbered sample identification labels with corresponding data sheets
Drum overpacks	Appropriate sample containers for laboratory analysis of contents
Drum/Tank Sampling Data Sheets and Field Test Data Sheets for Drum/Tank Sampling or similar	

3. PROCEDURE

3.1 PREPARATION

1. Determine the extent of the sampling effort, the sampling methods to be employed, and the types and amounts of equipment and supplies needed.

2. Obtain the necessary sampling and monitoring equipment.

3. Decontaminate or preclean equipment, and ensure that it is in working order.

4. Prepare scheduling and coordinate with staff, clients, and regulatory agency, if appropriate.

5. Perform a general site survey prior to site entry in accordance with the site-specific Health and Safety Plan (HASP).

6. Use stakes, flagging, or buoys to identify and mark all sampling locations. If required, the proposed locations may be adjusted based on site access, property boundaries, and surface obstructions.

3.2 DRUM EXCAVATION

If it is presumed that buried drums are onsite and prior to beginning excavation activities, geophysical investigation techniques should be utilized to approximate the location and depth of the drums. In addition, it is important to ensure that all locations where excavation will occur are clear of utility lines, pipes, and poles (subsurface as well as above surface).

Excavating, removing, and handling drums are generally accomplished with conventional heavy construction equipment. These activities should be performed by an equipment operator who has experience in drum excavation. During excavation activities, drums must be approached in a manner that will avoid digging directly into them.

The soil around the drum should be excavated with non-sparking hand tools or other appropriate means and, as the drums are exposed, a visual inspection should be made to determine the condition of the drums. Ambient air monitoring should be performed to determine the presence of unsafe levels of volatile organics or other anticipated hazards. Based on this preliminary visual inspection, the appropriate mode of drum excavation and handling may be determined.

Drum identification and inventory should begin before excavation. Information such as location, date of removal, drum identification number, overpack status, and any other identification marks should be recorded on the Drum/Tank Sampling Data Sheet (Attachment A-1) or similar project-specific form.

3.3 DRUM INSPECTION

Appropriate procedures for handling drums depend on the contents. Thus, prior to any handling, drums should be visually inspected to gain as much information as possible about their contents. The drums should be inspected for the following:

- Drum condition, corrosion, rust, punctures, bungs, and leaking contents

- Symbols, words, or other markings on the drum indicating hazards (i.e., explosive, radioactive, toxic, flammable), or further identifying the drums

- Signs that the drum is under pressure

- Shock sensitivity.

Monitoring should be conducted around the drums using instruments such as radiation meters, organic vapor analyzers, and combustible gas indicators as specified in the site-specific HASP.

Survey results can be used to classify the drums into categories, including the following:

- Radioactive
- Leaking/deteriorating
- Bulging
- Laboratory packs
- Explosive/shock sensitive
- Empty.

All personnel should assume that unmarked drums contain hazardous materials until their contents have been categorized. Once a drum has been visually inspected and any immediate hazard has been eliminated by overpacking or transferring the drum's contents, the drum is affixed with a numbered tag and transferred to a staging area. Color-coded tags, labels, or bands should be used to identify the drum's category based on visual inspection. A description of each drum, its condition, any unusual markings, the locations where it was buried or stored, and field monitoring information should be recorded on a Drum/Tank Sampling Data Sheet or similar project-specific form. These data sheets become the principal recordkeeping tools for tracking the drum onsite.

3.4 DRUM STAGING

Prior to sampling, the drums should be staged to allow easy access. Ideally, the staging area should be located just far enough from the drum opening area to prevent a chain reaction if one drum should explode or catch fire when opened.

During staging, the drums should be physically separated into groups based on their contents, condition, or other criteria specified in the site-specific Work Plan. This separation is performed because the strategy for sampling and handling drums/containers in each of these categories will be different. This may be achieved by visual inspection of the drum and its labels, codes, etc. Solids and sludges are typically disposed of in open top drums. Closed head drums with a bung opening generally contain liquid.

Where there is good reason to suspect that drums contain radioactive, explosive, or shock-sensitive materials, these drums should be staged in a separate, isolated area. Placement of explosives and shock-sensitive materials in diked and fenced areas will minimize the hazard and adverse effects of any premature detonation of explosives.

Where space allows, the drum opening area should be physically separated from the drum removal and drum staging operations. Drums should be moved from the staging area to the drum opening area one at a time using forklift trucks equipped with drum grabbers or a barrel grappler. In a large-scale drum handling operation, drums may be conveyed to the drum opening area using a roller conveyor. Drums may be restaged as necessary after opening and sampling.

3.5 DRUM OPENING

There are three basic techniques available for opening drums at hazardous waste sites:

1. Manual opening with non-sparking bung wrenches
2. Drum deheading
3. Remote drum puncturing or bung removal.

The choice of drum opening techniques and accessories depends on the number of drums to be opened, their waste contents, and physical condition. Remote drum opening equipment should always be considered in order to protect worker safety. Under Occupational Safety and Health Administration 1910.120, manual drum opening with bung wrenches or deheaders should be performed ONLY with structurally sound drums and waste contents that are known to be non-shock sensitive, non-reactive, non-explosive, and non-flammable.

3.5.1 Manual Drum Opening with a Bung Wrench

Manual drum opening with bung wrenches should not be performed unless the drums are structurally sound (no evidence of bulging or deformation) and their contents are known to be non-shock sensitive, non-reactive, non-explosive, or non-flammable. If opening the drum with bung wrenches is deemed safe, then certain procedures should be implemented to minimize the hazard:

- Field personnel should be fully outfitted with protective gear.

- Drums should be positioned upright with the bung up, or, for drums with bungs on the side, laid on their sides with the bung plugs up.

- The wrenching motion should be a slow, steady pull across the drum. If the length of the bung wrench handle provides inadequate leverage for unscrewing the plug, a “cheater bar” can be attached to the handle to improve leverage.

3.5.2 Manual Drum Opening with a Drum Deheader

Drums are opened with a drum deheader (Attachment B, Figure B-1) by first positioning the cutting edge just inside the top chime and then tightening the adjustment screw so that the deheader is held against the side of the drum. Moving the handle of the deheader up and down while sliding the deheader along the chime will enable the entire top to be rapidly cut off if so desired. If the top chime of a drum has been damaged or badly dented, it may not be possible to cut the entire top off. Since there is always the possibility that a drum may be under pressure, the initial cut should be made very slowly to allow for the gradual release of any built-up pressure. A safer technique would be to employ a remote method prior to using the deheader.

Self-propelled drum openers that are either electrically or pneumatically driven are available and can be used for quicker and more efficient deheading.

The drum deheader should be decontaminated, as necessary, after each drum is opened to avoid cross contamination and/or adverse chemical reactions from incompatible materials.

3.5.3 Remote Drum Opening with Hydraulic Devices

A piercing device with a non-sparking metal point is attached to the end of a hydraulic line and is pushed into the drum by the hydraulic pressure. The piercing device can be attached so that a hole for sampling can be made in either the side or the head of the drum. Some of the metal piercers are hollow or tube-like so that they can be left in place if desired and serve as a permanent tap or sampling port. The piercer is designed to establish a tight seal after penetrating the container.

3.5.4 Remote Drum Opening with Pneumatic Devices

Pneumatically operated devices utilizing compressed air have been designed to remove drum bungs remotely. Prior to opening the drum, a bung fitting must be selected to fit the bung to be removed. The adjustable bracketing system is then attached to the drum and the pneumatic drill is aligned over the bung. This must be done before the drill can be operated. The operator then moves away from the drum to operate the equipment. Once the bung has been loosened, the bracketing system must be removed before the drum can be sampled. This remote bung opener does not permit the slow venting of the container and, therefore, appropriate precautions must be taken. It also requires the container to be upright and relatively level. Bungs that are rusted shut cannot be removed with this device.

3.6 DRUM SAMPLING

After the drum has been opened, preliminary monitoring of headspace gases should be performed first with an explosimeter/oxygen meter. Afterwards, an organic vapor analyzer or other instrument(s) should be used. If possible, these instruments should be intrinsically safe. In most cases, it is impossible to observe the contents of these sealed or partially sealed drums. Since some layering or stratification is likely in any solution left undisturbed, a sample that represents the entire depth of the drum must be taken.

When sampling a previously sealed drum, a check should be made for the presence of a bottom sludge. This is easily accomplished by measuring the depth to apparent bottom and then comparing it to the known interior depth.

3.6.1 Glass Thief Sampler

The most widely used implement for sampling drum liquids is a glass tube commonly referred to as a glass thief (Attachment B, Figure B-2). This tool is cost effective, quick, and disposable. Glass thieves are typically from 6- to 16-millimeter inner diameter and 48 inches long.

Procedures for use:

1. Remove the lids from the sample containers.

2. Insert the glass tubing almost to the bottom of the drum or until a solid layer is encountered. Approximately 1 foot of tubing should extend above the drum.

3. Allow the waste in the drum to reach its natural level in the tube.

4. Cap the top of the sampling tube with a tapered stopper or thumb, ensuring liquid does not come into contact with the stopper.

5. Carefully remove the capped tube from the drum and insert the uncapped end into the appropriate sample container.

6. Release stopper and allow glass thief to drain until the container is approximately two-thirds full.

7. Remove tube from the sample container, break it into pieces, and place the pieces in the drum.

8. Cap the sample container lightly and label it. Place the sample container into a carrier.

9. Replace the bung or place plastic over the drum.

10. Log all samples in the site logbook and on Drum/Tank Sampling Data Sheets or similar.

11. Perform hazard categorization analyses if included in the project scope.

12. Transport the sample to the decontamination zone and package it for transport to the analytical laboratory, as necessary. Complete chain-of-custody records.

In many instances, a drum containing waste material will have a sludge layer on the bottom. Slow insertion of the sample tube into this layer, then a gradual withdrawal will allow the sludge to act as a bottom plug to maintain the fluid in the tube. The plug can be gently removed and placed into the sample container by the use of a stainless steel laboratory spoon.

It should be noted that, in some instances, disposal of the tube by breaking it into the drum may interfere with eventual plans for the removal of its contents. The use of this technique should be cleared with the project officer or other glass thief disposal techniques should be evaluated.

3.6.2 Composite Liquid Waste Sampler

The Composite Liquid Waste Sampler (COLIWASA) and modifications thereof are equipment that collect a sample from the full depth of a drum and maintain it in the transfer tube until delivery to the sample bottle. The COLIWASA (Attachment B, Figure B-3) is a frequently cited sampler designed to permit representative sampling of multiphase wastes from drums and other containerized wastes. One configuration consists of a 152- × 4-centimeter inner diameter section of tubing with a neoprene stopper at one end attached by a rod running the length of the tube to a locking mechanism at the other end.

Manipulation of the locking mechanism opens and closes the sampler by raising and lowering the neoprene stopper. One model of the COLIWASA is shown in Attachment B; however, the design can be modified and/or adapted somewhat to meet the needs of the sampler.

The major drawbacks associated with using a COLIWASA concern decontamination and costs. The sampler is difficult to decontaminate in the field, and its high cost in relation to alternative procedures (glass tubes) makes it an impractical throwaway item. It still has applications, however, especially in instances where a true representation of a multiphase waste is absolutely necessary.

Procedures for use:

1. Put the sampler in the open position by placing the stopper rod handle in the T-position and pushing the rod down until the handles sits against the sampler's locking block.

2. Slowly lower the sampler into the liquid waste. Lower the sampler at a rate that permits the levels of the liquid inside and outside the sampler tube to be about the same. If the level of liquid in the sample tube is lower than that outside the sampler, the sampling rate is too fast and will result in a non-representative sample.

3. When the sampler stopper hits the bottom of the waste container, push the sampler tube downward against the stopper to close the sampler. Lock the sampler in the closed position by turning the T-handle until it is upright and one end rests tightly on the locking block.

4. Slowly withdraw the sample from the waste container with one hand while wiping the sampler tube with a disposable cloth or rag with the other hand.

5. Carefully discharge the sample into the appropriate sample container by slowly pulling the lower end of the T-handle away from the locking block while the lower end of the sampler is positioned in a sample container.

6. Cap the sample container tightly and label it. Place the sample container in a carrier.

7. Replace the bung or place plastic over the drum.

8. Log all samples in the site logbook and on Drum/Tank Sampling Data Sheets or similar.

9. Perform hazardous categorization analyses if included in the project scope.

10. Transport the sample to the decontamination zone and package for transport to the analytical laboratory, as necessary. Complete the chain-of-custody records.

3.6.3 Coring Device

A coring device may be used to sample drum solids. Samples should be taken from different areas within the drum. This sampler consists of a series of extensions, a T-handle, and the coring device.

Procedures for use:

1. Assemble the sampling equipment.

2. Remove the lids from the sample containers.

3. Insert the sampling device to the bottom of the drum. The extensions and the “T” handle should extend above the drum.

4. Rotate the sampling device to cut a core of material.

5. Slowly withdraw the sampling device so that as much sample material as possible is retained within it.

6. Transfer the sample to the appropriate sample container, and label it. A stainless steel spoon or scoop may be used, as necessary.

7. Cap the sample containers tightly and place them in a cooler.

8. Replace the bung or place plastic over the drum.

9. Log all samples in the site log book and on Drum/Tank Sampling Data Sheets or similar project-specific form.

10. Perform hazard categorization analyses if included in the project scope.

11. Transport the sample to the decontamination zone and package it for transport to the analytical laboratory, as necessary. Complete the chain-of-custody records.

3.7 HAZARD CATEGORIZATION

The goal of characterizing or categorizing the contents of drums is to obtain a quick, preliminary assessment of the types and levels of pollutants contained in the drums. These activities generally involve rapid, non-rigorous methods of analysis. The data obtained from these methods can be used to make decisions regarding drum staging or restaging, bulking, or compositing of the drum contents.

As a first step in obtaining these data, standard tests should be used to classify the drum contents into general categories such as auto-reactives, water reactives, inorganic acids, organic acids, heavy metals, pesticides, cyanides, inorganic oxidizers, and organic oxidizers. In some cases, further analyses should be conducted to more precisely identify the drum contents.

Examples of tests used to categorize drums include:

- HazCat^{R} chemical identification systems
- Chlor-N-Oil Test Kit
- Spill-fyter Chemical Classifier Strips
- Setaflash (for ignitability).

These methods must be performed according to the manufacturers' instructions and the results must be documented on the Field Test Data Sheet for Drum/Tank Sampling (Attachment A-2) or similar project-specific form.

Other tests that may be performed include:

- Water Reactivity
- Specific Gravity Test (compared to water)
- Water Solubility Test
- pH of Aqueous Solution.

The tests must be performed in accordance with the instructions on the Field Test Data Sheet for Drum/Tank Sampling or similar project-specific form, and results of the tests must be documented on these data sheets.

The specific methods that will be used for hazard categorization must be documented in the Quality Assurance Work Plan.

4. MAINTENANCE

Not applicable.

5. PRECAUTIONS

When working with potentially hazardous materials, follow U.S. Environmental Protection Agency, Occupational Safety and Health Administration, and Corporate Safety and health procedures. All drum sampling activities must be conducted in accordance with the site-specific HASP. Any activities or conditions not directly addressed by the HASP must be approved by EA's safety coordinator.

More specifically, the opening of closed containers is one of the most hazardous site activities. Maximum efforts should be made to ensure the safety of the sampling team. Proper protective equipment and a general awareness of the possible dangers will minimize the risk inherent to sampling operations. Employing proper drum opening techniques and equipment will also safeguard personnel. The use of remote sampling equipment whenever feasible is highly recommended. It is important to understand and acknowledge that the use of non-sparking tools does not completely eliminate spark risk when working with drums and may require additional measures to protect field staff.

6. REFERENCES

Not applicable.

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Attachment A

Field Test Data Sheets

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Attachment A-1
Drum/Tank Sampling Data Sheet

Samplers: ____________________ Date: ____________________

Site Name: ____________________ Work Order Number: 3347-040-001- ________

Container Number/Sample Number: ______ REAC Task Leader: ____________________

SITE INFORMATION :

1. Terrain, drainage description: ____________________

2. Weather conditions (from observation): ____________________

MET station on site: No Yes

CONTAINER INFORMATION :

1. Container type: Drum Tank Other: ____________________

2. Container dimensions: Shape: ____________________

Approximate size: ____________________

3. Label present: No
Yes: ____________________

Other Markings: ____________________

4. Spill or leak present: No Yes Dimensions: ____________________

5. Container location: (Circle one) N/A See Map Other: ____________________

Attachment A-1
Drum/Tank Sampling Data Sheet (continued)

Samplers: ________________________ Date: __________________

Site Name: ________________________ Work Order Number: 3347-040-001-________

Container Number/Sample Number: ___________ REAC Task Leader: ____________________

SAMPLE MONITORING INFORMATION :

1. PID: ________________ Background (clean zone)

________________ Probe used/Model used

________________ Reading from sample

2. FID: ________________ Background (clean zone)

________________ Reading from sample

3. Radiation Meter: _____________ Model used

_____________ Background (clean zone)

_____________ Reading from sample

4. Explosimeter/Oxygen Meter: __________ Oxygen level (sample)

__________ LEL level (sample)

SAMPLE DESCRIPTION :

_______ Liquid _______ Solid _______ Sludge _______ Color _______ Vapors

WATER REACTIVITY :

1. Add small amount of sample to water: _____ bubbles _____ color change to ____________

_____ vapor formation _____ heat _____ No Change

SPECIFIC GRAVITY TEST (compared to water):

1. Add small amount of sample to water: _____ sinks _____ floats

2. If liquid sample sinks, screen for chlorinated compounds. If liquid sample floats and appears to be oily, screen for PCBs (Chlor-N-Oil kit).

Attachment A-2
Field Test Data Sheet for Drum/Tank Sampling (continued)

CHLOR N OIL TEST KIT INFORMATION :

1. Test kit used for this sample: Yes No

2. Results: _____ PCB not present _____ PCB present, less than 50 ppm

_____ PCB present, greater than 50 ppm _____ 100% PCB present

WATER SOLUBILITY TEST :

1. Add approximately one part sample to five parts water. You may need to stir and heat gently. **[DO NOT HEAT IF WATER REACTIVE!]** Results: _______ total _______ partial _______ no solubility

pH OF AQUEOUS SOLUTION :

1. Using 0-14 pH paper, check pH of water/sample solution: _________________.

SPILL-FYTER CHEMICAL CLASSIFIER STRIPS :

1. Acid/Base Risk: (Circle one)

	Color Change
Strong acid (0)	RED
Moderately acidic (1-3)	ORANGE
Weak acid (5)	YELLOW
Neutral (7)	GREEN
Moderately basic (9-11)	Dark GREEN
Strong Base (13-14)	Dark BLUE

2. Oxidizer Risk: (Circle one)

Not Present	WHITE
Present	BLUE, RED, OR ANY DIVERGENCE FROM WHITE

3. Fluoride Risk: (Circle one)

Not Present	PINK
Present	YELLOW

Attachment A-2
Field Test Data Sheet for Drum/Tank Sampling (continued)

4. Petroleum Product, Organic Solvent Risk: (Circle one)

Not Present	LIGHT BLUE
Present	DARK BLUE

5. Iodine, Bromine, Chlorine Risk: (Circle one)

Not Present	PEACH
Present	WHITE OR YELLOW

SETAFLASH IGNITABILITY TEST :

140°F	Ignitable: _______	Non-Ignitable _______
160°F	Ignitable: _______	Non-Ignitable _______
_____	Ignitable: _______	Non-Ignitable _______
_____	Ignitable: _______	Non-Ignitable _______
_____	Ignitable: _______	Non-Ignitable _______
_____	Ignitable: _______	Non-Ignitable _______

Comments:

HAZCAT KIT TESTS :

1. Test: ______________________ Outcome: ______________________

Comments: ______________________

2. Test: ______________________ Outcome: ______________________

Comments: ______________________

Attachment A-2
Field Test Data Sheet for Drum/Tank Sampling (continued)

3. Test: ______________________ Outcome: ______________________

Comments: ____

____

4. Test: ______________________ Outcome: ______________________

Comments: ____

____

5. Test: ______________________ Outcome: ______________________

Comments: ____

____

HAZCAT PESTICIDES KIT :

Present: ______________________ Not Present: ______________________

Comments: ____

____

____

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Attachment B

Equipment Diagrams

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Figure B-1. Drum Deheader

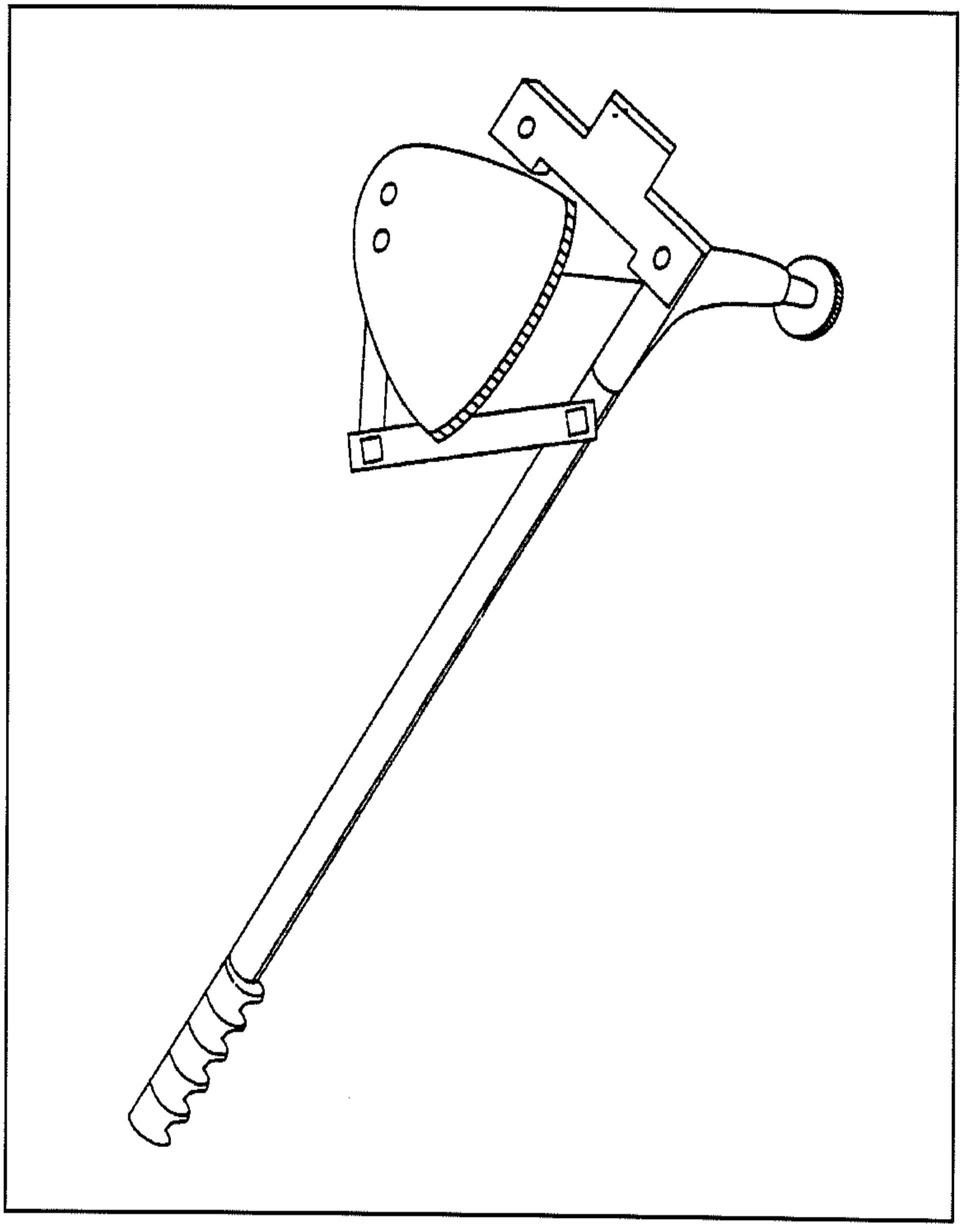

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Figure B-2. Glass Thief

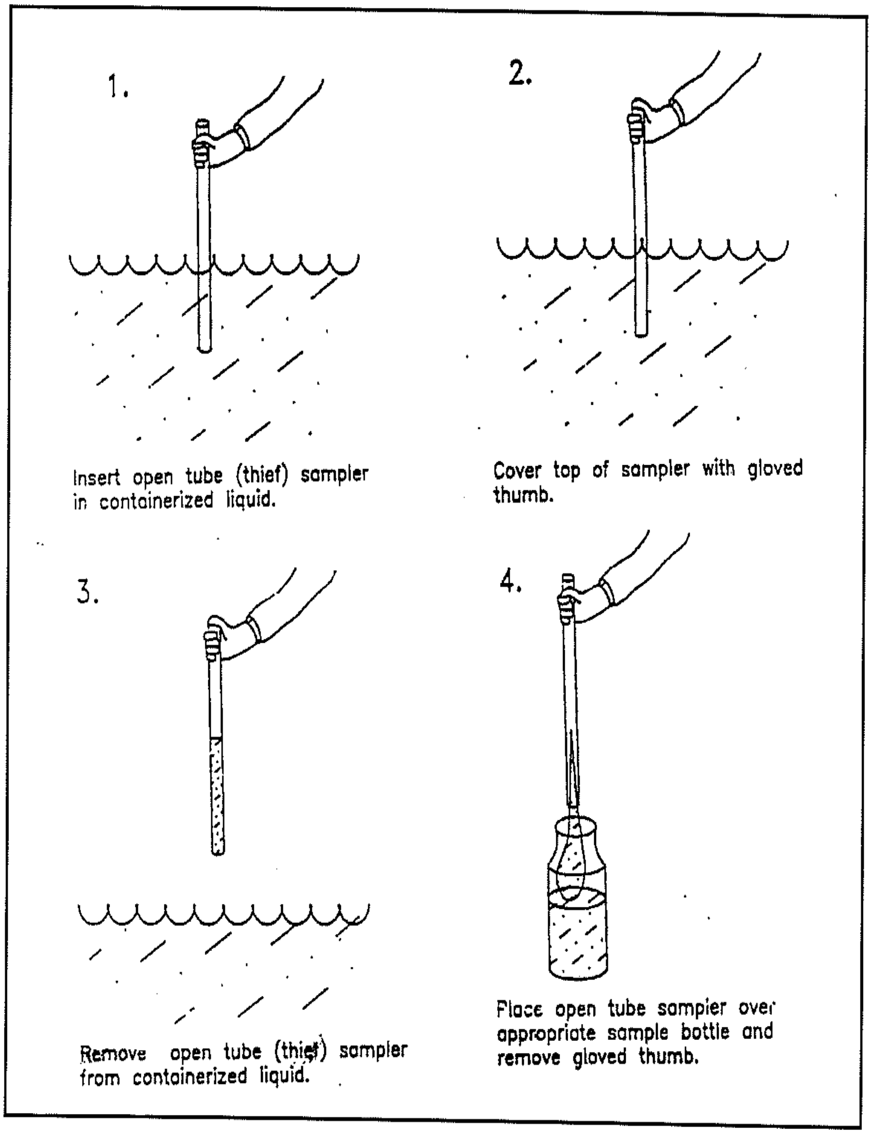

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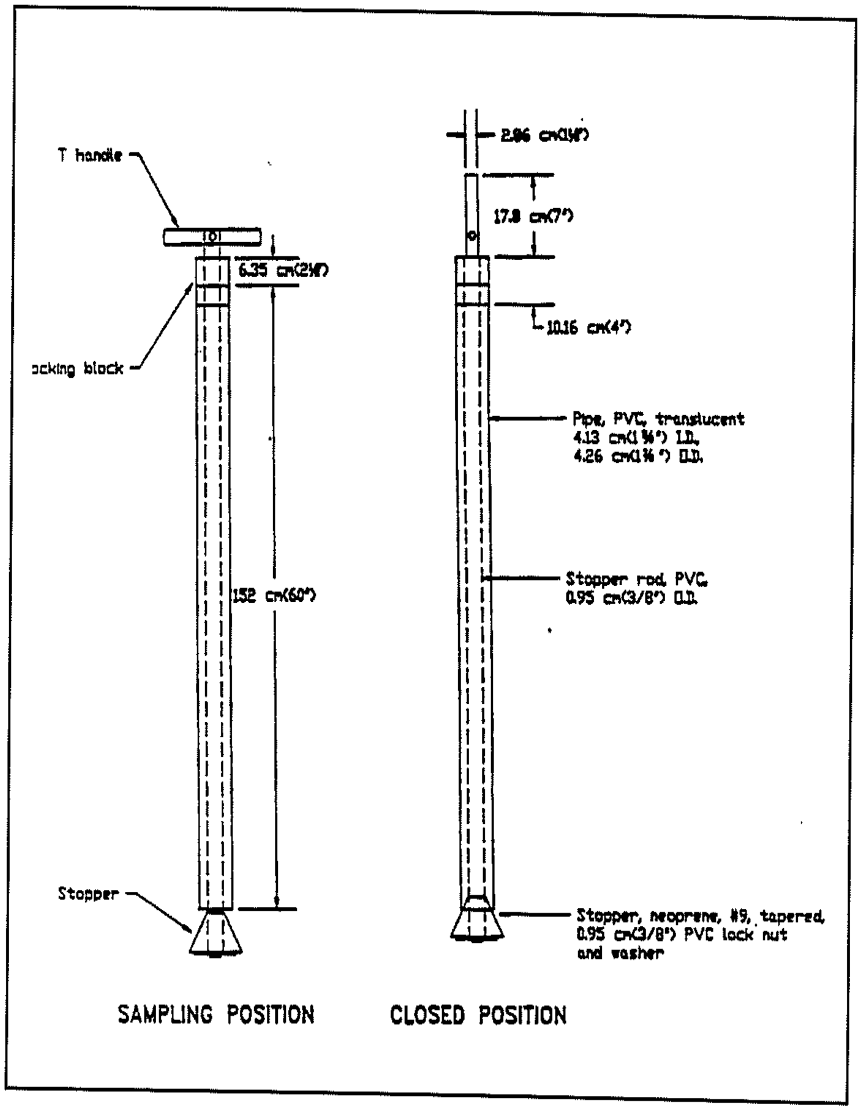
Figure B-3. COLIWASA



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6332106 Standard Operating Procedure No. 039
for
Sample Preservation and
Container Requirements

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Revision 1
August 2021

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1. PURPOSE AND SCOPE

The purpose of this Standard Operating Procedure (SOP) is to define the preservatives and techniques to be employed in preserving environmental samples between collection and analysis.

2. MATERIALS

The following materials may be required:

- Containers (Section 3 provides a description)
- Nitric acid
- Sulfuric acid
- Sodium hydroxide
- Ice chests
- Ice.

3. DEFINITION OF CONTAINER TYPES

Listed below are the definitions of various container types. The container type for PFAS analysis is specific to sampling for these constituents and will be coordinated with the selected laboratory to ensure PFAS compatibility.

Type	Container	Closure	Septum
A	80-ounce amber glass, ring handle bottle/jug, 38-millimeter (mm) neck finish	White polypropylene or black phenolic, baked polyethylene cap, 38-430 size, 0.015-mm polytetrafluoroethelyne (PTFE) liner	
B	40-milliliter glass vial, 24-mm neck finish	White polypropylene or black phenolic, open top, screw cap, 15-mm opening, 24-400 size	24-mm disc of 0.005-inch) PTFE bonded to 0.120-inch silicon for total thickness of 0.125 inches
C	1-liter high density polyethylene, cylinder-round bottle, 28-mm neck finish	White polyethylene cap, white ribbed, 28-410 size; F217 polyethylene liner	
D	120-milliliter wide mouth glass vial, 48-mm neck finish	White polyethylene cap, 40-480 size; 0.015-mm PTFE liner	
E	250-milliliter Boston round glass bottle	White polypropylene or black phenolic, open top, screw cap	Disc of 0.005-inch PTFE bonded to 0.120-inch silicon for total thickness of 0.125 inches
F	8-ounce short, wide mouth, straight-sided, flint glass jar, 70-mm neck finish	White polypropylene or black phenolic, baked polyethylene cap, 48-400 size; 0.030-mm PTFE liner	
G	4-ounce tall, wide mouth, straight-sided, flint glass jar, 48-mm neck finish	White polypropylene or black phenolic, baked polyethylene cap, 48-400 size; 0.015-mm PTFE liner	

Type	Container	Closure	Septum
H	1-liter amber, Boston round, glass bottle, 33-mm pour-out neck finish	White polypropylene or black phenolic, baked polyethylene cap, 33-430 size; 0.015-mm PTFE liner	
K	4-liter amber glass ring handle bottle/jug, 38-mm neck finish.	White polypropylene or black phenolic, baked polyethylene cap, 38-430 size; 0.015-mm PTFE liner	
L	500-milliliter high-density polyethylene, cylinder bottle, 28-mm neck finish	White polypropylene, white ribbed, 28-410 size; F217 polyethylene liner	
N	250-milliliter polyethylene bottle	Unlined polypropylene caps	

4. PROCEDURE

All containers described in Section 3 must be certified clean (SOP Number [No.] 031), with copies of laboratory certification furnished upon request. There may be circumstances when alternative containers will be used (e.g., aluminum foil around tissue samples placed in plastic bags, plastic buckets or bags for large soil/sediment samples, etc.) for which laboratory certification may not be available. Such containering should be appropriately decontaminated or verified appropriately clean prior to using.

Water samples will be collected into pre-preserved containers appropriate to the intended analyte as documented in the Quality Assurance Project Plan. Samples taken for volatile organic compounds will be collected in accordance with SOP No. 003, Section 3.3.8. Samples taken for metals analysis will be verified in the field to a pH <2. The container should be tightly capped, then swirled to thoroughly mix the sample. The cap will then be loosened to release any excess pressure that this operation may have generated. Samples taken for total phosphorous content will be verified in the field to a pH <2. The container should be tightly capped and swirled to thoroughly mix the sample. The cap will then be loosened to release any excess pressure that this operation may have generated. Samples taken for cyanide will be verified for a pH >12. Most other samples do not require added preservation; however, there are analytes that may require special preservation, (i.e., sulfide that requires a zinc acetate preservation). Preservation must be performed as documented in the project-specific Quality Assurance Project Plan. These samples will be immediately placed on ice and cooled to 4±2 degrees Celsius (°C).

Soil and sediment samples will be collected into containers appropriate to the intended analyte as documented in the Quality Assurance Project Plan. Samples taken for volatile organic compound analysis will collected in accordance with the site-specific SOP. Samples taken for metals analysis will be tightly capped, placed on ice, and maintained at a temperature of 4°C. Samples taken for total phosphorous content will be tightly capped, placed on ice, and maintained at a temperature of 4°C. Large (1-2 kilograms) soil/sediment samples taken for incremental samples (SOP No. 057) can be placed in pre-cleaned (SOP No. 005) gallon plastic bags or plastic buckets. Under most circumstances, no preservatives will be added to soil or sediment samples; follow project-specific requirements as documented in the Quality Assurance Project Plan. These samples will be immediately placed on ice and cooled to 4±2°C.

5. MAINTENANCE

Not applicable.

6. PRECAUTIONS

Note that acidifying a sample containing cyanide may liberate hydrogen cyanide gas.

- Avoid breathing any fumes emanating from acidified samples.
- Acidify samples only in the open, rather than in closed spaces (i.e., a vehicle).
- Hold suspected hydrogen cyanide-generating sample away from body and downwind while manipulating it.
- See the Health and Safety Plan for other safety measures.

7. REFERENCES

U.S. Environmental Protection Agency (EPA). 1986. Test Methods for Evaluating Solid Waste, SW-846.

———. 1987. A Compendium of Superfund Field Operations Methods, EPA 540-P87-001.

———. 1991. A Compendium of ERT Soil Sampling and Surface Geophysics Procedures.

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6332106 Standard Operating Procedure No. 042
for
Disposal of
Investigation-Derived Material

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Revision 1
August 2021

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1. SCOPE AND APPLICATION

The purpose of this Standard Operating Procedure is to define the required steps for disposing of investigation-derived material (IDM) generated during field activities. For handling of wastes potentially containing PFAS constituents, IDM management will also comply with any additional requirements specified in the project planning documents and/or as instructed by the client/installation.

IDM, as used herein, includes soil cuttings, drilling muds, extraneous sediment, purged groundwater, decontamination fluids, and disposable personal protective equipment. For the sake of clarity and ease in use, this Standard Operating Procedure is subdivided into procedures for disposal of liquid IDM and solid IDM as follows:

- Liquid IDM (Section 3.2) includes the following materials:
  - Water from initial development of new wells and the redevelopment of existing wells
  - Purge water from groundwater sampling
  - Decontamination fluids (Section 3.4)
- Solid IDM (Section 3.3) consists of the following materials:
  - Soil drill cuttings from monitoring well installation
  - Sediment remaining after collection of the required sample volume
  - Grout, a mixture of cement and bentonite, generated during installation of monitoring wells
  - Disposable personal protective equipment (Section 3.4).

2. MATERIALS

The following materials may be required:

Any additional equipment that may be dictated by project or site-specific plans	Hazardous waste labels
Bar codes	Permanent marker
Chain-of-custody forms	Field logbook (loose leaf, not waterproof)
Department of Transportation 17C specification metal containers	Waste identification labels

When sampling for PFAS constituents, the materials utilized in the management of IDM will be verified for compatibility for this type of activity prior to field events.

3. PROCEDURE

3.1 GENERAL

No container will be labeled as a "Hazardous Waste" unless the contents are in fact known to be hazardous as defined by 40 Code of Federal Regulation 261.

IDM may be disposed onsite if it is: (1) initially screened or evaluated to determine whether it is contaminated; (2) not abandoned in an environmentally unsound manner; and (3) not inherently waste-like.

IDM is to be considered contaminated if: (1) it is visually or grossly contaminated; (2) it has activated any field monitoring device that indicates that the level exceeds standard Level 1; (3) it has previously been found to exhibit levels of contamination above environmental quality standards; and (4) the responsible party and/or appropriate regulator deem(s) that records of historical uses indicate that additional testing of the IDM is needed, or additional caution is warranted handling IDM from a given site.

Waste containing per- and polyfluoroalkyl substance (PFAS) is not classified as characteristic or listed hazardous waste based solely on the presence of PFAS chemicals; however, given the potential for future liability, it is recommended that project teams design investigations to minimize generation of IDM.

3.2 PROCEDURES FOR LIQUID INVESTIGATION-DERIVED MATERIAL DISPOSAL

Listed below are the procedures for the disposal of liquid IDM:

1. A sample shall be analyzed prior to disposal. All water from the initial development of new wells, and purge water generated during the first round of groundwater sampling, will be containerized in Department of Transportation approved 55-gallon drums. Decontamination fluids may be bulk-containerized until completion of the field task.

2. Label all containers as to type of media, date the container was sealed, point-of-generation, and points-of-contact. The well number and container number will be identified on the container.

3. The contractor/support personnel will log all media generated onsite into a the Field Logbook. Media information should include the following: date of generation, contents of containers, number of containers with the same contents (if applicable), location of

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1. This value is defined as two times background, where "background" values are to be determined as follows: (1) regional background values will be used where they are available; and (2) if regional values are not available, background may be empirically determined at uncontaminated sampling sites using onsite sensors such as organic vapor analyzers (photoionization detector or flame ionization detector), scintillometers, etc.

containers, well number the media is associated with, personnel sampling the media, sampling dates, and sampling results.

4. Containers of well development water and purge water may be stored at the well site pending the first round analytical results.

5. Laboratory turnaround time must be no greater than 30 days. Upon receipt of the analytical results, a copy will be furnished to the client within 3 working days. Both the client and contractor will evaluate the data to determine disposal requirements, per state and local regulations. A disposal decision is required within 10 days of receipt of sampling results. Appropriate disposal must be performed no later than 50 days from the decision date unless prevented by inclement weather (e.g., rain and muddy conditions may preclude site access, freezing weather may freeze media) or an alternate disposal schedule is agreed upon by the client.

   Dispose of media in accordance with Steps 6 and 7 of this procedure, as appropriate.

6. If the combined concentration of perfluorooctanoic acid/perfluorooctane sulfonate (PFOS/PFOA) is less than United States Environment Protection Agency (USEPA) Lifetime Health Advisory (LHA) of 70 part per trillion (ppt) or state promulgated standard, and assuming that no other contamination is present and no state or local regulations prohibits it, the water may be returned to the source location at the point of generation or discharged to the sanitary sewer after disclosing the nature and concentration of PFAS constituents contained in the liquid IDW to the local wastewater authority.

   Upon completion of water discharge to ground, enter type of media, amount of media, date of disposal, and discharge point(s) in the Field Logbook and provide this information to the client. Location information in the form of coordinates will also be documented for the point of discharge.

   Empty containers are to be properly decontaminated, stored, and reused by the appropriate personnel.

7. Liquid IDW with a combined PFOS/PFOA concentration greater than the USEPA LHA or state promulgated standard shall be treated on-site prior to discharge or held pending written authorization by the facility director of an approved, permitted treatment plant that will receive the liquid.

3.3 PROCEDURES FOR SOLID INVESTIGATION-DERIVED MATERIAL DISPOSAL

Listed below are the procedures for the disposal of solid IDM:

1. If the conditions outlined in Section 3.1 are met, proceed to Section 3.3, Step 2; otherwise, proceed to Section 3.3, Step 8.

2. A sample shall be analyzed prior to disposal. During soil drilling operations or sediment sampling, the resulting cuttings, mud, and/or extraneous sediment will be discharged onto the ground (or waterbody for sediment) near the well (or sample location for sediment) if the following conditions are met: (1) no visual contamination is observed, (2) organic vapors are less than 5 parts per million above background, (3) radiological meter readings (if applicable) are under two times background, and (4) the medium has been screened and found to be less than two times background if the potential for contamination exists. When sampling for PFAS constituents, review Step 7 prior to disposal.

   Proper sediment and erosion control measures will be implemented as follows:

   - Soil drill cuttings will be uniformly spread and contoured to blend with the surroundings of the site.
   - If amount of solid IDM exceeds 5,000 square feet or 100 cubic yards of material, a sediment and erosion control plan is required.
   - If the amount of solid IDM is under 5,000 square feet or 100 cubic yards, the site will be stabilized as soon as possible. Stabilization includes mulch, seed, and tack.
   - Critical areas require stabilization within 7 days from the date of well completion. Critical areas include swales, water sources, drainage ditches, etc.
   - All other disturbed areas require stabilization within 14 days from the date of well completion.

3. If the well location is in or near a wetland, the soil drill cuttings will be drummed and transported away from the site for spreading.

4. Label all IDM containers that will not be spread on the day of generation. Each container should be labeled with the type of media, date the container was sealed, point-of-generation, and name of the contact person. The well number or sample location and container number should be identified on the container.

5. The contractor/support personnel will log all media generated onsite into a Field Logbook. Media information should include: date of generation, contents in containers, number of containers with the same contents, location of containers, and well number or sample location the media is associated with.

6. Containers will be staged at the well site until contractor/support personnel spread the cuttings in the appropriate locations, using proper sediment and erosion control measures per Section 3.3.

7. If combined concentration of PFOS/PFOA is less than the approved Regional Screening Level (RSL), which is currently 1.26 parts per million (ppm), and assuming that no other

contamination is present and no state or local regulation prohibits it small quantities of the soil and/or sediment may be returned to the source location at the point of generation. Location information in the form of coordinates will be collected.

8. The solid IDM should be sampled and appropriate Toxicity Characteristic Leaching Procedure analyses conducted prior to determining disposition. Laboratory turn-around time must be no greater than 30 days. Upon receipt of analytical results, a copy will be furnished to the client within 3 working days. The contractor will evaluate the data to determine disposal requirements within 10 days. Appropriate disposal must be performed no later than 50 days after the decision date if weather permits (Section 3.2) or based on an alternate schedule agreed upon by the client.

   - If the solid IDM is determined to be non-hazardous and uncontaminated, proceed to Section 3.3.

   - If the solid IDM is determined to be non-hazardous but contaminated, proceed to Section 3.3.

   - If the solid IDM is found to be hazardous wastes, proceed to Section 3.3.

9. Soil and/or sediment IDW with a combined concentration of PFOS/PFOA greater than the approved RSL (currently 1.26 ppm) or state promulgated standard may be returned to the source location at the point of generation only with approval from the facility director. Otherwise, the soil and/or sediment shall be incinerated at an approved permitted facility or treated on-site prior to discharge via other available technology. Soil may be held on-site pending written authorization by the facility director of an approved, permitted treatment plant that will receive the soil and/or sediment.

   - If no treatment facility is available, then disposing PFAS-containing IDW an non-hazardous waste at an USEPA approved Subtitle D Industrial Waste Landfill or equivalent facility capable of processing non-hazardous waste should be considered, and written authorization and acceptance of the PFAS containing IDW should be obtained from the landfill.

10. If the solid IDM is not a hazardous waste **and** analytical data show contaminant concentrations below the U.S. Environmental Protection Agency Region 3 (or applicable Region where work is being performed) Risk-Based Concentrations, contact the appropriate federal, state, or local agency for approval to discharge onto the ground or back to the waterbody near the site of generation.

    - Follow steps detailed in Section 3.3, Step 2 (above) pertaining to sediment and erosion control.

    - Upon completion of the solid IDM discharge to the ground or waterbody (for sediment), enter type of media, amount of media, date of disposal, and discharge point(s) in a bound Field Logbook. This information must be provided to the client.

- Empty containers are to be properly decontaminated, stored, and reused by appropriate personnel.

11. If the intrusive media is not a hazardous waste but analytical data show concentrations above the screening criteria, dispose of the IDM according to state and local regulations.

    - Ensure that the waste containers are properly labeled as applicable in accordance with Section 3.3, Step 4.

    - Inform the client of the type and amount of waste, and location of the waste.

    - When the waste is removed, enter the type of waste, amount of waste, date of pickup, and destination of the waste in a bound Field Logbook. This information must be provided to the client.

3.4 PROCEDURES FOR DECONTAMINATION SOLUTION AND PERSONAL PROTECTIVE EQUIPMENT DISPOSAL

Decontamination solutions include catch water from steam-cleaning operations performed on large sampling equipment, drill rigs, and drums, as well as smaller quantities of soapy water and rinse solutions used in decontaminating field sampling equipment. At the completion of the field event, a composite sample of the decontamination solution will be taken. The decontamination solution will be treated as liquid IDM pending results (Section 3.2).

Person protective equipment, other debris, and spent treatment media may be disposed at a Resource Conservation and Recovery Act (RCRA) Subtitle D landfill. Spent treatment media contaminated with PFAS at high concentrations or PFAS products must be incinerated or thermally destructed at sustained temperatures above 1700 degrees Fahrenheit, disposed at a RCRA Subtitle C landfill, or solidified then disposed at a RCRA Subtitle D landfill.

4. MAINTENANCE

The waste manifest document and bill of lading should be uploaded to the project file as soon as possible in either hard copy or electronic format. Refer to EA's Records Retention Policy for archiving information.

5. REFERENCES

Environment Article Section 7-201(t).

U.S. Army Corps of Engineers. 2020. PFAS Chemistry Instructions for Scopes of Services for Contracted Environmental Studies. March.

U.S. Environmental Protection Agency. 1991. Management of Investigation-Derived Wastes during Site Inspections PB91-921331, OERR Directive 9345.3-02. Office of Emergency and Remedial Response U.S. Environmental Protection Agency, Washington, D.C. May.

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6332106 Standard Operating Procedure No. 043 for Multi-Probe Water Quality Monitoring Instruments

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Revision No. 1
August 2021

CONTENTS

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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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6332106 Standard Operating Procedure No. 047
Direct-Push Technology Sampling

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Revision: 1
August 2021

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1. SCOPE AND APPLICATION

This Standard Operating Procedure (SOP) establishes the protocol for using direct-push technology (DPT) in media sampling and performing subsurface characterization. This SOP includes the following DPT methods: Geoprobe®, Hydropunch®, Cone Penetrometer Testing (CPT), and Site Characterization and Analysis Penetrometer System (SCAPS).

2. MATERIALS

The following materials may be required:

Appropriately sized, all-terrain vehicle-skid-or track-mounted; DPT equipment; and supplies (i.e., hydraulic derrick and hammer assembly)	Personal protective equipment
Bentonite grout and clean sand for DPT hole abandonment	Phosphate-free, laboratory-grade detergent (e.g., Liquinox, Alconox, etc.)
DPT stainless steel rods	Source of approved water
Heavy plastic sheeting	Steam cleaner/sprayer and water obtained from approved source for decontaminating DPT equipment
Logbook	Steel drums for intrusion derived wastes (e.g., contaminated personal protective equipment, decon solutions, etc.)
Long-handled bristle brushes	Wash and rinse tubs
Mini-bailer or tubing and peristaltic pump (groundwater sampling only)	

3. GEOPROBE® AND HYDROPUNCH®

3.1 MATERIALS

Water sources for Geoprobe® and Hydropunch® activities, grouting, sealing, filter placement, well installation, and equipment decontamination must be approved by the Project Manager prior to arrival of the Geoprobe® and Hydropunch® equipment. Information required for the water source includes: water source, manufacturer/owner, address and telephone number, type of treatment and filtration prior to tap, time of access, cost per gallon (if applicable), dates and results associated with all available chemical analysis over the past 2 years, and the name and address of the analytical laboratory (if applicable).

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

Portland Type II cement will be used for grout (refer to SOP No. 019).

3.2 GROUNDWATER – HYDRAULIC PUSHING AND SAMPLING

The objective of the selected DPT sampling technique is to allow grab samples to be taken at a selected site to facilitate aquifer characterization and analysis of potential contaminants. The analytical results from sampling can also be used to determine the placement of monitoring wells.

A site geologist will be present during all sampling and installation procedures, and will fully document all procedures and soil characteristics in the Field Logbook (refer to SOP No. 016).

The site geologist will have on hand, at a minimum, a copy of the approved Health and Safety Plan, this SOP, the Field Investigation Work Plan, a hand lens (10X), a standard color chart, and a grain size chart.

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

Surface runoff or other fluids will not be allowed to enter any DPT location or well during or after DPT activities.

The subcontractor will use the equipment specific guidelines for installation of the Geoprobe® DPT equipment. Probe rods will be forced into the ground by hydraulic means.

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

- Collect the groundwater sample in the screen interval with a mini-bailer, peristaltic or vacuum pump, or other acceptable small diameter sampling device.

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

The subcontractor will use the equipment-specific guidelines for installation of the Hydropunch® equipment. Rods will be forced into the ground by hydraulic means.

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

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

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

- The sample volume collected with this technique is approximately 500-1,000 ml. Larger sample volumes can be collected by inserting tubing attached to a peristaltic pump into the rods to obtain water samples.

If desired, a small diameter monitoring well may be installed at this point. Refer to SOP No. 019 (Monitoring Well Installation).

If a well will not be installed, the rods will be removed as the borehole is simultaneously filled with a bentonite/grout mixture. A polyvinyl chloride (PVC) tube fed into the rod casing will allow the addition of grout.

3.3 SUBSURFACE SOIL – HYDRAULIC PUSHING AND SAMPLING

The objective of the selected DPT sampling technique is to allow grab samples to be taken at a selected site for characterization of the stratigraphy and for analysis of potential contaminants. The analytical results from sampling can also be used to determine the placement of monitoring wells.

A site geologist will be present during all DPT sampling and soil characterization. All procedures and soil characteristics will be fully documented in the Field Logbook (refer to SOP No. 016).

The site geologist will have on hand, at a minimum, a copy of the approved Health and Safety Plan, this SOP, the Field Investigation Plan, a hand lens (10X), a standard color chart, and a grain-size chart.

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

Surface runoff or other fluids will not be allowed to enter any DPT location or well during or after DPT activities.

The subcontractor will use the equipment specific guidelines for installation of the Geoprobe® DPT equipment. Probe rods will be forced into the ground by hydraulic means. Additional rods will be added in 3- to 4-ft increments until the leading edge of the sampler reaches the top of the desired sampling interval.

Once the desired sampling depth has been reached, insert extension rods down the inside diameter of the probe rods until it reaches the top of the sampler assembly. Attach the extension rod handle to the top extension rod. Turn the handle clockwise until the stop-pin detaches from the drive head.

Remove the extension rods and the stop-pin. Attach a drive cap to the probe and drive the sampler approximately 2 ft using hydraulic derrick.

The DPT sampler can be retrieved by pulling the probe rods from the hole with the hydraulic derrick and hammer assembly.

The liner will be capped with Teflon® tape and vinyl end caps. The liners can be split open to remove samples for composition analysis or for transfer to other containers for shipment to the laboratory for analysis.

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

3.4 DECONTAMINATION

All Geoprobe® and Hydropunch® DPT equipment must be thoroughly cleaned before and after each use to allow retrieval of representative groundwater samples. Geoprobe® soil sample liners are disposed of after each use. Scrub all metal parts with a stiff, long bristle brush and a non-phosphate soap solution. Steam cleaning may be substituted where available. Rinse with distilled water and allow to air-dry before assembly.

After decontamination, a new clean liner will be installed and all parts will be inspected for wear or damage.

Refer to SOP No. 005 (Field Decontamination).

3.5 ABANDONMENT

Pure bentonite or a bentonite/grout mixture (20:1) will be used to fill the resulting borehole if the water table is penetrated. Boreholes that do not penetrate the water table will be backfilled with cuttings from the hole and topped with a bentonite seal. Clean sand will be used to fill any remaining volume in the borehole.

Abandonment of Geoprobe® and Hydropunch® generated DPT boreholes will meet the standards established under SOP No. 028 (Well and Boring Abandonment).

4. CONE PENETROMETER TESTING

4.1 MATERIALS

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

Water sources for CPT activities and decontamination must be approved by the Project Manager prior to arrival of the CPT equipment. Information required for the water source includes: water source, manufacturer/owner, address and telephone number, type of treatment and filtration prior to tap, time of access, cost per gallon (if applicable), dates and results associated with all available chemical analysis over the past 2 years, and the name and address of the analytical laboratory (if applicable).

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

Portland Type II cement will be used for grout (refer to SOP No. 019).

4.2 SUBSURFACE CHARACTERIZATION

The objective of this technology is to collect stratigraphic information using CPT equipment to determine subsurface stratigraphy and geotechnical properties at a particular site. CPT activities will be in accordance with American Society for Testing and Materials D 3441-86 and American Society for Testing and Materials D 5778-95. The stratigraphic information gathered can be used to facilitate the selection of DPT sampling screen intervals. At the same time, it is possible to install a 0.25-in. diameter pre-packed PVC monitoring well.

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

The CPT probe includes the following components:

- A conical tip to measure vertical resistance beneath the tip.
- A friction sleeve to measure frictional resistance on the side of the probe, as a function of depth.

- Two internal strain gauge-type load cells, which independently measure the vertical resistance and side friction.

- A cone pressure gauge to measure the water pressure as the probe is pushed into the ground.

- Inclinometer to determine potential drifting of the probe (optional).

- Seismic transducers to perform downhole seismic surveys (optional). Therefore, stratigraphic data collected with the CPT include: tip resistance, local friction, friction ratio, pore pressure, and resistivity.

Data will be transferred from the probe to the data acquisition system or logger through an electrical cable. The hole will be advanced continuously at a rate of 0.6-1.0 in. per second. The data will be logged at every 0.4-0.8 in. of penetration. Monitor the probe's stratigraphic position will be monitored as it advances downward. Perform pore water pressure dissipation tests in representative hydrostratigraphic intervals. Record dissipated pore water pressures to represent hydraulic head values.

Once the confining unit underlying the surficial aquifer or the required depth has been reached, the CPT is pulled from the ground. Target interval samples can be collected during CPT hole advancement using direct push sampling techniques, i.e., Geoprobe® or Hydropunch® (Section 3).

4.3 DECONTAMINATION

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

Refer to SOP No. 005 (Decontamination).

4.4 ABANDONMENT

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

Refer to SOP No. 028 (Well and Boring Abandonment).

5. SITE CHARACTERIZATION AND ANALYSIS PENETROMETER SYSTEM

5.1 MATERIALS

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

All materials required to complete SCAPS analysis are provided by the subcontractor to include cone penetrometer equipment. All hydraulic equipment, SCAPS rods, nitrogen lasers, etc. are included within the vehicle. A decontamination water source and a source of water for mixing the grout are required.

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

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

Portland Type II cement will be used for grout (refer to SOP No. 019).

5.2 HYDRAULIC PUSHING AND SAMPLING

The objective of the SCAPS technique is to allow grab samples and stratigraphic information to be collected at a selected site to facilitate subsurface characterization and for analysis of potential contaminants. The analytical results obtained can also be used to determine the placement of monitoring wells. At the same time, it is possible to install a small diameter well for sampling purposes. Refer to SOP No. 019 (Monitoring Well Installation). If a well will not be installed, the borehole can be grouted as the equipment is removed.

A site geologist will be present during all installation and sampling procedures and will fully document all procedures and soil characteristics in the Field Logbook (refer to SOP No. 016).

The site geologist will have on hand, at a minimum, a copy of the approved Health and Safety Plan, this SOP, the Field Investigation Work Plan, a hand lens (10X), a standard color chart, and a grain-size chart.

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

Surface runoff or other fluids will not be allowed to enter any DPT location or well during or after direct-push activities.

The subcontractor will use the equipment specific guidelines for installation of the SCAPS DPT equipment. Prior to SCAPS field activities, calibration soil samples will be collected and analyzed in order to determine the LIF sensor fluorescence threshold and detection limits for the site.

SCAPS LIF technology uses a pulsed nitrogen laser coupled with an optical detector to make fluorescence measurements via optical fibers. The LIF sensor is mounted on a cone penetrometer probe so that soil classification data and fluorescence data are collected simultaneously. The laser consumes nitrogen gas, which is supplied from cylinders stored on the accompanying trailer.

The SCAPS CPT sensors are used to gather stratigraphic information. See Section 4 for CPT operating procedures.

Target interval samples can be collected during SCAPS hole advancement using direct push sampling techniques such as Geoprobe® or Hydropunch® (Section 3).

5.3 DECONTAMINATION

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

Worker exposure is reduced by minimizing contact with contaminated media.

Refer to SOP No. 005 (Decontamination).

5.4 ABANDONMENT

SCAPS automatically grouts the penetrometer cavity as the rods are removed. The grout is pumped at high pressure through a 0.25-in. diameter tube in the center of the penetrometer rods. The tip is sacrificed at the bottom of the cavity to allow release of the grout.

A trailer attached to the back of the vehicle contains the 300-gal grout mixing bin and pump.

If the automatic grout feed does not work, the cavity will be manually filled with grout.

Abandonment of SCAPS generated borehole will meet the standards established under SOP No. 028 (Well and Boring Abandonment).

6. MAINTENANCE

Not applicable.

7. PRECAUTIONS

Refer to the site-specific Health and Safety Plan for discussion of hazards and preventive measures during intrusive activities.

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6332106 Standard Operating Procedure No. 048
for
Low-Flow Sampling

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Revision 1
August 2021

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1. GROUNDWATER SAMPLING BY LOW-FLOW PURGE AND SAMPLING METHOD USING DEDICATED PUMPS

1.1 SCOPE OF APPLICATION

The purpose of this Standard Operating Procedure (SOP) is to establish the protocol for collecting groundwater samples using dedicated pump systems. The procedure is designed to permit the collection of groundwater samples with minimum turbidity.

Note that groundwater sampling using dedicated equipment is not anticipated during the PFAS remedial investigations, and this SOP should be reviewed and revised should dedicated equipment be used.

1.2 EQUIPMENT/MATERIALS

- Work Plan.
- Well construction data, location map, and field data from last sampling event.
- Field logbook (non-waterproof when sampling for PFAS constituents) and Field Record of Well Gauging, Purging, and Sampling forms (Figure PFAS SOP048-1).
- Electric water level measuring device, 0.01 ft accuracy for monitoring water level during pumping operations.
- Pumps: adjustable rate, submersible pumps constructed of stainless steel and Teflon®.
- Tubing: Teflon or Teflon-lined polyethylene must be used to collect samples for organic analysis. For samples collected for inorganics analysis, Teflon or Teflon-lined polyethylene tubing will be used.
- Flow measurement supplies (e.g., graduated cylinder and stop watch).
- Power source (generator, etc.).
- Water quality indicator parameter monitoring instruments—pH, turbidity, specific conductance, and temperature. Optional indicators—Eh and dissolved oxygen.
- Flow-through cell (preferred) or clean container for water quality probes.
- Decontamination supplies (for monitoring instrumentation).
- Sample bottles and sample preservation supplies (as required by the analytical methods).
- Sample tags or labels.

- Cooler with bagged ice for sample bottles.

- Drum for purge water containment.

1.3 PRELIMINARY SITE ACTIVITIES

The following site activities are required prior to performing well purging and groundwater sampling. Field logbooks and sampling forms should be filled out as the procedure is being performed, as noted:

- Enter the following information in the field logbook and sampling form, as appropriate: site name, project number, field personnel, well identification, weather conditions, date and time, equipment used, and quality assurance/quality control data for field instrumentation.

- Check well for damage or evidence of tampering, record pertinent observations in field logbook and sampling form.

- Lay out sheet of polyethylene for monitoring and sampling equipment.

- Unlock well and remove well cap (if applicable).

- Measure VOCs with an ionization detector (flame or photo) instrument at the rim of the well and in the breathing zone, and record the readings in the field logbook and the sampling form.

- Measure and record the height of protective casing above the concrete pad or ground surface, as appropriate. This reading is compared to that recorded during well installation as an indication of possible well damage or settling that may have occurred.

- Dedicated sampling pumps should be positioned with the pump intake mid-point in the screened interval. If non-dedicated equipment is used, care will be taken to position pump or sampling hose intake at the screen mid-point.

- Measure and record the depth to water (to 0.01 ft) in the well to be sampled before purging begins. If the well casing does not have a reference point (usually a v-cut or indelible mark in the well casing), make one. If a reference point is made, it will be noted in the field logbook. Care should be taken to minimize disturbance of any particulate attached to the sides or at the bottom of the well. The depth to well bottom will be measured following the completion of sampling because of the potential to stir up sediment at the bottom of the well.

- Prepare the pump by checking electrical connections, discharge tubing, and motor (Grundfos Redi-Flo2). Locate the generator (if applicable) downwind of the well; connect the power converter to the generator and to the pump.

1.4 WELL PURGING AND SAMPLING PROCEDURE

The following general procedure should be followed to obtain representative groundwater samples. Field logbooks and sampling forms should be filled out as the procedure is being performed, as noted:

- Enter the following information in the field logbook and sampling form, as appropriate, prior to purging: purge date and time, purge method, and total well depth.

- Connect the flow-through cell or clean container containing the instrumentation header to the pump discharge and begin purging the well at 0.2-0.5 L/min, unless a different purge rate has been previously established for that well. Fill the flow cell completely. Care should be taken not to cause entrapment of air in the system. Record the purge start time and purge rate.

- Establish that the water level has not dropped significantly such that the pump is dry (bubbles in discharge) or water is heard cascading down the inside of the well. Ideally, the pump rate should cause little or no water level drawdown in the well (>0.5 ft and the water level should stabilize). The water level should be monitored every 3-5 minutes (or as appropriate) during pumping. Record pumping rate adjustments and depths to water. Pumping rates should, if needed, be reduced to the minimum capabilities of the pump (e.g., 0.1-0.2 L/min) to avoid pumping the well dry and/or to ensure stabilization of indicator parameters. If water levels continue to drop with the pump on the lowest flow rate, the pump will be shut off and the well will be allowed to recharge to prevent the well from going dry. **The well will not be purged to dryness prior to sampling to prevent erroneous field parameters and groundwater samples.** Sampling will commence as soon as the well has recharged to a sufficient level to collect the appropriate volume of samples with the pump.

- During purging of the well, monitor the water quality indicator parameters (turbidity, temperature, specific conductance, pH, etc.) every 3-5 minutes (or as appropriate). Record purge rate, volume purged, depth to water, water quality indicator parameters values, and clock time at 3- to 5-minute intervals in field logbook and sampling record. Purging of the standing well water is considered complete when three consecutive readings of the water quality indicator parameters agree within approximately 10 percent. Turbidity readings consistently below 10 nephelometric turbidity units (NTU) are considered to represent stabilization of discharge water for this parameter. If the parameters have stabilized, but the turbidity is not in the range of the 10 NTU goal, the pump flow rate should be decreased and measurement of the parameters should continue every 3-5 minutes.

- Purge water at a well will be containerized if a well has exceeded the MEG or MCL in previous sampling events. Any purge water that is collected will be treated at the groundwater treatment plant.

- Prior to sampling, disconnect the discharge tubing from the flow-through cell. If the water discharged by the pump is silty, wait for the water to clear before sampling. Ensure that bubbles are not observed in the discharge tubing. Record pertinent observations in field logbook and sampling records.

- 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. Collect the samples in the order below, as applicable:

  — VOCs
  — Inorganics.

- VOC samples requiring pH adjustment will have their pH checked to assure 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. Details on sample preservation are discussed in Section 1.5.

- Label each sample as collected. Those samples (VOCs, etc.) requiring cooling will be placed into an ice cooler for delivery to the laboratory. Inorganic samples, after preservation, do not need to be cooled.

- After collection of the samples, restore the dedicated pumping assembly to the well by hanging the tube, electric line, and support cable inside the well by the specially-designed PVC well cap assembly. Lock well.

- Complete remaining portions of Field Record of Well Gauging, Purging, and Sampling form (Figure SOP048-1) after each well is sampled, including sample date and time, total quantity of water removed, well sampling sequence, types of sample bottles used, sample identification numbers, preservatives used, parameters requested for analysis, and field observations of sampling event.

1.5 SAMPLE PRESERVATION

The following preservation procedures are examples of typical preservation protocols specific to the indicated analyses. Pre-preserved bottles will be used if possible. Minimum sample preservation requirements for each parameter group are summarized below:

- **VOCs—**Aqueous VOC samples must be collected as specified below. Each VOC sample is taken in duplicate:

— Uncap the sample bottle, taking care not to touch the Teflon-faced septum. If the septum is contaminated in any way, it should be replaced.

— Fill a sample bottle, preserve with HC1, and check the pH. Adjust the volume of HC1 to assure pH<2.

— Add the amount of HC1 determined in the above step, and fill the sample vial slowly from the tubing, minimizing air entrainment, until the vial slightly overflows.

— Place the Teflon-faced silicon rubber septum on the convex meniscus, Teflon side (shiny side) down and screw cap on.

— Invert the bottle, tap lightly, and check for air bubbles.

— If air bubbles are present, open the bottle, add sample to eliminate air bubbles, and reseal. Repeat this procedure until the bottle is filled and no air bubbles are detected.

— Place samples on ice until shipment.

- **Inorganics**—Fill the sample bottle, preserve the sample to pH<2 with nitric acid (HNO_3), seal container, and place sample on ice for shipment.

Disposable pipettes should be used to introduce chemicals into the samples if necessary. Chemicals used for preserving should be poured into a 150-ml beaker. They should not be drawn directly from the preservative bottles because the bottle may become contaminated. Measurements for pH and temperature should not be taken from the sample containers. When preserving samples to a required pH, pH paper should be used to check the resultant pH. The sample should be poured across the pH paper. Never place pH paper directly into sample.

NOTE: Shipping regulations limit the amount of preservative which can be added. For a 1-L sample, this is generally 1.5 ml of acid preservative.

1.6 FIELD QUALITY CONTROL

Quality control samples are required to verify that the sample collection and handling process has not affected the quality of the groundwater samples. All field quality control samples must be prepared exactly as regular investigation samples with regard to sample volume, containers, and preservation. The following quality control samples will be collected for each sample delivery group (SDG) (an SDG may not exceed 20 samples) at the frequency noted:

- Field Duplicate—Required at a frequency of 10 percent per SDG.

- Matrix Spike/Matrix Spike Duplicate—Required at a frequency of 5 percent.

- Equipment Rinsate Blank—Required once prior to installation of dedicated pump systems.

- Source Water Blank—Required at a frequency of once per source per sampling event when equipment (rinsate) blank is required.

- Trip Blank—Required for VOC samples at a frequency of one per sample shipment.

1.7 DECONTAMINATION

Non-dedicated sampling equipment and field monitoring equipment will be decontaminated prior to use and following sampling of each well. This equipment will be decontaminated by the procedure listed below. Alternative procedures must be approved by the Project Manager prior to sampling event. Decontamination fluids will be collected in a 5-gal bucket and treated at the groundwater treatment plant.

The following decontamination procedure will be used:

- Flush the equipment with potable water
- Flush with non-phosphate detergent solution
- Flush with tap water to remove all of the detergent solution
- Flush with distilled/deionized water
- Flush with isopropyl alcohol
- Flush with distilled/deionized water.

It is recommended that the detergent and isopropyl alcohol used in the above sequence be used sparingly.

2. GROUNDWATER SAMPLING BY LOW-FLOW PURGE AND SAMPLING METHOD USING PERISTALTIC PUMPS

2.1 SCOPE OF APPLICATION

The purpose of this SOP is to establish the protocol for collecting groundwater samples using peristaltic pump systems. The procedure is designed to permit the collection of groundwater samples with minimum turbidity and is intended to be used in conjunction with the analyses for the most common types of groundwater contaminants (VOCs and inorganic compounds). The SOP is also to be used in conjunction with PFAS analysis.

2.2 EQUIPMENT/MATERIALS

- Work Plan.

- Well construction data, location map, field data from last sampling event (if available).

- Field logbook (non-waterproof and compatible with PFAS sampling) and Field Record of Well Gauging, Purging, and Sampling forms (Figure SOP048-1).

- Water level measuring device, 0.01 ft accuracy (electronic preferred) for monitoring water level drawdown during pumping operations.

- Peristaltic pump.

- In-well tubing: Teflon or Teflon-lined polyethylene must be used to collect samples for organic analysis. For samples collected for inorganics analysis, Teflon or Teflon-lined polyethylene, PVC, Tygon, or polyethylene tubing may be used. For samples collected for PFAS analysis, only HDPE tubing may be used.

- Pump head tubing: Silicon tubing must be used to in the pump head assembly.

- Flow measurement supplies (e.g., graduated cylinder and stop watch).

- Power source (battery, etc.).

- Water quality indicator parameter monitoring instruments – pH, turbidity, specific conductance, and temperature. Optional indicators – Eh and dissolved oxygen.

- Flow-through cell (preferred) or clean container for water quality probe.

- Decontamination supplies (for monitoring instrumentation).

- Sample bottles and sample preservation supplies (as required by the analytical methods).

- Sample tags or labels.

- Cooler with bagged ice for sample bottles.

- Drum for purge water containment.

2.3 PRELIMINARY SITE ACTIVITIES

The following site activities are required prior to performing well purging and groundwater sampling. Field logbooks and sampling forms should be filled out as the procedure is being performed, as noted:

- Enter the following information in the field logbook and sampling form, as appropriate: site name, project number, field personnel, well identification, weather conditions, date and time, equipment used, and quality assurance/quality control data for field instrumentation.

- Check well for damage or evidence of tampering, record pertinent observations in field logbook and sampling form.

- Unlock well and remove well cap (if applicable).

- Measure VOCs with an ionization detector (photo or flame) instrument at the rim of the well and in the breathing zone and record the readings in the field logbook and the sampling form.

- Measure and record the height of protective casing above the concrete pad, or ground surface, as appropriate. This reading is compared to that recorded during well installation as an indication of possible well damage or settling that may have occurred.

- Measure and record the depth to water (to 0.01 ft) in the well to be sampled before purging begins. If the well casing does not have a reference point (usually a v-cut or indelible mark in the well casing), make one. If a reference point is made, it will be noted in the field logbook. Care should be taken to minimize disturbance of any particulate attached to the sides or at the bottom of the well. The depth to well bottom will not be measured following the completion of sampling because of the potential to stir up sediment at the bottom of the well.

- Position the intake of the sampling hose at the mid-point of the screened interval.

- Prepare the pump by checking electrical connections and discharge tubing. Locate the battery downwind of the well; connect the peristaltic pump to the battery.

2.4 WELL PURGING AND SAMPLING PROCEDURES

The following general procedure should be followed to obtain representative groundwater samples. Field logbooks and sampling forms should be filled out as the procedure is being performed, as noted:

- Enter the following information in the field logbook and sampling form, as appropriate, prior to purging: purge date and time, purge method, and total well depth.

- Measure the water level with the pump in well before starting the pump. Begin purging the well at 0.3-0.5 L/min, unless a different purge rate has been previously established for that well.

- If well diameter permits, establish that the water level has not dropped significantly such that the pump is dry (air in discharge) or tubing suction is broken. Ideally, the pump rate should cause little or no water level drawdown in the well (>0.5 ft and the water level should stabilize). The water level should be monitored every 3-5 minutes (or as appropriate) during pumping. Care should be taken not to cause pump suction to be broken, or entrainment of air in the pump system. Record pumping rate adjustments and depths to water. Pumping rates should, if needed, be reduced to the minimum capabilities of the pump (e.g., 0.3 L/min) to avoid pumping the well dry and/or to ensure stabilization of indicator parameters. If water levels continue to drop with the pump on the lowest flow rate, the pump will be shut off and the well will be allowed to recharge to prevent the well from going dry. **The well will not be purged to dryness prior to sampling to prevent erroneous field parameters and groundwater samples.** Sampling will commence as soon as the well has recharged to a sufficient level to collected the appropriate volume of samples with the pump.

- During purging of the well, monitor the field indicator parameters (turbidity, temperature, specific conductance, pH, etc.) every 3-5 minutes (or as appropriate). Purging will we considered complete when parameters stabilize for at least three consecutive readings within the following limits: 1°C for temperature, ± 0.1 pH, ± 0.1 mS/cm or ± 3% (whichever is less) for conductivity, ± 10 mV or 10% (whichever is less) for redox potential, <10 NTU for turbidity, or if purging has continued for more than two hours, ± 0.3 mg/L or ± 10% (whichever is less) for dissolved oxygen. Removal of specific volume of water is also not required, provided all water quality parameters are stable as noted above. Turbidity readings consistently below 10 NTU are considered to represent stabilization of discharge water for this parameter. If the parameters have stabilized, but the turbidity is not in the range of the 10 NTU goal, the pump flow rate should be decreased and measurement of the parameters should continue every 3-5 minutes.

- Purge water at a well will be containerized if a well has exceeded the MEG or MCL in previous sampling events. Any purge water that is collected will be containerized and managed as investigation-derived waste in accordance with project-specific procedures.

- Prior to sampling, disconnect the sample discharge tubing from the flow-through cell. If the water discharged by the pump is silty, wait for the water to clear before sampling. Ensure that bubbles are not observed in the discharge tubing.

- Collect groundwater samples directly from the silicon tubing into preserved (when appropriate) sample containers. Begin filling sample containers from the pump discharge, allowing the water to fill the containers by allowing the pump discharge to flow gently down the inside of the container with as little agitation or aeration as possible. Collect the samples in the order below, as applicable:

  — PFAS
  — VOCs
  — Inorganics.

- VOC samples requiring pH adjustment will have their pH checked to assure 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. Detail on sample preservation are discussed in Section 2.5.

- Label each sample as collected. Those samples (PFAS, VOCs, etc.) requiring cooling will be placed into an ice cooler for delivery to the laboratory. Inorganic samples, after preservation, do not need to be cooled.

- After collection of the samples, restore the dedicated tubing assembly to the well by hanging the tube inside the well by the specially-designed PVC well cap assembly. Lock well.

- Complete remaining portions of Field Record of Well Gauging, Purging, and Sampling form (Figure SOP048-1) after each well is sampled, including: sample date and time, total quantity of water removed, well sampling sequence, types of sample bottles used, sample identification numbers, preservatives used, parameters requested for analysis, and field observations of sampling event.

- The silicon tubing used in the peristaltic pump will be changed after use at each well.

2.5 SAMPLE PRESERVATION

The following preservation procedures are examples of typical preservation protocols specific to the indicated analyses. Pre-preserved bottles will be used if possible. Minimum sample preservation requirements for each parameter group are summarized below:

- **VOCs**—Aqueous VOC samples must be collected as specified below. Each VOC sample is taken in duplicate:

  — Uncap the sample bottle, taking care not to touch the Teflon-faced septum. If the septum is contaminated in any way, it should be replaced.

  — Fill a sample bottle, preserve with HCL, and check the pH. Adjust the volume of HCL to assure pH<2.

  — Add the amount of HCL determined in the above step, and fill the sample vial slowly from the tubing, minimizing air entrainment, until the vial slightly overflows.

  — Place the Teflon-faced silicon rubber septum on the convex meniscus, Teflon side (shiny side) down, and screw cap on.

  — Invert the bottle, tap lightly, and check for air bubbles.

  — If air bubbles are present, open the bottle, add sample to eliminate air bubbles, and reseal. Repeat this procedure until the bottle is filled and no air bubbles are detected.

  — Place samples on ice until shipment.

- **Inorganics**—Fill the sample bottle, preserve the sample to pH<2 with nitric acid (HNO_3), seal container, and place sample on ice for shipment.

Disposable pipettes should be used to introduce chemicals into the samples if necessary. Chemicals used for preserving should be poured into a 150-ml beaker. They should not be drawn directly from the preservative bottles because the bottle may become contaminated. Measurements for pH and temperature should not be taken from the sample containers. When preserving samples to a required pH, pH paper should be used to check the resultant pH. The sample should be poured across the pH paper. Never place pH paper directly into sample.

NOTE: Shipping regulations limit the amount of preservative that can be added. For a 1-L sample, this is generally 1.5 ml of acid preservative.

2.6 FIELD QUALITY CONTROL

Quality control samples are required to verify that the sample collection and handling process has not affected the quality of the groundwater samples. All field quality control samples must be prepared exactly as regular investigation samples with regard to sample volume, containers, and preservation. Quality control samples will be collected as specified in the approved project work plans. The following quality control samples are listed as an example and may be collected for each SDG (an SDG may not exceed 20 samples) at the frequency noted:

- Field Duplicate—Required at a frequency of 10 percent per SDG
- Matrix Spike/Matrix Spike Duplicate—Required at a frequency of 5 percent
- Equipment (Rinsate) Blank—Required once prior to installation of dedicated sample tubing
- Source Water Blank—Required at a frequency of one per source per sampling event
- Trip Blank—Required for VOC samples at a frequency of one per sample shipment.
- Temperature Blank—Required at a frequency of once per sample shipment container.

2.7 DECONTAMINATION

Non-dedicated sampling and field monitoring equipment will be decontaminated prior to use and following sampling of each well. This equipment will be decontaminated by the procedure listed below. Alternate procedures must be approved by the Project Manager prior to the sampling event. Decontamination fluids will be collected in a 5-gal bucket and containerized as investigation-derived waste.

The following decontamination procedure will be used:

- Flush/wash the equipment with wash water containing a non-phosphate detergent solution
- Flush/wash with rinse water to remove all of the detergent solution
- Flush/wash with laboratory-provided certified PFAS-free water

It is recommended that the detergent and isopropyl alcohol used in the above sequence be used sparingly.

3. REFERENCES

U.S. Environmental Protection Agency. 1996. Groundwater Issue-Low Flow Sampling (Minimal Drawdown) Groundwater Sampling Procedures. April.

FIELD RECORD OF WELL GAUGING, PURGING, AND SAMPLING

Site Name:		Project Number:	
Well ID:		Well Lock Status:	
Well Condition:		Weather:	

Gauge Date:		Gauge Time:	
Sounding Method:		Measurement Ref:	
Stick Up/Down (ft):		Well Diameter (in.):	

Purge Date:		Purge Time:	
Purge Method:		Field Personnel:	
Ambient Air VOCs (ppm):		Well Mouth VOCs (ppm):	

WELL VOLUME

A. Well Depth (ft):		D. Well Volume/ft (L):	
B. Depth to Water (ft):		E. Well Volume (L) (C*D):	
C. Liquid Depth (ft) (A-B)		F. Three Well Volumes (L) (E*3):	

G. Measurable LNAPL? Yes ________ /ft No ________

Parameter	Beginning	1	2	3	4	5
Time (min.)						
Depth to Water (ft)						
Purge Rate (L/min)						
Volume Purged (L)						
pH						
Temperature (°C)						
Conductivity (µmhos/cm)						
Dissolved Oxygen (mg/L)						
Turbidity (NTU)						
eH (mV)						

Total Quantity of Water Removed (L):			
Samplers:		Sampling Time (Start/End):	
Sampling Date:		Decontamination Fluids Used:	
Sample Type:		Sample Preservatives:	
Sample Bottle IDs:			
Sample Parameters:			

Figure PFAS SOP048-1.

FIELD RECORD OF WELL GAUGING, PURGING, AND SAMPLING

Site Name:	Project Number:	Date:
Well ID:	Field Personnel:	

Parameter	6	7	8	9	10	11
Time (min.)						
Depth to Water (ft)						
Purge Rate (L/min)						
Volume Purged (L)						
pH						
Temperature (°C)						
Conductivity (µmhos/cm)						
Dissolved Oxygen (mg/L)						
Turbidity (NTU)						
eH (mV)						

Parameter	12	13	14	15	16	17
Time (min.)						
Depth to Water (ft)						
Purge Rate (L/min)						
Volume Purged (L)						
pH						
Temperature (°C)						
Conductivity (µmhos/cm)						
Dissolved Oxygen (mg/L)						
Turbidity (NTU)						
eH (mV)						

Comments and Observations:

Figure PFAS SOP048-1.

6332106 Standard Operating Procedure No. 073 for Sampling for Per- and Polyfluorinated Alkyl Substances

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Revision 1
August 2021

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CONTENTS

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1. SCOPE AND APPLICATION

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

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

This SOP was developed primarily based on guidance from the U.S. Army Corps of Engineers (2016) and the Interstate Technology Regulatory Council (ITRC 2018).

2. ACCEPTABLE MATERIALS

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

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

Prohibited Items	Acceptable Alternatives
Field Equipment	
Teflon-containing or LDPE materials (including tubing, bailers, tape)	HDPE or silicone materials
Waterproof field books, plastic clipboards, binders, or spiral hard cover notebooks	Loose paper (non-waterproof) on aluminum or Masonite clipboards
Waterproof pens	Sharpies®/markers, Non-waterproof pens or pencils
Sticky notes (e.g., Post-It®) and glues	Not applicable/No alternative
Re-usable chemical (blue) ice packs	Regular ice in polyethylene bags (double bagged)
Aluminum foil	Thin HDPE sheeting
Plastic spoons used in soil/sediment sampling	Stainless steel trowels/spoons
Reusable core liners	Single-use PVC or acetate liners
LDPE HydraSleeve	HDPE HydraSleeve
Field Clothing and Personal Protective Equipment	
New cotton clothing; synthetic water resistant, waterproof, or stain- treated clothing; clothing containing Gore-Tex™	Well-laundered clothing, defined as clothing that has been washed 6 or more times after purchase, made of natural fibers (preferably cotton)
Clothing laundered using fabric softener	No fabric softener
Boots (e.g., steel-toed or waders) containing Gore-Tex™ or waterproof coatings	Boots made with polyurethane or PVC with no waterproof coating
Coated Tyvek® suits	Uncoated/plain Tyvek suits not containing PFAS

Prohibited Items	Acceptable Alternatives
Cosmetics, shampoo, conditioner, body gel, moisturizers, hand cream, waxed dental floss, or other personal care products used <u>on the day of sampling</u>.	Use bar soap not containing moisturizers and rinse well on the day of sampling (including for hand washing). Use any other required products the night before (rather than the day of) sampling.
Paper towels	Air dryers (for hand drying)
No sunscreens or insect repellents except approved 100% natural products such as those noted in the Alternatives column.	**Acceptable Sunscreens:** Alba Organics Natural Sunscreen, Yes To Cucumbers, Aubrey Organics, Jason Natural Sun Block, Kiss My Face, "free" or "natural" sunscreens for babies **Acceptable Insect Repellents:** Jason Natural Quit Bugging Me, Repel Lemon Eucalyptus Insect Repellant, Herbal Armor, California Baby Natural Bug Spray, BabyGanic Sunscreen and insect repellant – Avon Skin So Soft Bug Guard Plus – SPF 30 Lotion
Sample Containers	
LDPE or glass containers	HDPE containers (or polypropylene if required)
Teflon-lined caps	Unlined HDPE (or polypropylene if required) caps
Rain Events	
Rain gear that has been treated to make it waterproof/resistant and breathable (e.g., Gore-Tex™ treated)	PVC or polyurethane- or wax-coated rain gear that is confirmed not to contain PFAS, or utilize a gazebo tent that is only touched or moved prior to and following sampling activities.
Equipment Decontamination	
Decon 90	Alconox® and/or Liquinox®
Water from an onsite well	Potable water from municipal drinking water supply (not containing PFAS), and "PFAS-free" deionized water for final rinse
Food Considerations	
All food and drink, with exceptions noted in the Alternatives column. Paper food packaging (e.g., fast food wrappers, drink cups, paper bags) and foil, in particular, often contain PFAS.	Bottled water and hydration drinks (i.e., Gatorade® and Powerade®) to be brought and consumed only in the staging area
NOTES: HDPE = High-density polyethylene. PVC = Polyvinyl chloride.	

If a plastic product or chemical not included in the Acceptable Alternatives column of Table 1 is proposed for use, it is recommended that Safety Data Sheets and other references be reviewed prior to use to confirm that the material does not contain PFAS. Indications of potential PFAS ingredients, in addition to the items listed in Table 1, include the following materials (ITRC 2018):

- Polytetrafluoroethylene (fluorocarbon solids such as Teflon)
- Fluorinated ethylene propylene
- Ethylene tetrafluoroethylene
- Polyvinylidene fluoride
- Generally, any other ingredient names containing the prefix "fluoro."

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

3. PROCEDURES

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

3.1 GENERAL CONSIDERATIONS

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

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

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

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

PFAS-containing stain resistant products are often applied to vehicle seats that have fabric upholstery. Therefore, if no outer garments (e.g., coveralls) will be worn, or if the outer garments will be worn in the field vehicle then, if feasible, the seats of the vehicle should be covered in a well-laundered cotton blanket to avoid contact between clothing and the seats.

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

As indicated in Table 1, sampling personnel shall not use the personal care products or cosmetics (other than bar soap) prior to or during sample collection on any day. Additionally, clothes worn during sampling should be well-washed natural fibers.

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

Fluids used during laboratory- or fieldwork (e.g., drilling for monitoring well installation or for deep soil sampling) should be confirmed PFAS-free.

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

3.2 EQUIPMENT DECONTAMINATION

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

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

Hand-held, non-dedicated sampling equipment, which is used at multiple field sampling locations, shall be decontaminated using the following procedure:

- Rinse with a non-PFAS-containing detergent (e.g., Alconox or Liquinox)
- Rinse with laboratory-provided, "PFAS-free" water (Grade 3 distilled, Millipore deionized)

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

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

3.3 SAMPLE COLLECTION AND PRESERVATION

The sampling team shall coordinate with the analyzing laboratory regarding requirements for sample bottle, volume, and preservation requirements for samples for PFAS analysis, and the laboratory should provide certified "PFAS-free" containers. HDPE bottles with unlined caps are typically used for collection of samples for PFAS analyses. Polypropylene may also be used for specific applications (e.g., collection of drinking water samples to be analyzed for the short list of PFASs by Method 537) (Department of Defense Environmental Data Quality Workgroup 2017).

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

For each sample, the required minimum volume of drinking water, surface water, or groundwater is 125 milliliters (mL), and the required minimum amount of soil or sediment is at least 2 grams on a dry weight basis. If quantitation limits lower than 4 parts per trillion (ppt) are needed to meet data quality objectives, the required minimum volume of drinking water, surface water, or groundwater is 250 mL. These sampling requirements may vary by laboratory. Prior to sampling, confirm sample size requirements with the selected analytical laboratory as the entire sample plus bottle rinsate must be extracted, with highly concentrated samples such as aqueous film-forming foam (AFFF) as the only exception. Sampling volume is determined by the analytical laboratory and should be adapted to expected PFAS levels and analytical capacities. The instrumental limit of detection is the main factor limiting the sensitivity and the volume should be enough to reach quantitation levels.

For chlorinated drinking water, each sample bottle may be required to contain a small amount (g per liter) of Trizma®, a buffering reagent that removes free chlorine from chlorinated drinking water, or similar sample additive as specified by the selected analytical laboratory. Confirm the need for additive with the selected analytical laboratory and the USACE chemist.

During sample processing and storage, minimize the exposure of the sample to light. Sampling personnel shall put on a clean pair of nitrile gloves immediately prior to collection of each sample for PFAS analyses, prior to removing the lid from the sampling container. After the sample is collected and the container is closed, pens or pencils, but not markers, shall be used in completing sample labels or in the vicinity of samples during collection.

Following sample collection and addition of preservative (if required), sample containers for PFAS analyses shall be placed in coolers with new double-bagged ice and not re-usable chemical ice packs unless confirmed PFAS-free and regulatorily accepted, such that meltwater does not contact sample containers during transport. The use of chemical or gel-based coolant products (eg., BlueIce®) to maintain samples at less than 6ºC following sample collection is prohibited.

3.4 SOIL/SEDIMENT SAMPLING CONSIDERATIONS

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

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

3.5 GROUNDWATER SAMPLING CONSIDERATIONS

It is recommended that, where feasible, measurements of monitoring well water levels and well depths be performed after sampling for PFAS to avoid possible cross-contamination.

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

All sample ports or wells will be purged, as necessary, prior to sample collection. The approximate amount of purge water will be recorded. All purge water shall be collected and either treated or disposed of in accordance with all applicable local, state, federal, and USACE regulations.

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

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

Filtration is not recommended because the filter may sorb PFAS or be a source of PFAS contamination.

3.6 SURFACE WATER AND POREWATER SAMPLING CONSIDERATIONS

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

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

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

As for groundwater samples, filtration is not recommended.

3.7 FIELD QUALITY CONTROL SAMPLES

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

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

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

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

4. MAINTENANCE

Not applicable.

5. PRECAUTIONS

See detailed precautions noted above.

6. REFERENCES

Department of Defense Environmental Data Quality Workgroup. 2017. *Bottle Selection and other Sampling Considerations When Sampling for Per-and Poly-Fluoroalkyl Substances (PFAS)*. Revision 1.2. July.

Interstate Technology Regulatory Council (ITRC). 2018. *Fact Sheet: Site Characterization Considerations, Sampling Precautions, and Laboratory Analytical Methods for Per- and Polyfluoroalkyl Substances (PFAS).* March.

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

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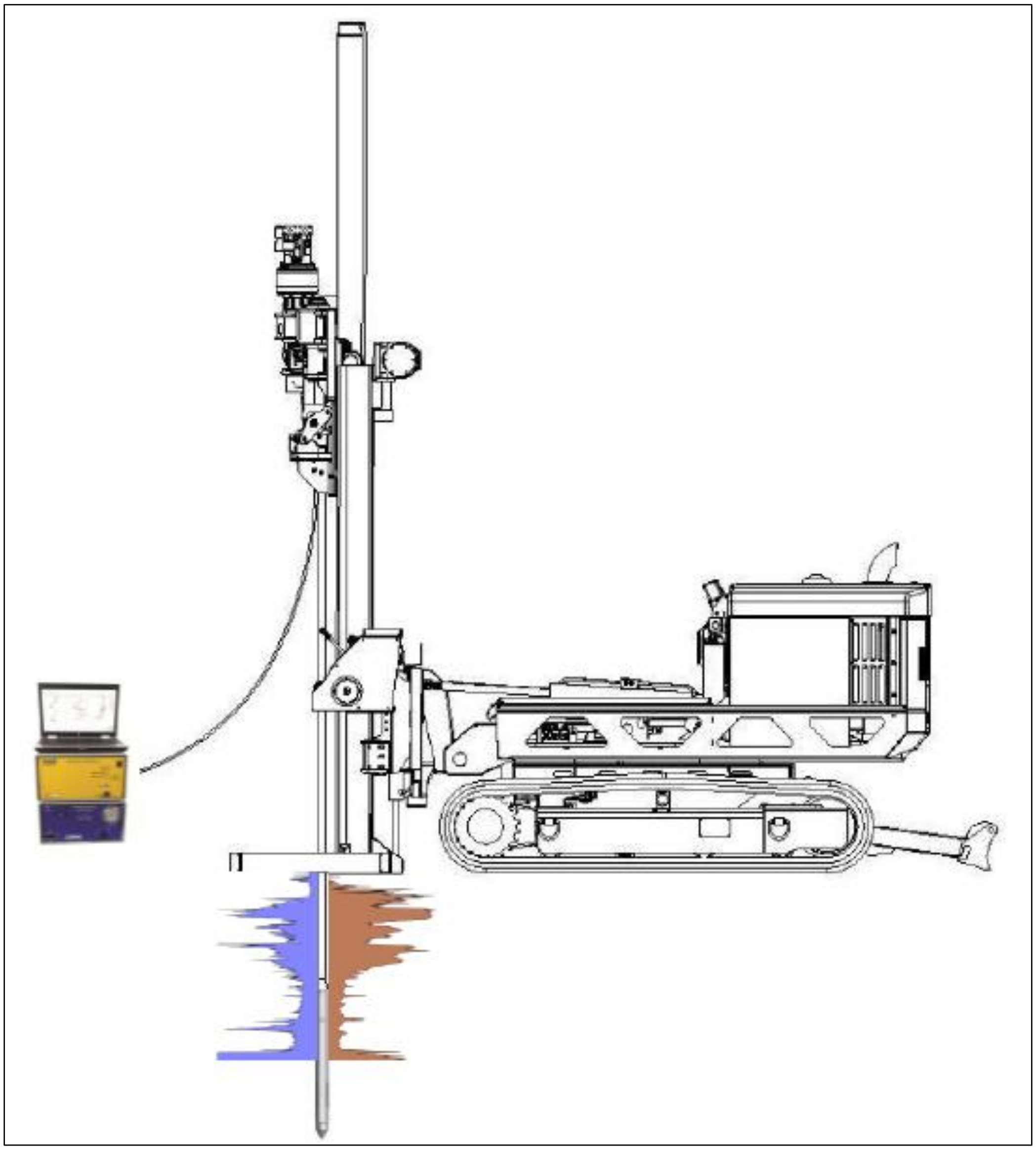
Geoprobe® Hydraulic Profiling Tool (HPT) System

Standard Operating Procedure

Technical Bulletin No. MK3137

Prepared: January 2015



1.0 Objective

This document serves as the standard operating procedure for the Geoprobe® Hydraulic Profiling Tool (HPT) system. In this procedure, the HPT system is used to measure the pressure response of soil to injected water for identifying potential flow paths and to assist with characterization of soil type.

2.0 Background

2.1 Definitions

Geoprobe®*: A brand of high quality, hydraulically-powered machines that utilize both static force and percussion to advance sampling and logging tools into the subsurface. The Geoprobe® brand name refers to both machines and tools manufactured by Geoprobe Systems®, Salina, Kansas. Geoprobe® tools are used to perform soil core and soil gas sampling, groundwater sampling and testing, electrical conductivity and contaminant logging, grouting, and materials injection.

**Geoprobe® and Geoprobe Systems® are registered trademarks of Kejr, Inc., Salina, Kansas.*

Hydraulic Profiling Tool (HPT) System: A system manufactured by Geoprobe Systems® to evaluate the hydraulic behavior of subsurface soil. The tool is advanced through the subsurface at a constant rate while water is injected through a screen on the side of the probe. An in-line pressure sensor measures the pressure response of the soil to water injection. The pressure response identifies the relative ability of a soil to transmit water. Both pressure and flow rate are logged versus depth.

2.2 Introduction

The HPT system has been developed by Geoprobe Systems® for the geohydrologic characterization of soils. The HPT probe and logging system is able to quickly provide logs that are easily interpreted. HPT logs are used to indicate hydraulic conductivity, EC, hydrostatic profile, and areas of EC/permeability anomalies.

The HPT system is designed to evaluate the hydraulic behavior of unconsolidated materials. As the probe is pushed or hammered at 2cm/s, clean water is pumped through a screen on the side of the HPT probe at a low flow rate, usually less than 300mL/min. Injection pressure, which is monitored and plotted with depth, is an indication of the hydraulic properties of the soil. That is, a low pressure response would indicate a relatively large grain size, and the ability to easily transmit water. Conversely, a high HPT pressure response would indicate a relatively small grain size and the lack of ability to transmit water.

An electrical conductivity measurement array is built into the HPT probe. This allows the user to collect soil electrical conductivity (EC) data for lithologic interpretation. In general, the higher the electrical conductivity value, the smaller the grain size, and vice versa. However, other factors can affect EC, such as mineralogy and pore water chemistry (brines, extreme pH, contaminants). In contrast, HPT pressure response is independent of these chemical and mineralogical factors.

There are four primary components of the HPT system: the probe assembly, trunkline, HPT Flow Controller (K6300 Series), and Field Instrument (FI6000 series). These primary components are shown in Figure 2.1.

The probe assembly consists of the HPT probe and connection section. This assembly houses the downhole HPT pressure transducer, water and electrical connections, and the probe body with the injection screen and electrical conductivity array.

Injecting water at a constant rate is integral to system operation. The HPT Flow Module houses the pump and associated hand crank mechanism used for adjusting the output flow of the HPT pump. The flow module also contains the HPT flow measurement and injection line pressure transducers. HPT flow can be adjusted from approximately 50 to 500ml/min. The HPT pump is a positive displacement pumping device with minimal decrease in flow over the HPT operating pressure range. The flow module is equipped with an internal bypass that is factory set to open and return flow to the supply reservoir at a pressure of 120psi.   When the soil resistance to water injection becomes sufficiently great, the HPT Flow Module bypass will open, returning some or all of the pumped flow to the supply reservoir. The flow meter only measures flow leaving the module to the HPT probe. The HPT Flow Module is connected to the Field Instrument via a data cable.

Water and power are transmitted from the controller to the probe assembly via the HPT trunkline. The probe rods must be pre-strung with the trunkline before advancing the probe.

Data collection occurs in real time by connecting the controller to the field instrument. The field instrument collects, stores and displays transducer pressure, flow rate and electrical conductivity, line pressure, probe rate, and diagnostic parameters, with depth via the field laptop.

Since the HPT pressure response is analogous to the soil’s ability to transmit water (and therefore the to the soil’s dominant grain size), the HPT system can be used to identify potential contaminant migration pathways. Similarly, it can help identify zones for remedial material injection or provide qualitative guidance on how difficult injection may be in different zones of the formation.

The HPT system may be used to direct other investigation methods, such as soil and groundwater sampling and slug testing. HPT pressure response and EC data can help target zones of geologic and hydraulic interest, minimizing the number of soil and groundwater samples required to adequately develop a site conceptual model. When hydraulic conductivity values are required, the

HPT system can also help the user identify zones to slug test, as well as the length of the screen required to adequately test the zone.

The HPT system also can be used to collect static water pressure data at discrete intervals during the logging process. These static pressure data can be used to calculate static water levels or to create a hydrostatic profile for the log.

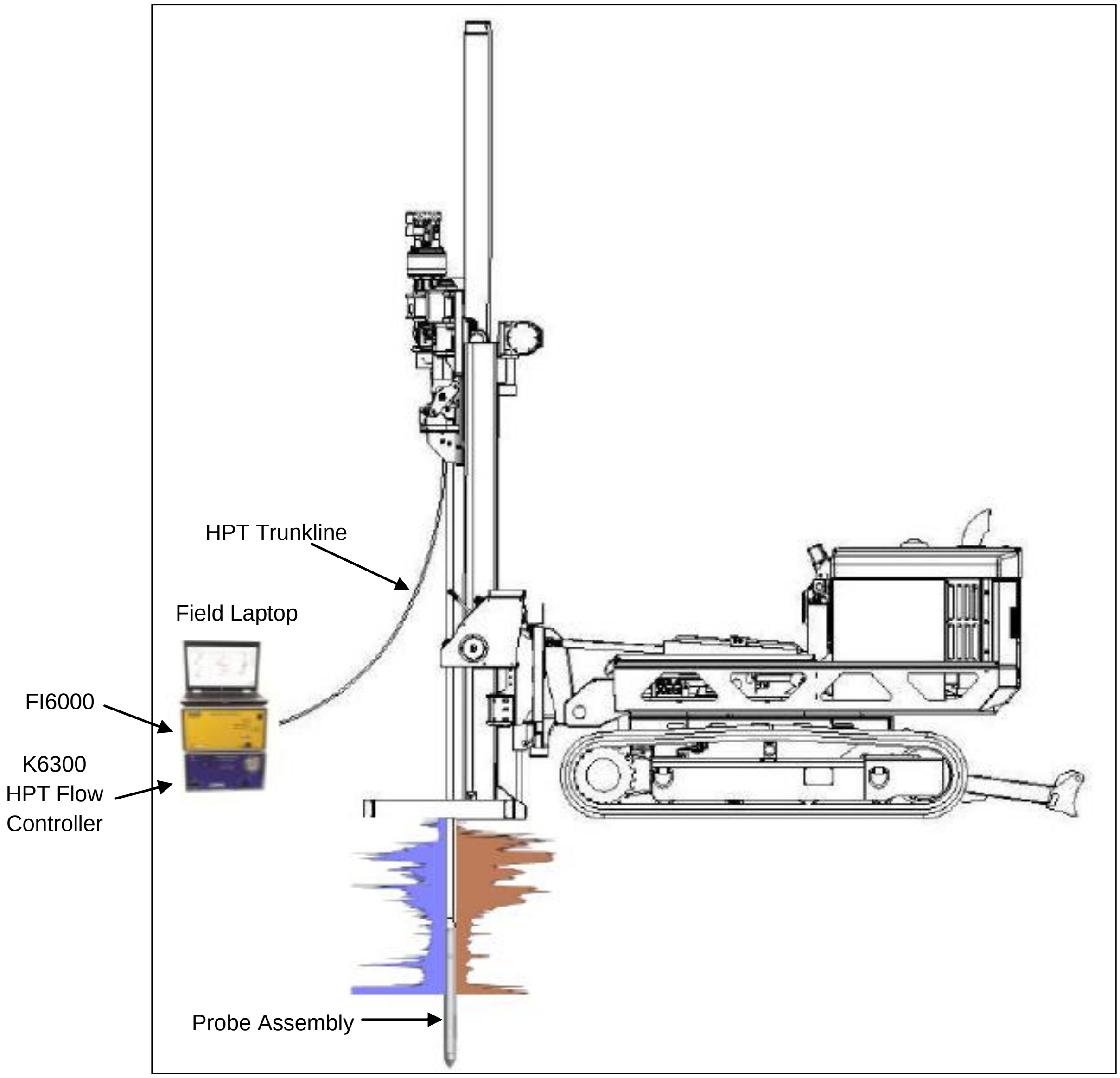


Figure 2.1: HPT Components

3.0 Tools and Equipment

The following equipment is required to perform and record an HPT log using a Geoprobe® 66- or 78-Series Direct Push Machine. Refer to Appendix I for identification of the specified parts.

Basic HPT System Components	Quantity	Material Number
Field Instrument, 120V (Model FI6000)	-1-	213940
Field Instrument, 220V (Model FI6003)	*	213941
HPT Acquisition Software	-1-	214128
HPT Flow Module, 120V (Model K6300)	-1-	214091
HPT Flow Module, 220V (Model K6303)	*	214093
HPT Probe, 1.75 inch	-1-	215667
MIP/HPT Connection Tube	-1-	206304
MIP/HPT Adapter 1.5 Pin x LB Box	-1-	203794
MIP/HPT Adapter 1.75ML Pin x LB Box	**	220966
HPT Probe, 2.25 inch	**	214097
2.25 Connection Tube	**	219455
2.25 Inch Water Seal Drive Head	**	212089
2.75 Inch Water Seal Drive Head	**	209796
HPT Reference Tube 1.75 in HPT Probe	-1-	212689
HPT Reference Tube 2.25 in HPT Probe	**	211762
HPT Trunkline 150 ft.	-1-	214095
HPT Trunkline 200 ft.	(optional)	214096
HPT Service Kit	-1-	205599
HPT Test Load	-1-	206552
EC Probe Test Jig	-1-	214237
EC Test Load	-1-	*208075*
EC Bypass Cable	-1-	204025
Stringpot, 100-inch	-1-	214227
Stringpot Cordset, 65-feet (19.8 m)	-1-	202884

*Use in place of 120V components if desired.

**Use in place of 1.75 inch probe and components if desired.

4.0 HPT Assembly

Refer to Appendix I

Threading the Rods

- Protect the end of the trunkline to be threaded through the rods with electrical tape or shrink tubing.
- Probe rods must alternate directions prior to threading the trunkline.
- The end of the HPT trunkline with chrome connectors is the downhole or probe end.
- The probe end of the trunkline will always enter the male end and exit the female end of the probe rods.
- The instrument end (no chrome connectors) will always enter the female end and exit the male end of the probe rods.
- After the trunkline is through the probe rods make sure the downhole end is threaded through the male end of the drive head and connection tube prior to connecting to the probe.
- The trunkline is now ready to connect to the instrument and HPT pressure sensor and probe.

5.0 Field Operation

5.1 Instrument Setup

1. Connect the HPT Controller (K6300), Field Instrument (FI6000) and laptop (Fig. 5.1) to an appropriate power source.

2. Connect the FI6000 to the K6300 using the 62-pin serial cable inserted into the acquisition port of each instrument.

3. Secure the EC wires into the Green terminal block connector and insert into the FI6000. The wires match to the EC dipoles in the following top down order when the probe tip is on the ground – white, black, yellow and blue (Fig 5.2).

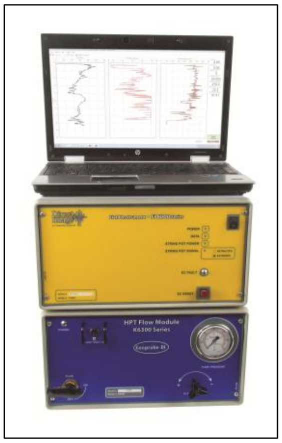


Figure 5.1: HPT Instrument Setup

4. Secure the HPT sensor wires to the appropriate inputs on the green terminal block connector and connect to the rear of the K6300. The top down order of the wires which is listed on the back of the instrument is: brown, orange, red and reserved (open).

5. Insert the nylon water line tubing from the trunkline into the water output connector on the back of the K6300.

6. Connect the HPT water supply hose into the input port on the rear of the K6300 and insert the filtered end of the supply line into a water supply tank. The bypass line connects to the bypass port and will follow the supply line back to the supply tank.

7. Connect the USB cable between the USB interface port on the rear of the FI6000 to USB input on the field laptop computer.

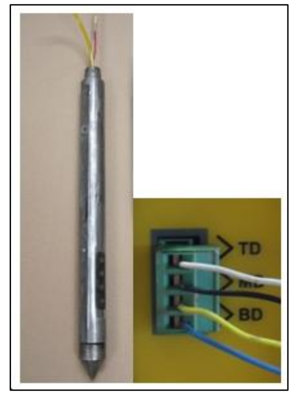


Figure 5.2: EC Wire Connections

8. A stringpot is required to measure depth. Bolt the stringpot onto the machine and the stringpot onto the bracket. Connect the plastic connector end of the stringpot cable to the “Stringpot” connector on the back of the Field Instrument and the metal connector to the stringpot. Pull the stringpot cable and attach to the stringpot piston weight which should be mounted to the probe machine foot and pull the keeper pin so the weight is free to move.

5.2 Starting the Software

1. Make sure the FI6000 and K6300 are connected together with the 62 pin cable, powered on and connected to the computer by the USB cable for the software to load properly.

2. Start the DI Acquisition Software which should open in HPT mode.

3. Select “Start New Log”. The software will request log information and have you browse for a storage location and create and save a file name for the log (Fig. 5.3).

4. Select “Next”. If the software has been run before it will show a list of previous settings including Probe Type, EC Configuration, Stringpot length, rod length and HPT Transducer. If any of these have changed or you are unsure select “No” but if they are all the same select “yes”. If you select “No” the software will have you select the proper settings after the EC Load Test, if you selected “Yes” the selection of these settings will be bypassed.

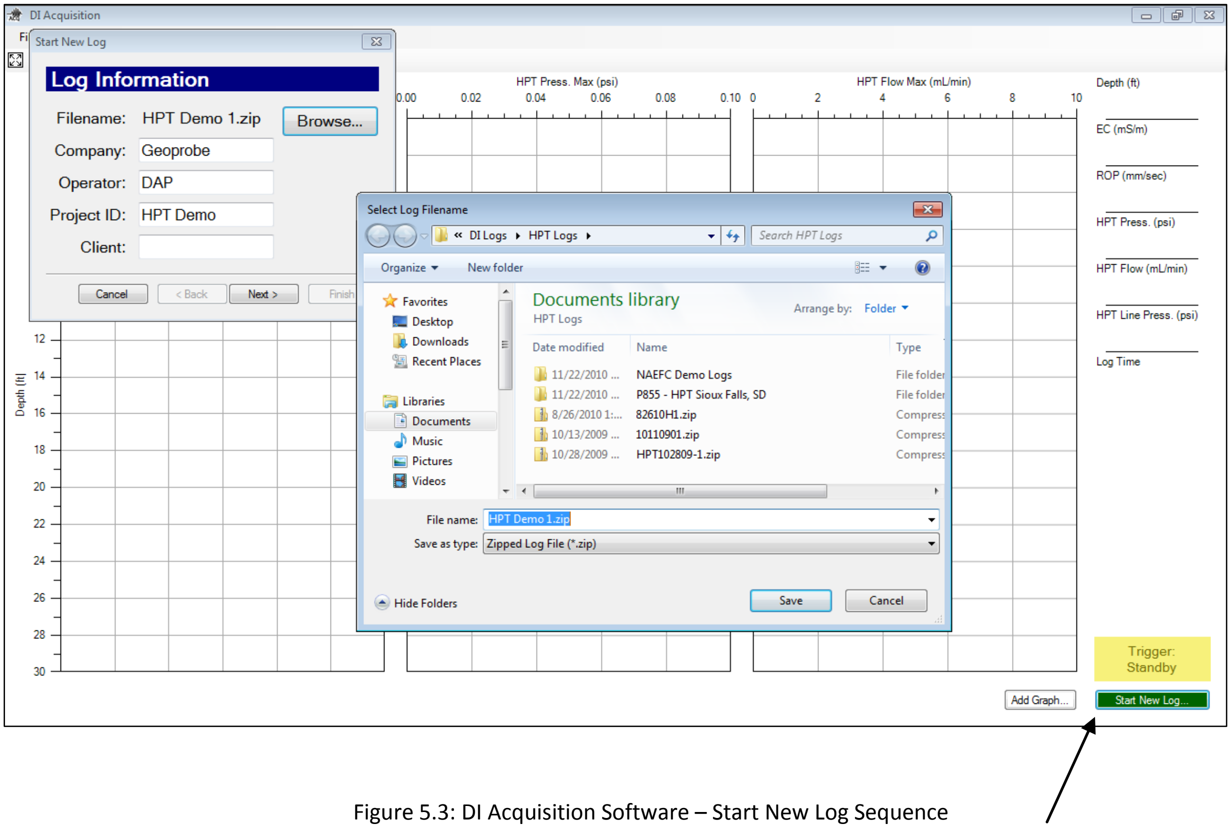


Figure 5.3: DI Acquisition Software – Start New Log Sequence

5.3 QA Testing the EC and HPT Systems

Both the EC and HPT components must be tested before and after each log. This is required to ensure that the equipment is working properly and capable of generating good data before and after the log.

A. Electrical Conductivity Load Test

1. Secure the EC 3 position test load connector (208075) to the test input jack on the back of the Field Instrument.

2. Secure the EC Probe Test Jig into the input on the EC 3 position test load.

3. Clean and dry the EC dipoles as well as several inches of the probe body above the pins.

4. Place the EC Test Jig (214237) so that the four springs on the test jig touch the four dipoles of the Wenner EC array (Fig. 5.4). Make sure the trunkline and test jig wires go in the same direction. The other spring on the test jig will ground the probe body above the Wenner array. Make sure the springs are pulled out far enough to make a solid contact on the dipoles.

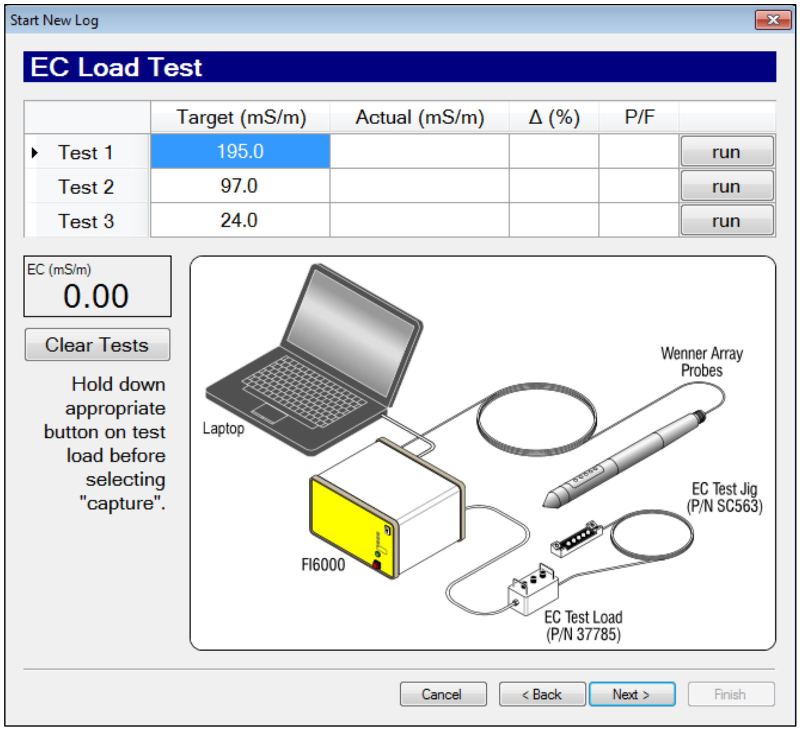


Figure 5.4: EC Load Test Screen

5. When you get to the EC Load Test Screen and the EC test load and test jig are in place on the probe press down on the test 1 button on the test load and select “run” of Test 1 (Fig. 5.4). After 5 seconds the actual value will acquire and will pass if within 10% of the target value. Continue on with Test 2 and 3.

6. If any of the EC load tests fail do not pass within the allowed 10% acceptance range you can make adjustments on the test jig and rerun the test by just re-clicking the “run” button for an individual test.

7. If the tests continue to fail, select “Next” and the software will conduct the “EC Troubleshooting Tests.” The Instrument Calibration Tests (Fig. 5.5) checks of the calibration within the FI6000. If these are far out of range it will influence the EC Test load values and will need to return to Geoprobe® for repair. The “Probe Continuity and Isolation Tests” confirm each of the wires is a complete circuit and is fully isolated from one another. If a probe continuity test fails just outside the target range of <8ohms this is typically a contact issue with the test jig and the dipoles. If the continuity is in the thousands of ohms this is a break in the EC wire circuit – either in the probe, the trunkline or the connection between them.

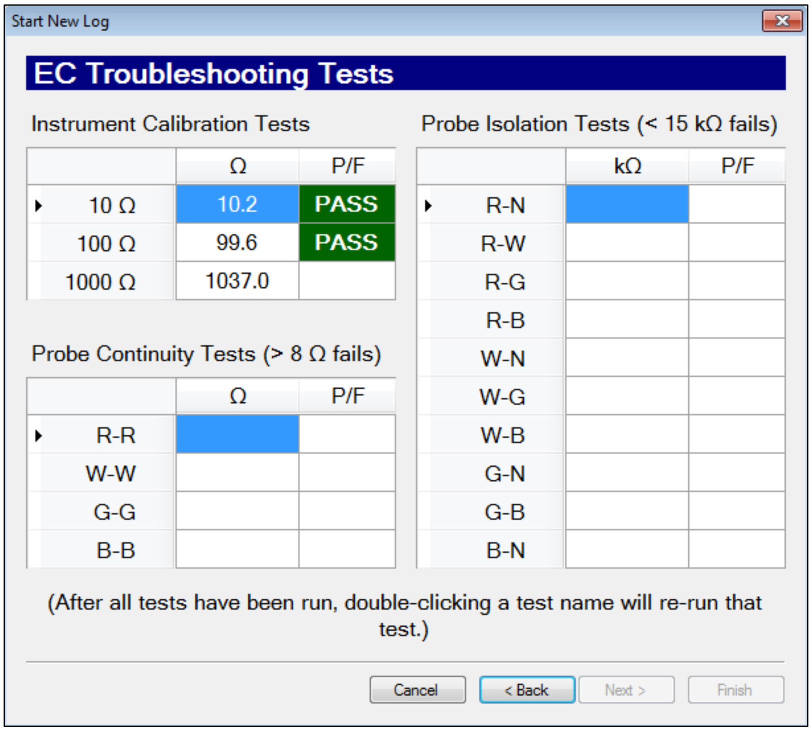


Figure 5.5: EC Troubleshooting Test Screen

8. When these tests are complete select next. In the next screen, the software will provide an EC option, if one is available. The EC Load Test will only work if EC can be operated in Wenner array meaning all of the EC wires in the continuity test pass with results <8ohms on the individual circuits. EC can be operated and collect good data in one of the dipole areas: top, middle or bottom dipole. If the R-R test fails but the others pass the software will provide the option in the next screen to run either middle dipole or bottom dipole arrays. If R-R and G-G are both an incomplete circuit then no EC array is available to run and a new probe must be connected or the problem fixed. In the Wenner configuration it requires 2 adjacent dipoles to operate in dipole mode. If an EC array is chosen and run in this last manner then all of the EC information collected will be bad data.

B. HPT Reference Testing

Reference testing is done to ensure that the HPT pressure sensor is in working order and to evaluate the condition of the HPT injection screen. The HPT reference test calculates atmospheric pressure which is required to obtain static water level readings and to determine the estimated K values for the log in our post log processing software the DI Viewer.

Reference Test Procedure

1. Connect a clean water source to the HPT controller and turn on the pump.

2. Allow water to flow through the system long enough so that no air remains in the trunkline or probe (air in the system can cause inaccurate flow and pressure measurements).

3. Insert the probe into the HPT reference tube and allow the water to flow out the valve adjusting the flow rate to between 250-300ml/min (Fig. 5.5). Ensure that the reference tube is close to vertical.

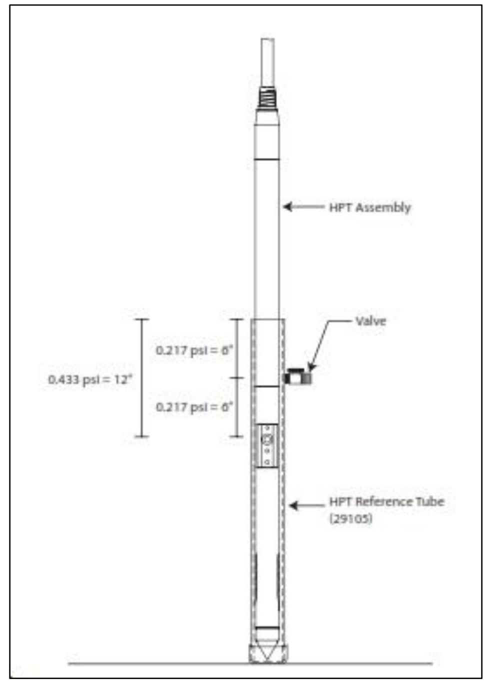


Figure 5.5: HPT Reference Test Setup

4. With a stable pressure reading and the water flowing out of the valve select "capture" - bottom with flow (Fig. 5.6)

5. Close the valve and allow the water to overflow the top of the tube. When the pressure stabilizes select "capture" - top with flow.

6. Shut off the water flow. When the pressure stabilizes select "capture" - top flow = 0.

7. Open the valve and allow the water to drain out. When the pressure stabilizes select "capture" - bottom flow = 0.

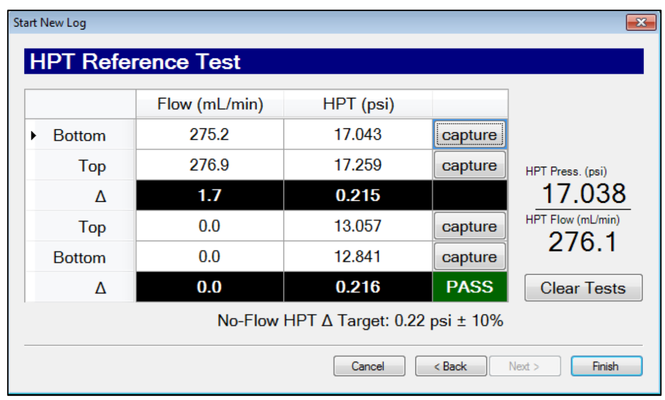


Figure 5.6: HPT Reference Test Screen

The HPT reference test reading flow = 0 is the true test of the condition of the pressure sensor and is the only sensor test to have a pass/fail reading on it. Ideally, the pressure difference between the top and bottom values will be 0.22psi (1.52kPa). Typical pressure readings of the sensor will be in the 12-15psi (83-104kPa) range.

5.4 Running an HPT Log

1. Place the rod wiper on the ground over the probing location and install the drive cushion in place of the anvil of the probing machine.

2. Place the probe tip in the center of the rod wiper, and place the slotted drive cap on top of the HPT probe.

3. Start the HPT water flow. **Note**: It is important that there is always water flowing when the probe is advanced to avoid soil particles from moving through the screen and causing problems with the pressure readings or causing a blockage behind the screen.

4. Adjust the probe so that it is vertical and advance the probe until the HPT screen is at the ground surface.

5. Click the trigger button in the lower right hand corner of computer screen. (The Trigger label will flash and the background will change from yellow to green).

9. Advance the probe at a rate of 2cm/s. If necessary, feather the hammer to maintain this advance rate.

10. Perform a dissipation test (Section 5.4) in a zone of higher permeability indicated by lower HPT pressure.

11. After completing the log, press the trigger button again and select “Stop Log”.

12. Pull the rod string using either the rod grip pull system or a slotted pull cap. Run a post-log EC test and HPT response test (Section 5.2).

5.5 Performing a Dissipation Test

At least one dissipation test must be performed in order to calculate the static water level and estimated K readings from the log. Dissipation tests need to be performed below the water table and are best in zones of high permeability where the injection pressure can dissipate off quickly once the flow is shut off.

1. Stop in a zone of higher permeability which is indicated by lower HPT inject pressure.

2. Switch the DI Acquisition display view from the depth screen to the time screen by pressing the F10 key (F9 and F10 toggle between the depth and time screen of the acquisition software).

3. The screen will be grayed out which means that the data up to that point has not been saved. Select “Start Dissipation Test” which will turn the screen from gray to a white background indicating that you are now saving the time data.

4. Now shut the pump switch off and when the line pressure reaches zero, turn the flow valve off.

5. The HPT Pressure will begin to drop (dissipate the hydrostatic increase) and allow it to stabilize so very little visible drop in pressure is seen. When the pressure has fully dissipated turn the flow valve and the pump switch back on. When the flow and pressure are reestablished select “End Dissipation test.”

6. Select F9 to return to the depth screen and advancing the tool into the ground.

   Note: Performing a dissipation test in zones of higher permeability may only take 30 seconds or so but if the HPT pressure was higher to start with it may take a long time up to several hours to dissipate off to equilibrium. This is why targeting the most permeable zone to perform the dissipation tests is most desirable.

6.0 HPT Log and Interpretation

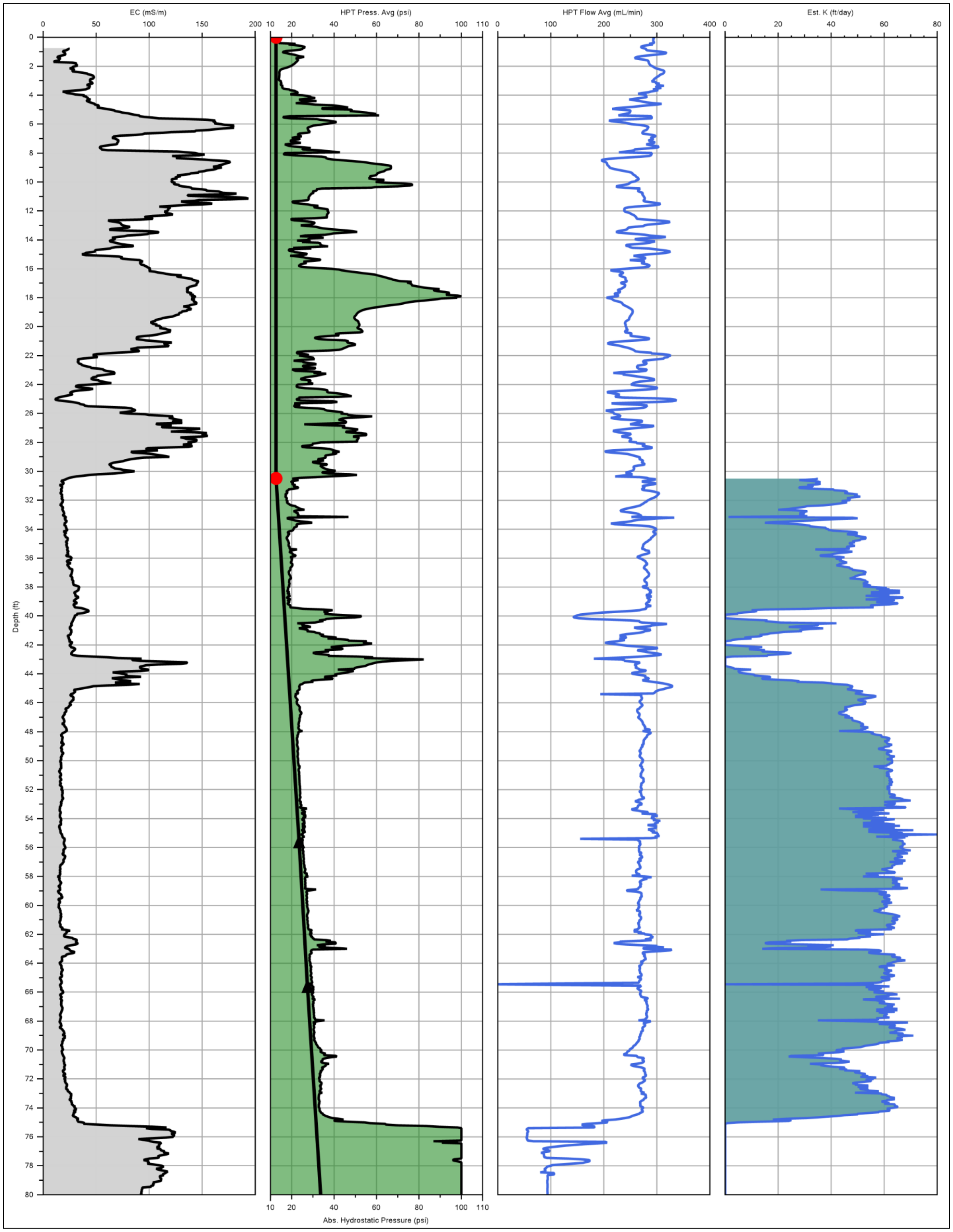


Figure 6.1: HPT Log file showing (left to right):
Electrical Conductivity (EC), HPT Injection Pressure with Hydrostatic Profile, HPT Flow, and Estimated K

A typical HPT log is shown in figure 6.1, which consists of both the HPT pressure response and electrical conductivity. In general, both HPT pressure and EC values increase with decreasing grain size, and decrease with increasing grain size. The log in Figure 6.1 shows good consistency between EC and HPT pressure for the majority of the log. It is only between 32'-42'bgs that we see some divergence of the graphs with higher HPT pressure while the EC readings remained low. This can happen for reasons such as poor mineralogy of the soil. Refusal was encountered in a shale layer beginning at 75'bgs and it can be noted that as we enter this layer the HPT flow gets suppressed as the pressure reaches a maximum value of 100psi (690kPa). The second graph of the log shows the hydrostatic profile on the secondary series of the graph. The hydrostatic profile has 2 black triangles which indicate where dissipation tests were run and used to calculate the profile. The red circle indicates the calculated water table based upon where the hydrostatic profile intersects atmospheric pressure. The fourth graph is the estimate K or groundwater flow graph. This is calculated based upon HPT pressure and HPT flow relationships. Less permeable soil will have less groundwater flow.

It is fairly common to see zones where EC readings and HPT pressure contradict one another. In cases where EC readings are low and HPT pressure trends higher as in the log in Figure 6.1 the following are possible reasons:

- Poor mineralogy of the soil particles resulting in silt and clay soils with very low EC readings. This is seen in many locations along the east coast of the United States.
- Silts intermixed with sand particles.
- Weathered bedrock may have low EC but would have low permeability.

Where we have cases of higher EC and lower HPT pressure typically is due to an ionic influence in the soil or groundwater. These higher EC readings can range from very slight to higher than typical soil readings. Very high EC readings can occur when the probe contacts metallic objects in the soil which will ground them out and typically will cause hard sharp spikes in the EC data.

- Chloride or other ionic contaminant (sea water, injection materials)
- Sea Water intrusion
- Wire, metal objects or Slag

In cases where HPT and EC do not confirm one another it is important to take confirmation soil and/or groundwater samples to help understand the difference between the two graphs.

7.0 Troubleshooting

7.1 Using the HPT Controller Test Load

The HPT Controller Test Load (206552) is included with the HPT Controller to help troubleshoot the HPT pressure sensor, trunkline, and controller. If there is a major problem with the HPT pressure sensor or the system wiring the system will not read anywhere close to atmospheric pressure with the probe at the surface. Commonly if the HPT sensor has broken the software will read either a maximum or minimum value which would be 100psi or 0psi (690kPa or 0kPa). If there is damaged wiring or nothing is connected to the controller the system typically reads 50psi (345kPa).

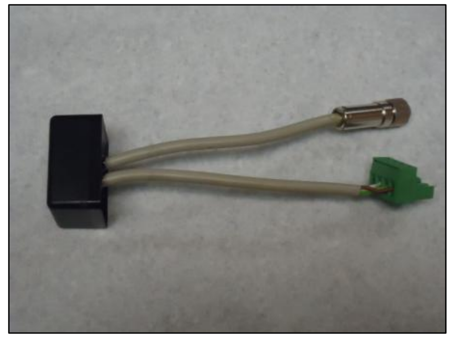


Figure 7.1: HPT Test Load (206552)

To use the test load, set up the system as previously described. Turn on both the field instrument and HPT controller and start the HPT software. Plug the green wire connector of the test load into the HPT sensor connector on the back of the HPT controller. If the pressure sensor value reads between 25-35psi (172 – 241kPa) the controller is able to properly read pressures so the problem is in the trunkline or the HPT sensor. If HPT controller has not moved from what it was reading or is way out from the expected value of the load test the HPT controller may require servicing. Contact Geoprobe Systems® for service.

Next, connect the HPT sensor wires of the trunkline to the controller with the green connector and then connect the chrome connector side of the test load to the female chrome connector on the downhole end of the trunkline in place of the pressure sensor. Again, the pressure value displayed on the field instrument should read between 25-35psi (172 – 241kPa) and should be the same as what was seen with the load test connected into the controller. If the load test read the expect value 25-35psi (172 – 241kPa) at both locations then both the trunkline and the controller are working properly and the problem is in the HPT sensor. If the test load read the expected value at the controller but not at the end of the trunkline, the trunkline may be defective and should be replaced. Before restringing another HPT trunkline, first connect the new trunkline sensor wires into the HPT controller and the downhole end into the test load. If the system now reads in the expected test load range the original trunkline needs replacing.

Finally, connect the pressure sensor to the trunkline. If it reads atmospheric pressure, approximately 12-15psi (83-104kPa), then the pressure transducer is functioning properly. However, if it does not, replace the sensor with a new one and re-check the pressure reading. Be sure to enter the new sensor calibration values into the software prior to starting the new log. Additional pressure sensors may be purchased from Geoprobe®.

7.2 Common Problems

Problem: The pressure transducer is connected to the trunkline, but the software is reporting a reading of ~ 50psi (345kPa).
Solution: Make sure all trunkline wires are secured to the green terminal blocks and plugged in to the back of the HPT controller and sensor chrome connectors are secure. Check components using the HPT Controller Test Load (Section 7.1).

Problem: The pressure transducer is connected to the trunkline, but the software is reporting a reading of 100psi or 0psi (690kPa or 0kPa).
Solution: Make sure all of the connections are good and recheck the pressure reading. If still bad connect a new HPT pressure sensor onto the trunkline and see if it reads atmospheric pressure. If not check all the components using the HPT Controller Test Load (Section 7.1).

Problem: The pressure with flow values keep drifting when water is flowing out the port or over the top of the reference tube.
Solution 1: If the trunkline was just connected and flow was just started air may still be in the lines. Allow the water to continue to flow through system which will purge out the remaining air. When it appears that most of the air is out of the lines press your thumb over the injection screen for a few seconds to help drive out any remaining air from the trunkline.
Solution 2: There may be debris behind the screen. Remove the HPT screen with the membrane wrench and turn the water flow on, use a small screwdriver to scrap out any debris in the screen socket as well as any that might be behind the screen. Replace the screen and retry the reference test with flow.
Solution 3: If the with flow pressure values continue to not settle down and provide close to the expected difference for a 6” water column then the problem may be inside the HPT control box. When you remove the cover of the HPT controller there will be a brass filter located on the left side when viewing from the front of the instrument (Fig 7.2). Particulates and precipitates can collect inside this filter causing problems with HPT pressure stability. Remove this filter and open up using appropriate wrenches. The filter can be easily cleaned by rinsing water over the screen. Reassemble and return to its proper location inside the control box. Resume reference testing the system.

Figure 7.2: Location of Inline Filter in K6300 and buildup of particulates in filter.

Problem: Atmospheric pressure values are way off from normal (12-15psi (83-104kPa)) after installing a new HPT sensor.
Solution: Check the calibration values that were entered into the software to ensure that they are correct.

Problem: Winterizing the HPT system for subfreezing work or air transport.
Solution: Pump RV antifreeze through the HPT pump and bypass pathway which can be done by blocking off the inject line. The trunkline can either be purge free of water by the pump or with an air compressor. NOTE: Never purge the HPT Controller of water using an air compressor this will damage sensor components in the controller.

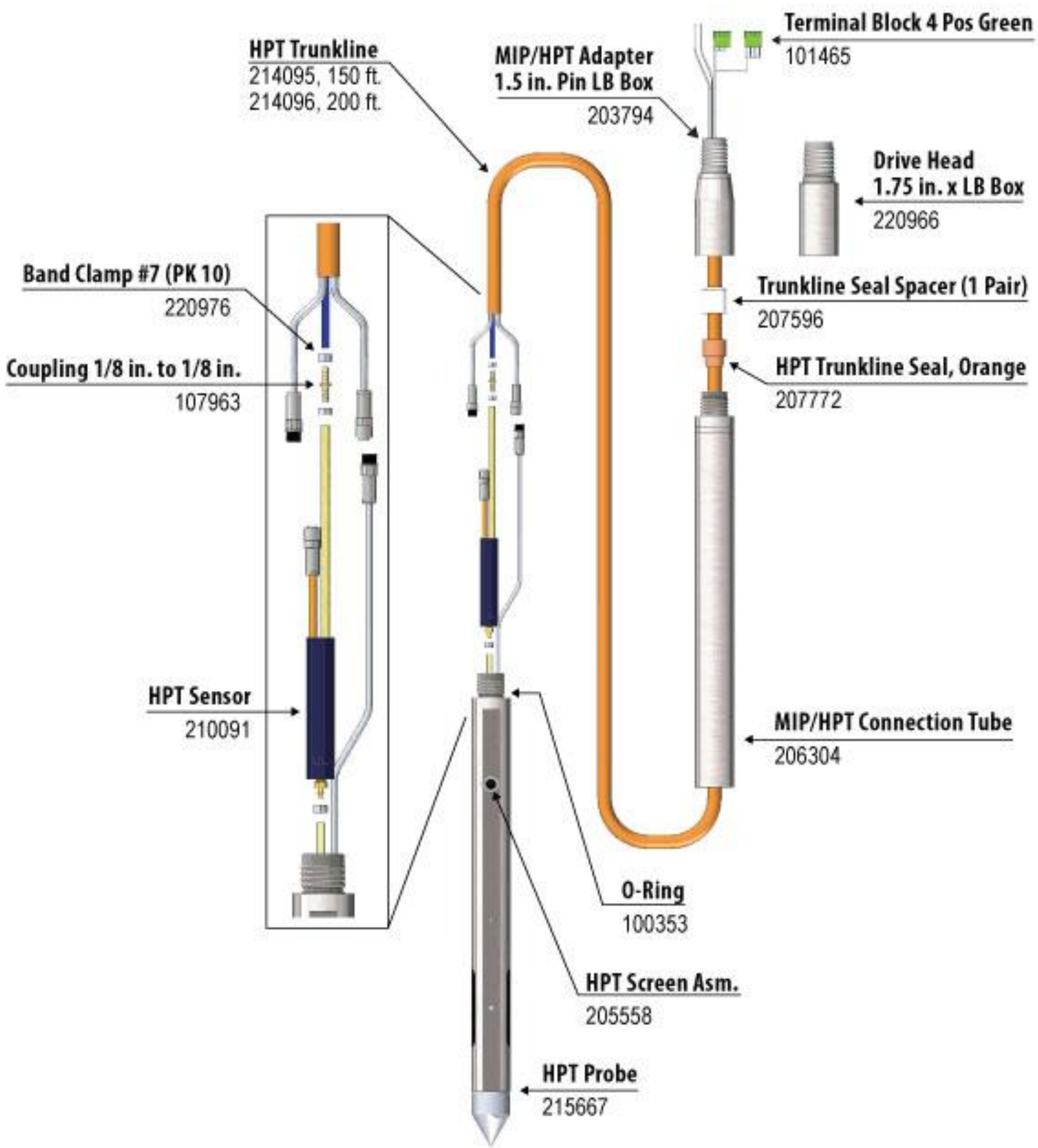
Problem: HPT flow sensor reading 0ml/min
Solution: If the flow sensor reads 0 or some other stabile number that does not correspond to actual water flow out the controller likely the flow sensor has been damaged. The flow sensor is very susceptible to damage from freezing. To repair the HPT flow sensor contact Geoprobe-DI technical support.

Problem: EC won't pass the QA tests.
Solution: Check the trunkline to probe EC connections ensuring they are tight. Run the troubleshooting tests (Section 5.3A), test EC on a new probe. If multiple probes and trunklines do not pass EC isolate the FI6000 instrument using the EC bypass cable (204025). The bypass cable is a six inch long cable that connects between the Test input and the EC probe connections on the back of the FI6000. Once connected start an EC or HPT log and fail the EC test load tests on purpose and run the EC troubleshooting tests (Figure 5.5). If the EC calibration or the EC continuity readings fail there could be an issue in the FI6000. In this case contact Geoprobe-DI technical support. If all of the troubleshooting tests pass then the problem is not in the instrument but in the trunkline, probe or their connections.

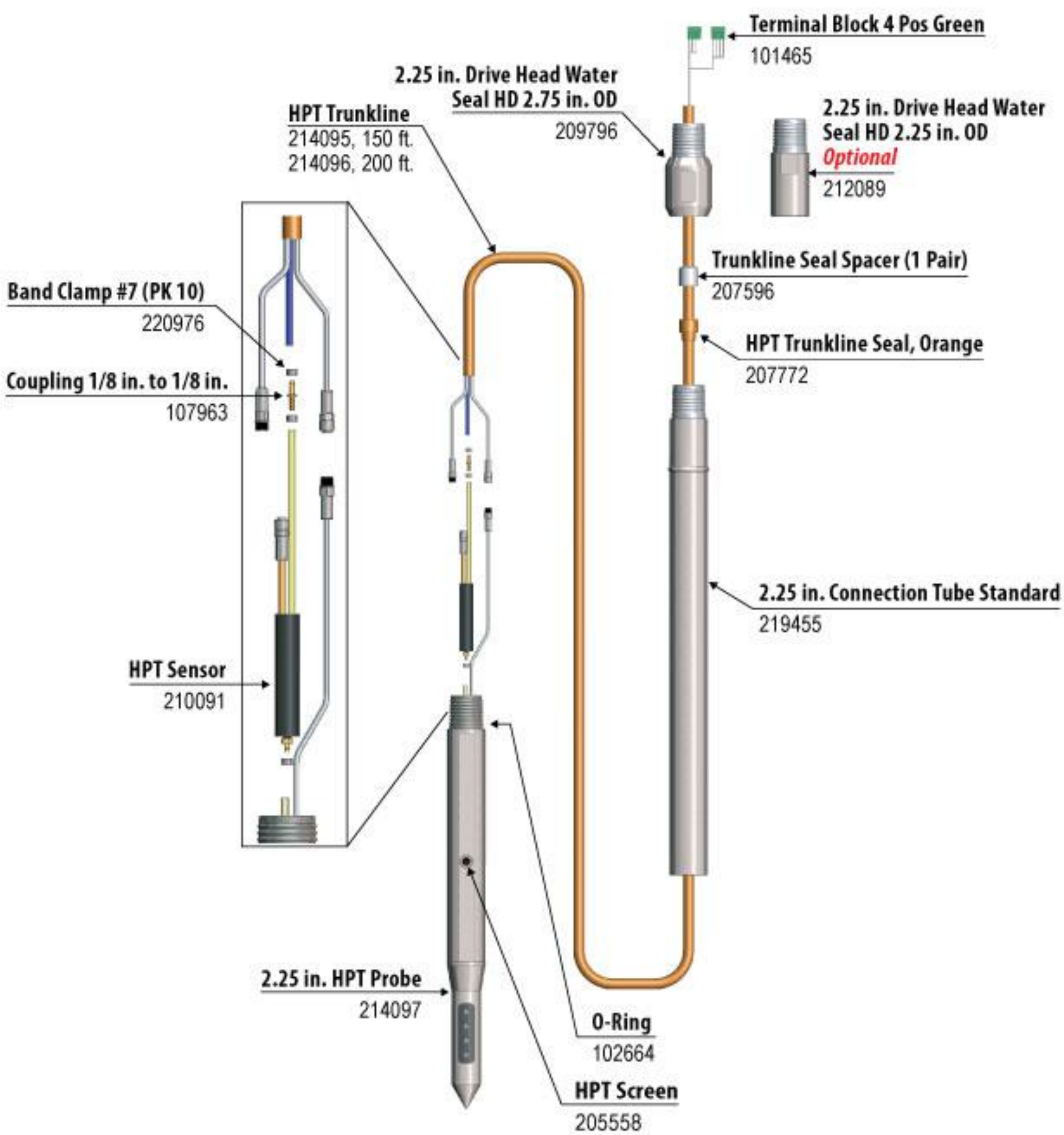
APPENDIX I

HPT Tool Configurations

HPT – K6050 (1.5 in / 1.75 in. system)



HPT – K8050 (2.25 in. system)



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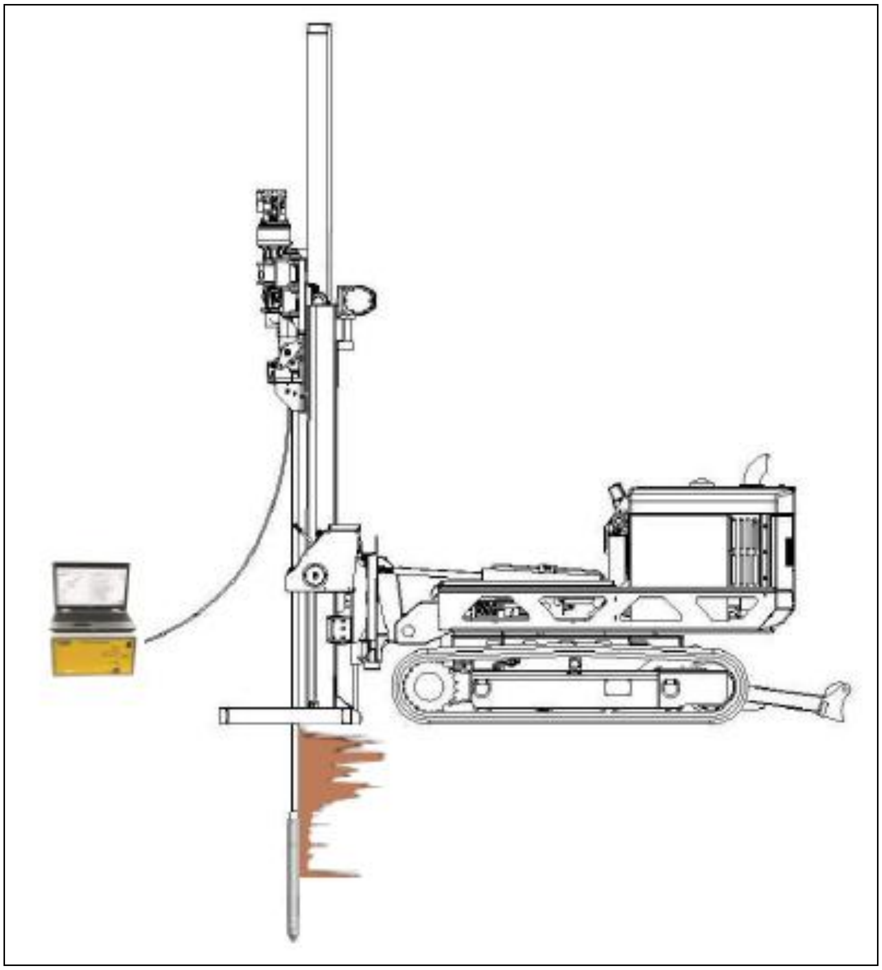
GEOPROBE SYSTEMS®
ELECTRICAL CONDUCTIVITY (EC) SYSTEM

STANDARD OPERATING PROCEDURE

Technical Bulletin No. MK3201

Prepared: January, 2015



1.0 Objective

This document serves as the standard operating procedure for the Geoprobe® Electrical Conductivity (EC) system. In this procedure, the EC system is used to measure the soils ability to conduct a current to assist with characterization of soil type. This document has been updated from Geoprobe Systems® Technical Bulletin No. to show the use of an FI6000 field instrument for EC system control and data acquisition.

2.0 Background

2.1 Definitions

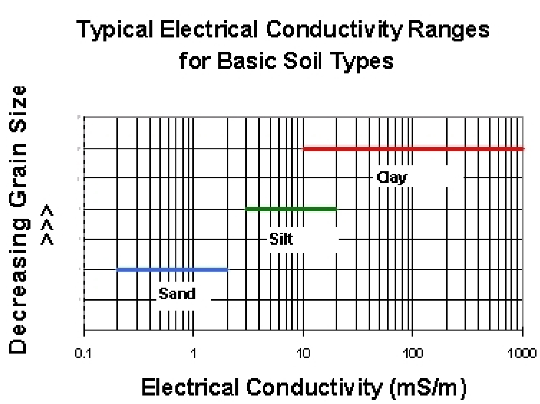
Geoprobe®*: A brand of high quality, hydraulically-powered machines that utilize both static force and percussion to advance sampling and logging tools into the subsurface. The Geoprobe® brand name refers to both machines and tools manufactured by Geoprobe Systems®, Salina, Kansas. Geoprobe® tools are used to perform soil core and soil gas sampling, groundwater sampling and testing, electrical conductivity and contaminant logging, grouting, and materials injection.

**Geoprobe® and Geoprobe Systems® are registered trademarks of Kejr, Inc., Salina, Kansas.*

Electrical Conductivity System: A system manufactured by Geoprobe Systems® to evaluate the soils ability to conduct an applied current for the determination of subsurface soil types. The tool is advanced through the subsurface at a constant rate and a current is sent through the formation between two probe contacts. This current is measured along with the voltage that results. Both electrical conductivity and rate of push are logged versus depth.

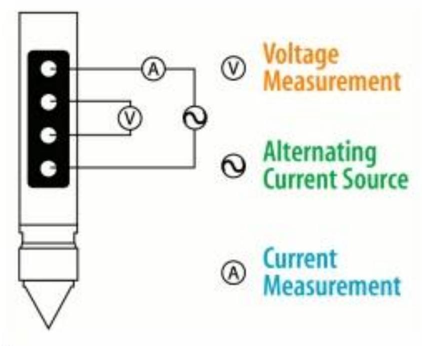
2.2 Discussion

The field instrument induces a current across electrical dipoles placed in the soil. The system measures electrical current and voltage and from these parameters, calculates electrical conductivity. Higher electrical conductivities typically are representative of finer grained sediments, such as silts and clays, while sands and gravels have distinctively lower conductivities. Ionic contaminants in the soil or pore water can increase the measured conductivity.



Interpretation of EC logs comes with field experience and an initial core sample to confirm lithologic changes. As a generalization, a high conductivity reading indicates a smaller particle size and a low conductivity reading indicates a larger particle size (Figure 2.1).

Figure 2.1: General Conductivity Ranges



The EC probe comes in two different configurations, Dipole Array and Wenner Array. Both configurations have the same theory of operation. A current is sent through the formation between two probe contacts. This current is measured along with the voltage that results (Figure 2.2). The conductivity is a ratio of current to voltage times a constant. The resulting reading is in milli-Siemens per meter (mS/m).

Figure 2.2: Wenner Array for Conductivity Measurements

3.0 Tools and Equipment

The following equipment is required to perform and record an EC log using a Geoprobe® 66- or 78-Series Direct Push Machine. Refer to Figures 3.1, 3.2, and 3.3 for identification of the specified parts.

Basic EC System Components	Quantity	Material Number
Field Instrument, 120V (Model FI6000)	-1-	213940
Field Instrument, 220V (Model FI6003)	*	213941
Acquisition Software	-1-	214128
EC Probe, 1.75 inch	-1-	214236
1.75 inch Connection Tube	-1-	211310
1.5 inch Drive Head	-1-	203794
EC Cordset - 97ft.	-1-	214229
EC Cord Adapter	-1-	214231
EC Probe, 2.25 inch	**	214238
2.25 Connection Tube	**	219455
2.25 Inch Water Seal Drive Head	**	212089
2.75 Inch Water Seal Drive Head	**	209796
EC Water Seal	-1-	209568
Trunkline Water Seal Spacers	-1-	207596
EC Probe Test Jig	-1-	214237
EC Test Load	-1-	208075
EC Bypass Cable	-1-	204025
Stringpot, 100-inch	-1-	214227
Stringpot Cordset, 65-feet (19.8 m)	-1-	202884

*Use in place of 120V components if desired.

**Use in place of 1.75 inch probe and components if desired.

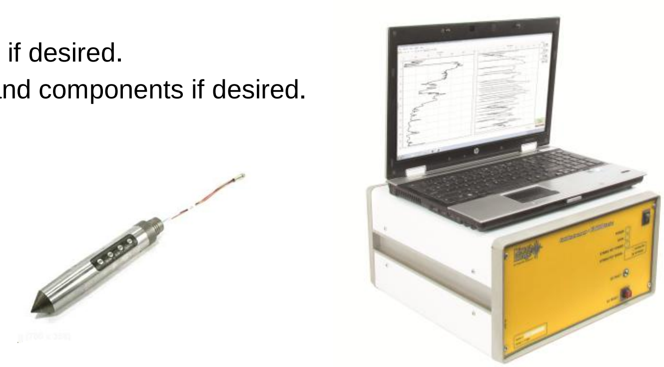


Figure 3.1: EC Probe (214236) and FI6000 (213940)

4.0 Assembly

Threading the Rods

- Protect the end to be threaded through the rods with electrical tape or shrink tubing.
- Probe rods must alternate directions prior to threading the trunkline.
- The end of the EC trunkline with chrome connectors is the downhole or probe end.
- The probe end of the trunkline always enters the male end and exits the female end of the probe rods.
- The instrument end will always enter the female end and exit the male end of the probe rods.
- After the trunkline is through the probe rods make sure the downhole end is threaded through the male end of the drive head and connection tube prior to connecting to the probe.
- The trunkline is now ready to connect to the instrument and EC probe.

5.0 Field Operation

5.1 Instrument Setup

1. Connect the Field Instrument (FI6000) and laptop (Fig. 5.1) to an appropriate power source.

2. Connect the FI6000 to the field laptop with the USB cable.

3. Secure the EC wires into the Green terminal block connector and insert into the FI6000. The wires match to the EC dipoles in the following top down order when the probe tip is on the ground – white, black, yellow and blue (Fig 5.2).

Figure 5.1: EC Instrument (FI6000)

4. Connect the USB cable between the USB interface port on the rear of the FI6000 to USB input on the field laptop computer.

5. A stringpot is required to measure depth. Bolt the stringpot onto the machine and the stringpot onto the bracket. Connect the plastic connector end of the stringpot cable to the “Stringpot” connector on the back of the Field Instrument and the metal connector to the stringpot. Pull the stringpot cable and attach to the stringpot piston weight which should be mounted to the probe machine foot and pull the keeper pin so the weight is free to move.

5.2 Starting the Software

1. Make sure the FI6000 is powered on and connected to the computer by the USB cable for the software to load properly.

2. Start the DI Acquisition Software which will open in EC mode.

3. Select “Start New Log”. The software will request log information and have you browse for a storage location and create and save a file name for the log (Fig. 5.2).

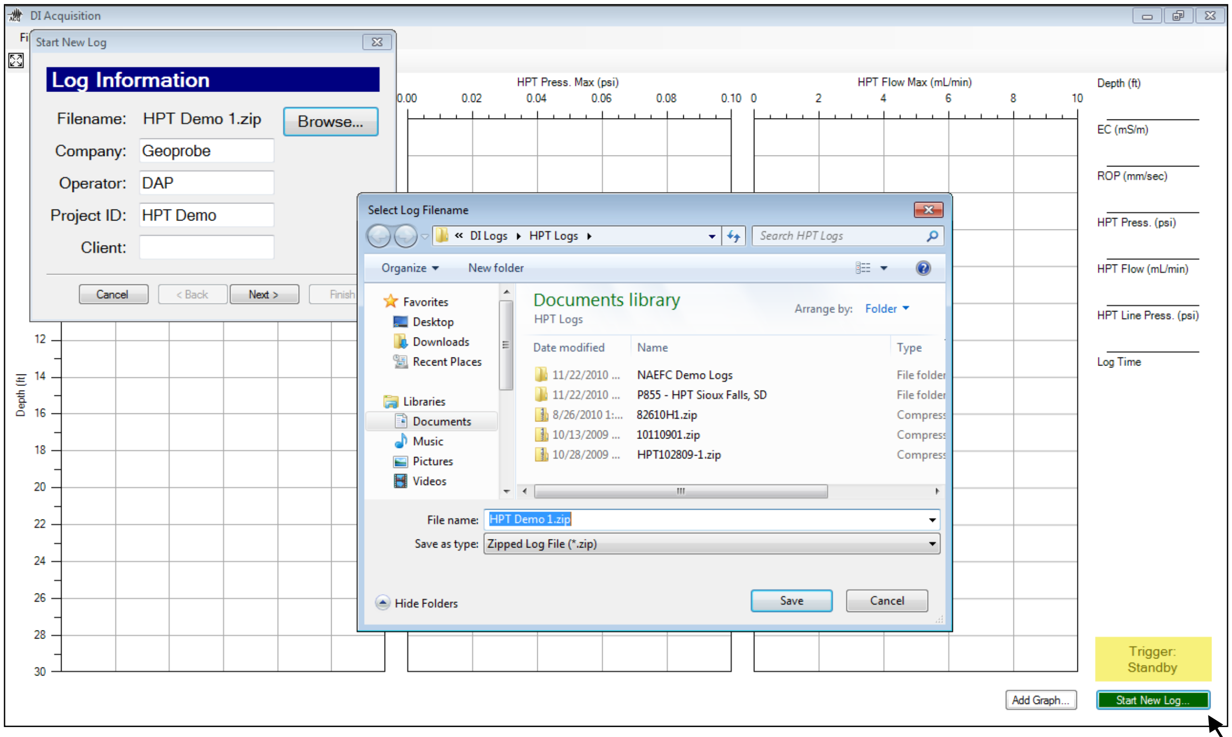


Figure 5.2: DI Acquisition Software – Start New Log Sequence

4. Select “Next”. If the software has been run before it will show a list of previous settings including Probe Type, EC Configuration, Stringpot length, rod length. If any of these have changed or you are unsure select “No” but if they are all the same select “yes”. If you select “No” the software will have you select the proper settings after the EC Load Test, if you selected “Yes” the selection of these settings will be bypassed.

5.2 QA Testing the EC Systems

The EC components must be tested before and after each log. This is required to ensure that the equipment is working properly and capable of generating good data before and after the log.

A. Electrical Conductivity Load Test

1. Secure the EC 3 position test load connector (208075) to the test input jack on the back of the Field Instrument.

2. Secure the EC Probe Test Jig (214237) into the input on the EC 3 position test load.

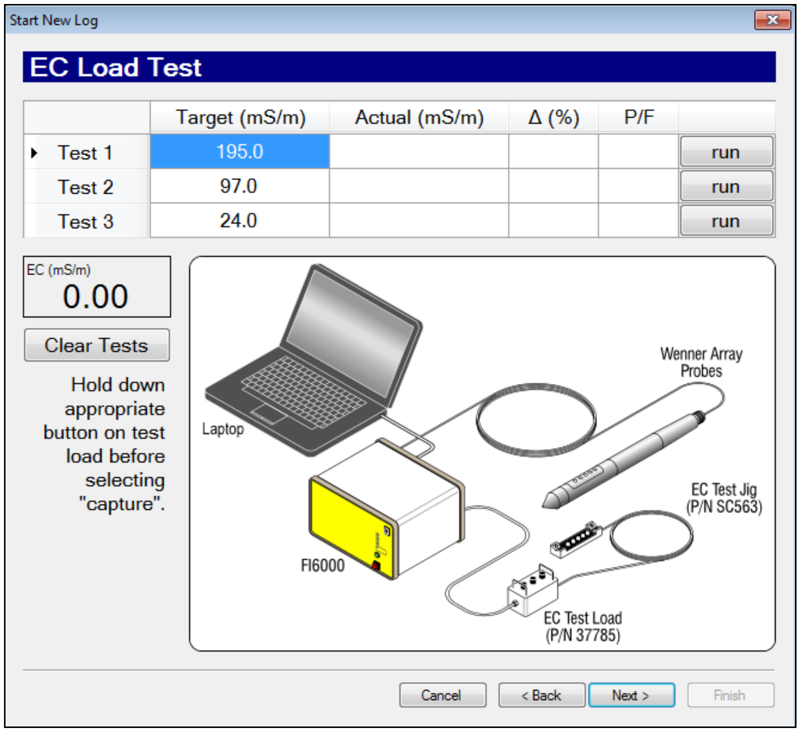


Figure 5.3: EC Load Test Screen

3. Clean and dry the EC dipoles as well as several inches of the probe body above the pins.

4. Place the EC Test Jig so that the four springs on the test jig touch the four dipoles of the Wenner EC array (Fig. 5.3). Make sure the trunkline and test jig wires go in the same direction. The other spring on the test jig will ground the probe body above the Wenner array. Make sure the springs are pulled out far enough to make a solid contact on the dipoles.

5. When you get to the EC Load Test Screen and the EC test load and test jig are in place on the probe press down on the test 1 button on the test load and select “run” of Test 1 (Fig. 5.4). After 5 seconds the actual value will acquire and will pass if within 10% of the target value. Continue on with Test 2 and 3.

6. If any of the EC load tests fail do not pass within the allowed 10% acceptance range you can make adjustments on the test jig and rerun the test by just re-clicking the “run” button for an individual test.

7. If the tests continue to fail, select “Next” and the software will conduct the “EC Troubleshooting Tests.” The Instrument Calibration Tests (Fig. 5.4) checks of the calibration within the FI6000. If these are far out of range it will influence the EC Test load values and will need to return to Geoprobe® for repair. The “Probe Continuity and Isolation Tests” confirm each of the wires is a complete circuit and is fully isolated from one another. If a probe continuity test fails just outside the target range of <8ohms this is typically a contact issue with the test jig and the dipoles. If the continuity is in the thousands of ohms this is a break in the EC wire circuit – either in the probe, the trunkline or the connection between them.

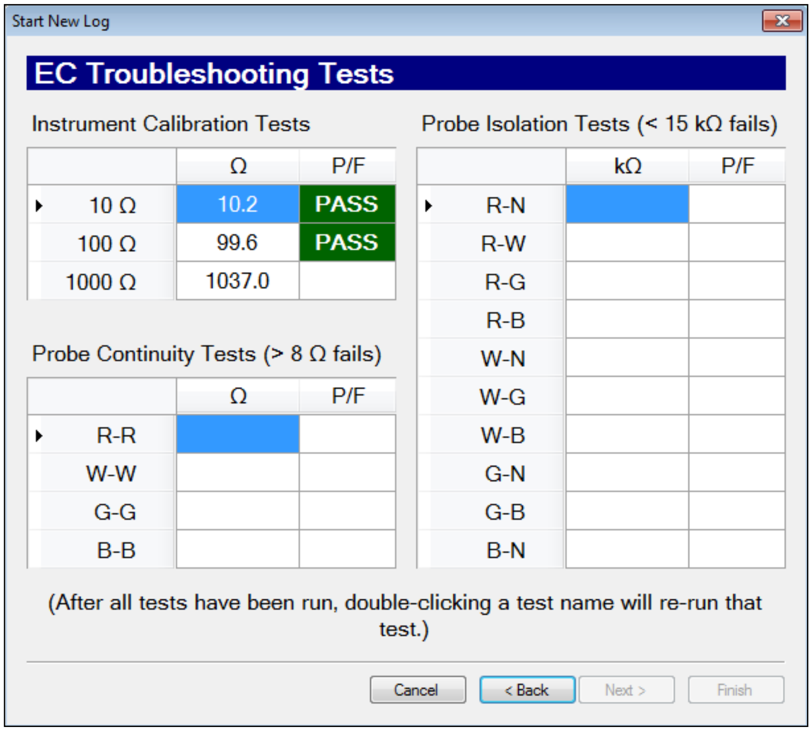


Figure 5.4: EC Troubleshooting Test Screen

8. When these tests are complete select next. In the next screen, the software will provide an EC option, if one is available. The EC Load Test will only work if EC can be operated in Wenner array meaning all of the EC wires in the continuity test pass with results <8ohms on the individual circuits. EC can be operated and collect good data in one of the dipole areas: top, middle or bottom dipole. If the R-R test fails but the others pass the software will provide the option in the next screen to run either middle dipole or bottom dipole arrays. If R-R and G-G are both an incomplete circuit then no EC array is available to run and a new probe must be connected or the problem fixed. In the Wenner configuration it requires 2 adjacent dipoles to operate in dipole mode. If an EC array is chosen and run in this last manner then all of the EC information collected will be bad data.
9. When the EC check has passed click “next”. If the rod length, stringpot length have not been selected previously do that now. Select “Next”.

5.3 Running an EC Log

1. Place the rod wiper on the ground over the probing location and install the drive cushion in place of the anvil of the probing machine.

2. Place the probe tip in the center of the rod wiper, and place the slotted drive cap on top of the EC probe.

3. Adjust the probe so that it is vertical and advance the probe until the EC dipoles are split half in half out of the ground.

4. Click the trigger button in the lower right hand corner of computer screen. (The Trigger label will flash and the background will change from yellow to green).

5. Advance the probe at a rate of 2 cm/s. If necessary, feather the hammer to maintain this advance rate.

6. The trigger may be turned off at any time to make adjustments w/o recording any probe movement. With the trigger turned “off”, the cable may be disconnected to add rods or to add an additional cable. When everything is reconnected and ready to advance turn the trigger “on”.

7. After completing the log, press the trigger button again and select “Stop Log”.

8. Disconnect the stringpot cable and pull the rod string using either the rod grip pull system or a slotted pull cap.

9. Run a post-log EC test (Section 5.3).

10. Open the log using the DI Viewer software, adjust the scales and log settings as desired and print the log (Figure 5.5).

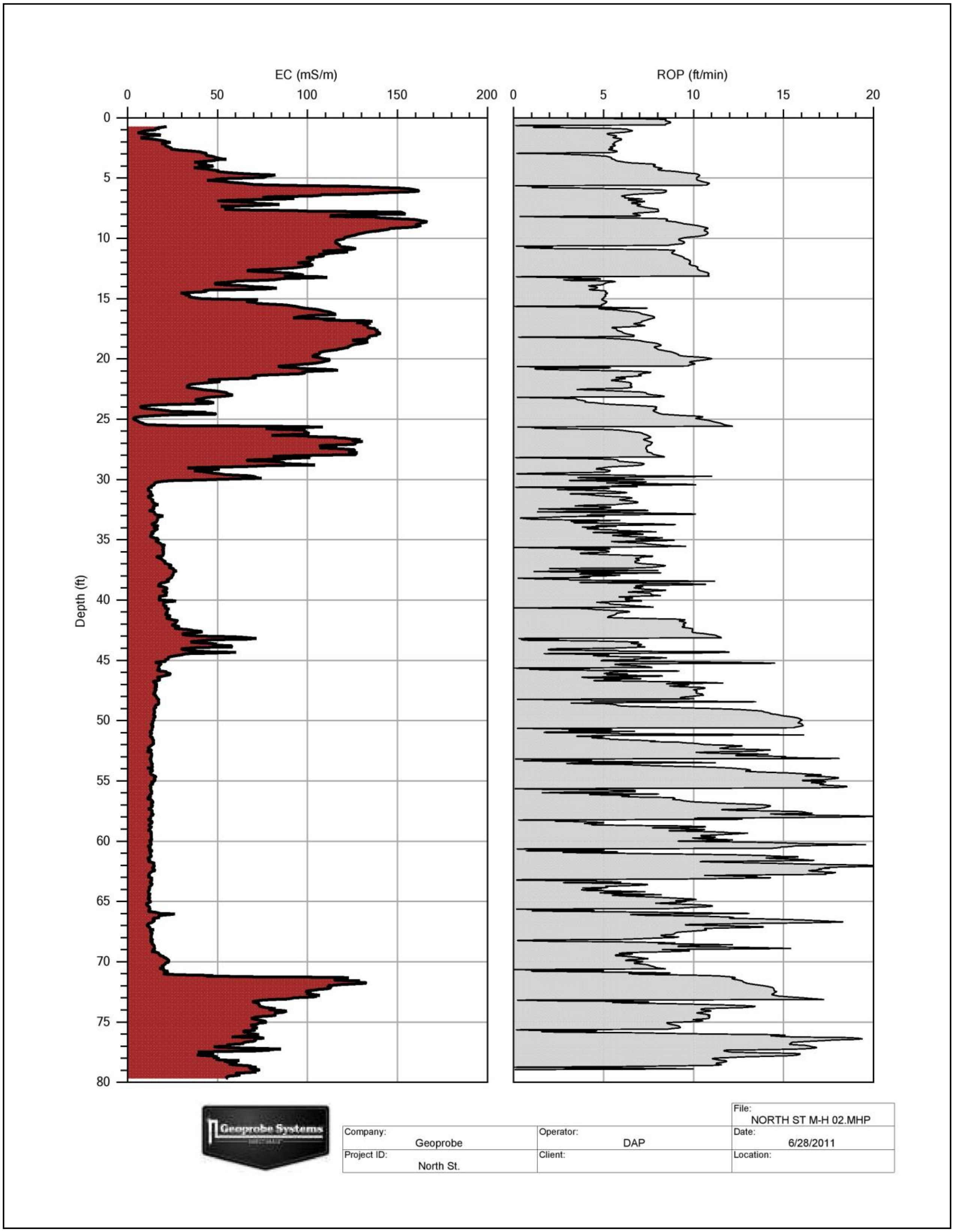
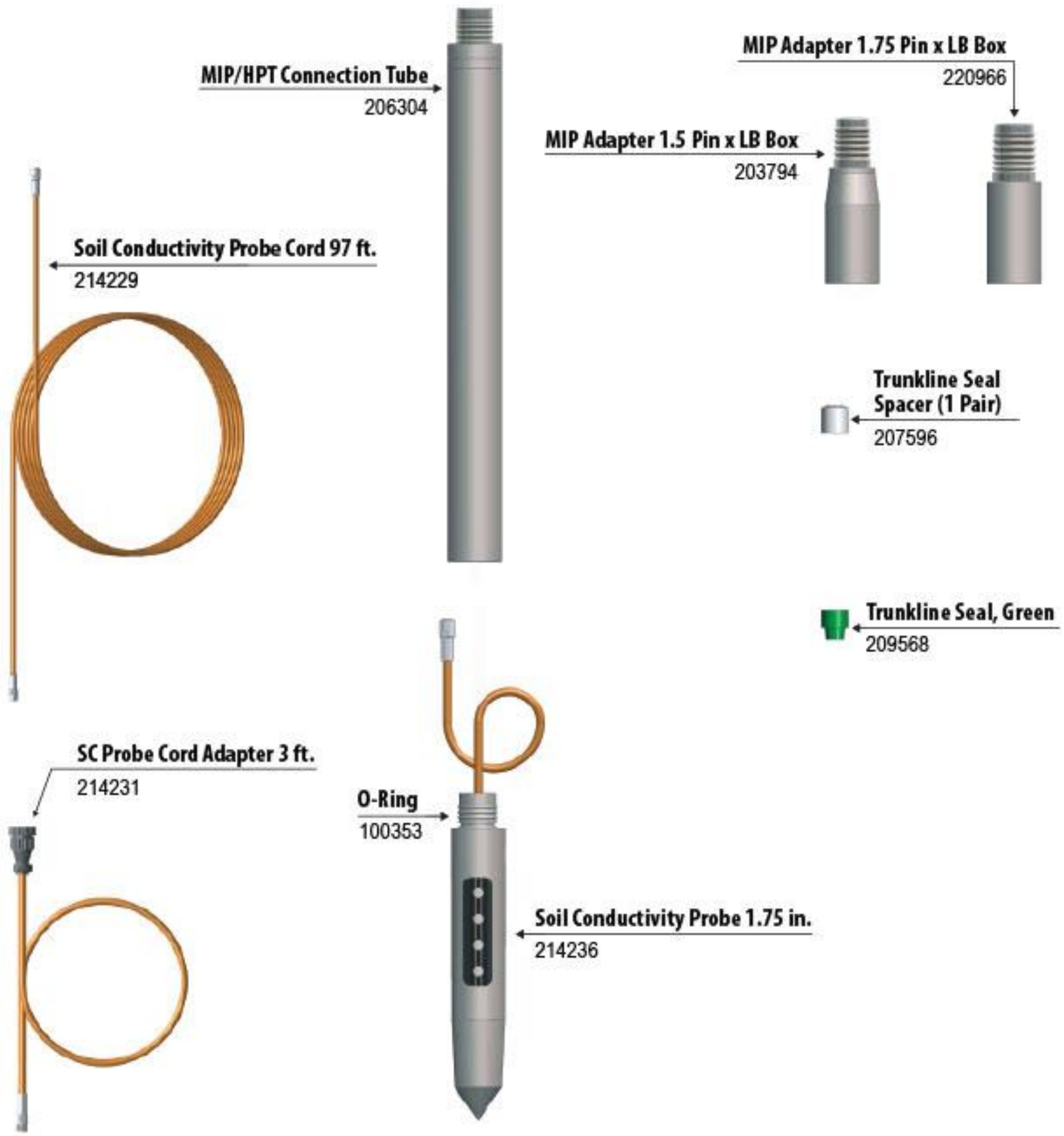


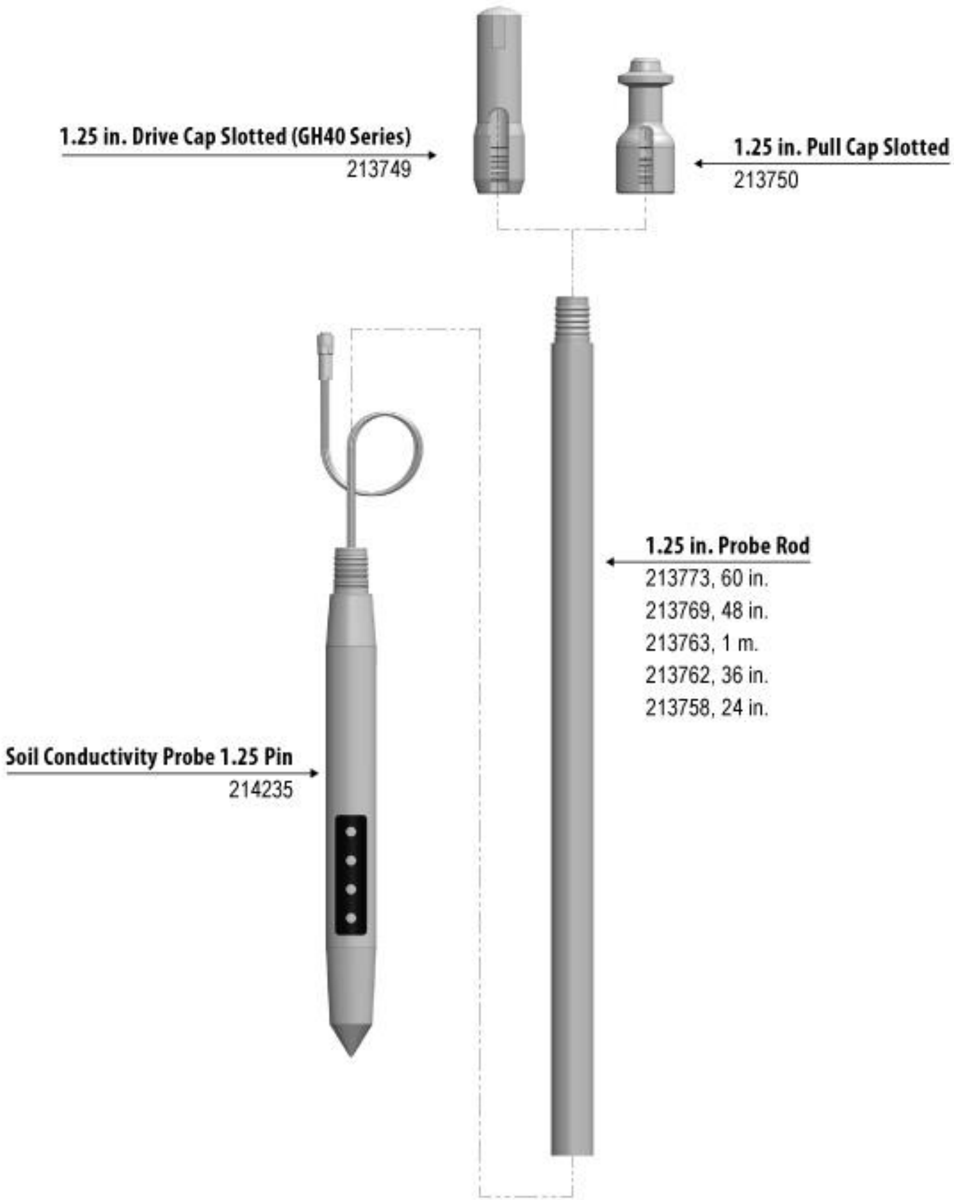
Figure 5.5: Example EC Log

APPENDIX VI
EC Tool Configurations

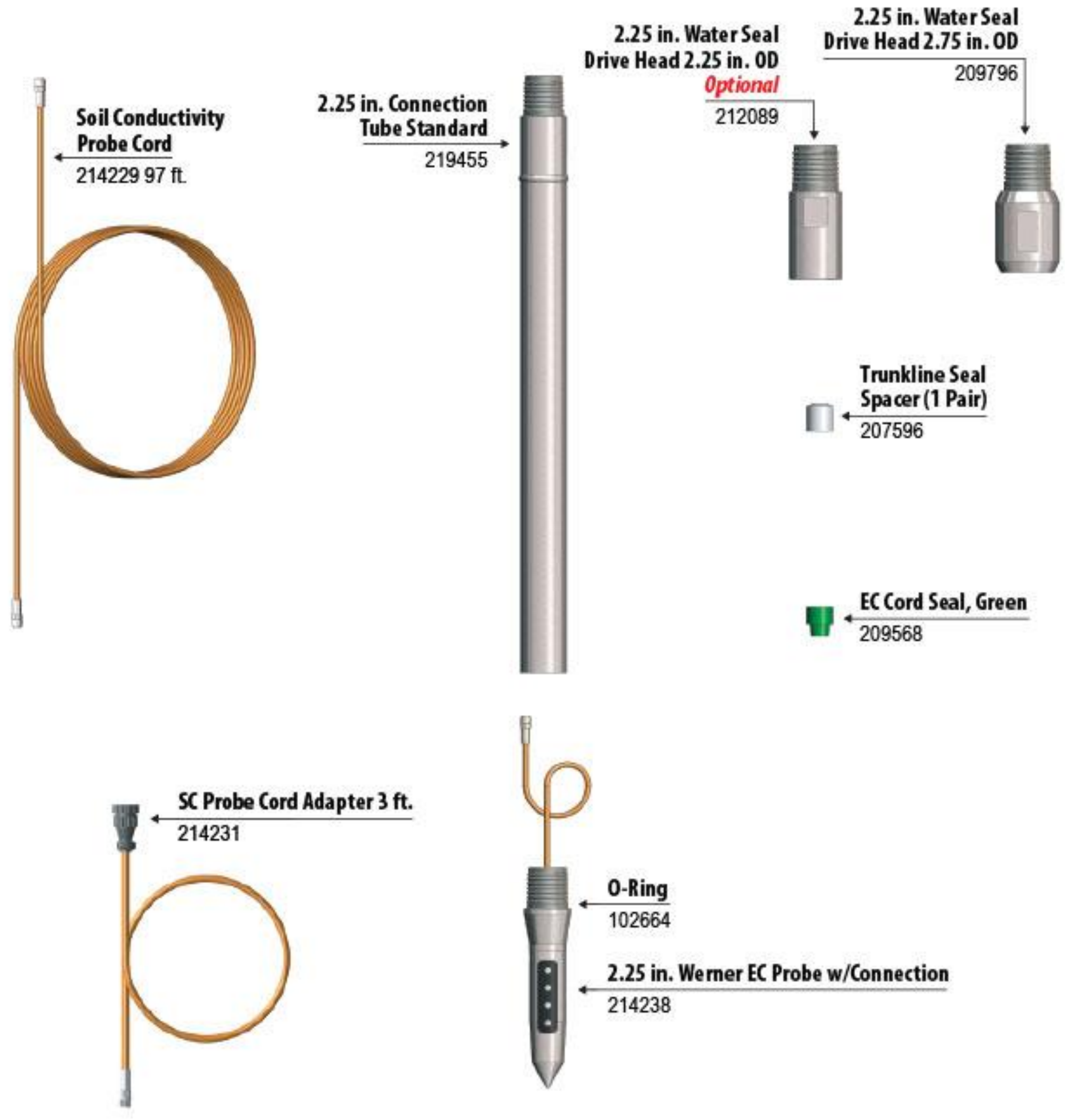
EC – SC520 (1.5 in / 1.75 in. system)



EC – SC400 (1.25 in. system)



EC – SC820 (2.25 in. system)



Revision 13
7/11/2019
Exp. 7/11/2020

UNITED STATES ARMY CORPS OF ENGINEERS

OMAHA DISTRICT (CENWO)

CHEMISTRY INSTRUCTIONS FOR SCOPES OF SERVICES FOR CONTRACTED ENVIRONMENTAL STUDIES

July 2019

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LIST OF ACRONYMS

AGC	Advanced Geophysical Classification
ANSI	American National Standards Institute
ASQ	American Society for Quality
CENWO	United States Army Corps of Engineers Northwestern Division Omaha District
CERCLA	Comprehensive, Environmental Response, Compensation, and Liability Act
COPC	Contaminant of Potential Concern
CSM	Conceptual Site Model
DERP	Defense Environmental Restoration Program
DL	Detection Limit
DoD	Department of Defense
DoDI	Department of Defense Instruction
DOE	Department of Energy
DQCR	Daily Quality Control Report
DQO	Data Quality Objective
EDD	Electronic Data Deliverable
ELAP	Environmental Laboratory Accreditation Program
ERPIMS	Environmental Resources Program Information Management Systems
FUDS	Formerly Used Defense Sites
IDQTF	Intergovernmental Data Quality Task Force
IEC	International Electrotechnical Commission
ISO	International Organization for Standardization
LOD	Limit of Detection
LOQ	Limit of Quantitation
MARLAP	Multi-Agency Radiological Laboratory Analytical Protocols
MFR	Memorandum For Record
NCP	National Contingency Plan
NELAP	National Environmental Laboratory Accreditation Program
OSD	Office of Secretary of Defense
PDT	Project Delivery Team
PFAS	per- and polyfluoroalkyl substances
PT	Proficiency Testing (sample)
QA	Quality Assurance
QC	Quality Control
QSM	Quality Systems Manual
RCRA	Resource Conservation and Recovery Act
SEDD	Staged Electronic Data Deliverable
SOP	Standard Operating Procedure
SOS	Scope of Services
UFP-QAPP	Uniform Federal Policy for Quality Assurance Project Plan
U.S.	United States

USACE	United States Army Corps of Engineers
USEPA	United States Environmental Protection Agency

1 Introduction to Chemistry Scope of Services

1.1 Purpose and Applicability

The Chemistry Scope of Services (SOS) is a supplement to contractual actions requiring collection, management, and use of environmental data. It complies with Section 515(a) of Public Law 106-554 (the Data Integrity Act) as implemented by the Office of Secretary of Defense (OSD) Memorandum, *Ensuring Quality Information Disseminated to the Public by the Department of Defense*, February, 2003, and requirements of Department of Defense (DoD) Instruction (DoDI) 4715.15, *Environmental Quality Systems*, dated December 11, 2006, and revised August 31, 2018. The Chemistry SOS requirements are established to improve continuity in data among DoD components; provide a fair open competition among commercial laboratories and environmental professionals; and promote the collection of data of known, legally defensible, and documentable quality, suitable for their intended uses.

The requirements established herein are applicable to the execution of projects within the environmental programs, including the Defense Environmental Restoration Program (DERP). This SOS applies to DoD operations, activities, and installations, including Government-owned/Contractor-operated facilities and Formerly Used Defense Sites (FUDS). Requirements apply to Government personnel, as well as Contractors, and any subcontractors working on behalf of United States (U.S.) Army Corps of Engineers (USACE), and are contractually binding. All work shall be performed in accordance with the Chemistry SOS, unless otherwise specified in the Site-specific SOS. If there are any differences between this Chemistry SOS and the Site-specific SOS, execution shall follow Site-specific instructions. Site-specific instructions should be well documented along with any justifications for variance.

1.2 Compliance with Federal and State Environmental Regulations, and other non-DoD Programs

The majority of environmental work falls under the U.S. Environmental Protection Agency (USEPA) environmental regulations covered by the Comprehensive, Environmental Response, Compensation, and Liability Act (CERCLA) 42 U.S. Code 103, the National Contingency Plan (NCP) 40 Code of Federal Regulations Part 300, the Resource Conservation and Recovery Act (RCRA), or other State-level programs. As such, each project's lead regulatory agency must be identified, and any special certification or other unique requirements be firmly established. Work for non-DoD customers may apply to any or all parts of this SOS, or defer to project specific requirements.

2 Project Planning and Documentation

2.1 Quality Systems and Systematic Planning

The Contractor shall develop project specific Data Quality Objectives (DQOs) consistent with the project's requirements and designed to ensure data of adequate quality are collected to support project decisions. DQOs shall be developed in consensus with the project team and in accordance with the DoD established policy for environmental quality systems in DoD 4715.15.RR-M-2, *Uniform Federal Policy for Implementing Environmental Quality Systems,* to improve the planning, collection, and use of environmental data. This guidance establishes consistency with American National Standards Institute (ANSI)/American Society for Quality (ASQ) Standard E4 and the International Organization for Standardization (ISO)/International Electrotechnical Commission (IEC) standard 17025. The Uniform Federal Policy for Quality Assurance Project Plan (UFP-QAPP) manual was created by the Intergovernmental Data Quality Task Force (IDQTF), which is composed of the USEPA, DoD, and Department of Energy (DOE) personnel. It is based on ANSI/ASQ E-4 Section 6 (Part B) and complies with EPA QA/R-5 and QA/G-5.

In order to obtain data of sufficient quality to satisfy DQOs for legally-defensible data, the USEPA, and/or state regulators require the preparation of appropriate planning documents for all environmental measurements that will be used for environmental regulatory compliance. The Contractor is responsible for preparing the appropriate planning document that complies with the USEPA or other lead regulatory agency regulations, USACE guidance, the DoD Quality Systems Manual (QSM), and USEPA guidance. The UFP-QAPP is the required format for all quality assurance (QA) planning documentation deliverables as outlined in the DoDI 4715.15, and satisfies all CERCLA and RCRA requirements for investigative purposes. The UFP-QAPP combines the work plan, the field sampling plan, and the quality assurance project plan into one uniformed standard format. A separate Accident Prevention Plan and Site Safety and Health Plan are required as either an attachment to the UFP-QAPP or as a stand-alone document. Please reference the Health and Safety SOS for USACE Northwestern Division Omaha District (CENWO) health and safety requirements. The UFP-QAPP manual and instructions can be found at USEPA, IDQTF, *Uniform Federal Policy for Implementing Environmental Quality Systems: Evaluating, Assessing, and Documenting Environmental Data Collection/Use and Technology Programs*, Final, Version 2, March 2005. The optimized UFP-QAPP worksheets can be found at USEPA, IDQTF, *Optimized Uniform Federal Policy for Quality Assurance Project Plans Worksheets*, March 2012 or USEPA, IDQTF, *Uniform Federal Policy for Quality Assurance Project Plans, Munitions Response QAPP Toolkit*, December 2018 for Military Munitions Response Program (MMRP) projects, as applicable, or USEPA, IDQTF, *Uniform Federal Policy for Quality Assurance Project Plans, Advanced Geophysical Classification for Munitions Response (AGC-QAPP)*, March 2016 for MMRP projects requiring AGC.

The UFP-QAPP integrates technical and quality control (QC) aspects of a project including planning, DQOs, implementation, assessment, and corrective action. The UFP-QAPP must provide information in sufficient detail regarding sample design, sample types, sample locations, interpretation scenarios, any field contingencies, sampling methodologies, and other sample handling techniques to collect data that meets the project objectives. All field tasks, including geological activities such as well design and installation, well abandonment, soil boring logging, field measurements, and surveying must be included. Please reference the Geology SOS for CENWO geology requirements. Specifics on detection and reporting limits of analytics used to support decisions, analytical methods, sample collection methods, field decision logic, data handling, application to the Conceptual Site Model (CSM), QC practices, data submittals, and CSM updating activities must also be addressed. Data management strategies must be established within the UFP-QAPP, and appropriately handled during fieldwork to ensure that all data generated is made available to any stakeholders, decision-makers, and personnel involved in the work or near real-time decision-making. The UFP-QAPP also describes the organization and QA objectives for field sampling and laboratory efforts, and any evaluation and interpretation of the data before its use. Please reference the per- and polyfluoroalkyl substances (PFAS) SOS for CENWO PFAS requirements.

All procedures and activities including, but not limited to, those required for the acquisition of data shall be presented in the UFP-QAPP for approval by the USACE Project Delivery Team (PDT), state representatives, and USEPA authorities, as necessary, prior to the initiation of any fieldwork. UFP-QAPP provides project-level guidance for implementing the systematic planning process including; project management and objectives; measurement, field tasks, and data acquisition; assessment and oversight; and data review. The UFP-QAPP is intended to be a living document and should be designed such that change pages may be provided to update the document. Modifications shall go through the appropriate approval process, prior to implementation. Any variances from the UFP-QAPP format must be approved by the USACE PDT and documented in the project file.

It is highly recommended that an initial scoping session be held as soon as possible after award to discuss approaches and initial planning steps (Basewide or Facility UFP-QAPP with Site-specific Addenda, stand-alone Site-specific UFP-QAPP, etc.) prior to beginning any document writing. It is best to have all possible Stakeholders present to allow for better consensus on approaches and requirements.

2.2 Contractor's Chemist's Role in Project Delivery Team

The Contractor Project Chemist shall accomplish the objectives of the project; including planning appropriate data needs, and more specifically the scope of testing such as matrices, methods, target analytes, and measurement quality objectives. The Project Chemist also performs oversight of the laboratory's scope of accreditation to ensure it meets project requirements and Measurement Performance Criteria. Other chemistry support roles include execution/oversight of field activities; data generation, data review, data validation, and data interpretation responsibilities; and identification of nonconformance issues and monitoring of corrective actions as necessary. The Contractor/subcontractor team shall clearly define the program and Project Chemists' involvement on all applicable project activities. General guidelines are provided in OSD memorandum, *Acquisitions Involving Environmental Sampling or Testing Services*, December 2007.

2.3 Environmental Laboratory and Analytical Testing

All laboratory services shall be conducted in accordance with the approved project QAPP. Samples shall not be submitted for analysis until the QAPP is approved by USACE and other stakeholders, as applicable. The laboratories shall perform QC requirements, as specified in the project QAPP. The analytical capabilities of the laboratory shall be sufficient for the methods specified in the QAPP, and the laboratory shall have sufficient through-put capacity to handle the necessary analytical work-load during all field activities. Laboratories performing environmental testing in support of DERP are required to be accredited per OSD memorandum, *DoD Environmental Laboratory Accreditation Program* (ELAP), December 2008. DoD ELAP accreditation is open to all environmental laboratories that can demonstrate conformance with the DoD QSM via inspection. Proposed environmental laboratories shall follow at a minimum, the most recent version of the DoD QSM for Environmental Laboratories. The DoD QSM was adopted into DoD policy guidance as DoDI 4715.15.RR-M-1, and is available at *www.denix.osd.mil*. The recommendation for acceptability of an environmental laboratory and any project-specific variances from the DoD QSM will be at the discretion of the USACE Project Chemist. A variance may be allowed if the laboratory's most recent ELAP accreditation is based on the previous version of the DoD QSM and the current accreditation cycle has not been completed since the release of the most recent version of the DoD QSM. If a laboratory fails to meet the DoD QSM or project-specific requirements at any time, the USACE Project Chemist may request the use of the laboratory be discontinued and replacement analytical services be procured from a laboratory which can meet these requirements. In addition, specific state requirements for laboratory accreditation must be met, including National Environmental Laboratory Accreditation Program (NELAP) accreditation. Any subcontracted laboratories must meet all project requirements included in this SOS.

Per the UFP-QAPP, definitive data is defined as analytical data that are suitable for final decision-making. Project-specific contaminants of potential concern (COPCs) must be clearly identified. Additionally, the acceptance criteria for calibration standards, laboratory control samples, and project QC samples must be defined and strictly enforced for the COPCs or other contaminants of interest.

2.4 Data Management Procedures

The data management system covers capture and management of field data, lab data, data quality assessment, and data interpretation into a CSM for final decision-making or use. The data management system will include, but not be limited to, final archive storage and any data sharing platforms such as ftp sites or password-protected project websites. Documentation shall follow DoD standard record-keeping practices, standard document control systems, and electronic data management systems. Details are presented as flow diagrams for a conceptual overview of the data management scheme, including various organizations' coordination, execution, and release. In order to effectively and cost efficiently manage analytical data, all contracts require definitive analytical data to be captured electronically and be evaluated by experienced environmental professionals using automated and manual data review tools. These procedures must be captured in the UFP-QAPP and approved by all stakeholders.

Once specific projects are awarded, each project must prepare an electronic project library. The project library shall include all of the project-specific objectives in the form of measurement performance criteria for definitive data management. Default performance criteria are established within the DoD QSM for several analytical parameters in water and solid matrices. Modifications to widen or tighten criteria will be at the discretion of the USACE Project Chemist and be fully justified as a variance in a Memorandum for Record (MFR). Details to be included in the project library are the analytical methods, the matrices sampled, the target analytes reported, Detection Limits (DL) and/or Limits of Detection (LOD), Limits of Quantitation (LOQ), associated precision and accuracy limits for method QC samples, and all method-specific criteria.

3 Assessment/Oversight

3.1 Onsite Assessments and Response Actions

The Contractor and any subcontractors shall be responsible for performing QC oversight of the field-sampling efforts, overseeing the Contractor laboratory performance and results, and proposing and implementing a system to improve overall effectiveness. These QC assessment activities shall be identified and discussed in the UFP-QAPP. Routinely, these activities ensure that the provisions of the UFP-QAPP are followed, substantiate project objectives or performance-based milestones are met, and ensure payment is authorized. Acceptance criteria and contingencies are presented for each assessment activity and submitted to the Government for review and approval according to project schedule. All planned performance audits for measurement systems or field-activities and proficiency testing (PT) samples, if any, shall be identified and their frequency and reporting defined. As part of the QC assessment and oversight requirements, the Contractor shall propose solutions to any laboratory or field sampling problems that arise. Analytical problems that the laboratory and the Contractor cannot resolve shall be brought to the attention of the Contractor's project manager, the COR, and the PDT as needed for resolution. For fieldwork, this includes supervising field sampling teams, performing field audits, and reviewing logbooks periodically to ensure the sampling standard operating procedures (SOPs) are being correctly executed. This secondary review of field and laboratory data ensures equipment is correctly calibrated and used in accordance with the approved UFP-QAPP.

3.2 Data Assessment Activities – Data Verification and Validation

The Contractor shall be responsible for assessing the environmental data's quality by performing full data verification and validation against criteria established within the analytical method, DoD QSM, project-specific DQOs, and as documented in the UFP-QAPP and electronic project library. The data assessment process applies to all data, regardless of whether it's generated in the field or at a subcontract laboratory. The level of the data assessment required is dictated by the data's intended use.

Data verification procedures evaluate the testing results compliance with the acceptance criteria established within the USEPA method (or other standard method), criteria in the most recent version of the DoD QSM, and/or project-specific DQOs. Full data verification is performed by evaluating documentation from sampling logs, sample shipment records, the sample's condition upon receipt at the lab and through the analytical process (analytical instrument's calibration, calibration verification, and all instrument performance checks), as well as the various method QC samples.

After data verification, the data is validated by the Contractor Project Chemist to determine if there is any impact to the integrity of the data or its usability. The minimum acceptable level of data validation for all data is Stage 2B as defined by USEPA *Guidance for Labeling Externally Validated Laboratory Analytical Data for Superfund Use* and the DoD *General Data Validation Guidelines,* and shall include validation of all items in the relevant DoD QSM, Appendix B, Quality Control requirement tables. Higher stages of data validation may be required dependent on the data's intended use. Highger level of data validation required shall be defined in the performance work statement.

Data verification and validation procedures shall be detailed within the UFP-QAPP per EPA QA/G-8, *Guidance on Environmental Data Verification and Data Validation.* Data validation procedures apply decision logic and qualifiers, as necessary. Routinely, data validation procedures follow the most recent version of the DoD G*eneral Data Validation Guidelines* and any current releases of DoD validation guidelines as found at https://www.denix.osd.mil/edqw/documents/documents/ or the USEPA *National Functional Guidelines*. These may be modified as appropriate, or the use of other project-specific protocols may be warranted. Multi-Agency Radiological Laboratory Analytical Protocols (MARLAP) shall be used for radiological parameters. Data assessment qualifiers must be clearly defined and documented along with the basis for the data qualification. It is also important to clearly present data assessment qualifiers separate from any qualifiers applied initially to the data by the laboratory to avoid confusion. Finally, data representativeness can be evaluated within a context of general continuity with historic results, or within the spatial realm of a CSM.

Several options are available for software that performs verification of batch method QC samples for a variety of analytical parameters, it may not capture or assess certain sample, instrument batch-specific, or method calibration data, however. Manual review of the method-specific calibration, calibration verification, and instrument performance checks are still mandatory, and shall be required to fully verify/validate the data's compliance with USEPA methods, the DoD QSM, and project-specific criteria. Any aspects not reviewed by automated software, but required by DoD QSM current version, Appendix B, will be manually verified and validated by the Contractor's Project Chemist to augment the automated data validation. The results of the data assessment including data qualifiers applied as interpreted by a chemist at validation shall be summarized in the Data Quality Control Summary Report/Data Validation Report. The Data Validation Report is routinely an appendix to the report or other construction completion submittals to address QC practices and conditions of the sampling and analyses, and summarize any impact to the data's usability. Support for specific programs may also mandate the submission of chemical and/or sampling data in electronic formats for archival / retrieval within an agency-specific database systems.

4 Data Deliverables, Forms, and Reports

4.1 Daily Quality Control Report and Cooler Receipt Forms

During the field investigation activities, Daily Quality Control Reports (DQCRs) shall be submitted to the Government at the frequency defined in the UFP-QAPP. Should problems arise, the Contractor shall notify the Government immediately. DQCRs are routinely submitted weekly by electronic mail, fax or express mail; or on a daily basis or greater frequency when problems have triggered corrective actions.

The government may also elect to require periodic submission of Cooler Receipt Forms. These documents are required by the DoD QSM and can be requested on an as-needed basis or periodically to confirm the acceptability of critical samples' condition upon receipt at the lab.

4.2 Electronic Data Deliverables

All data shall be submitted as an electronic data deliverable (EDD) in the required unique EDD format(s) for the DoD component(s) or non-DoD customers. The USACE has adopted the Staged Electronic Data Deliverable (SEDD) 5.2 minimum of Stage 2a for all projects. All FUDS projects require the use of FUDSChem. Please reference the FUDSChem SOS for CENWO FUDSChem requirements. Air Force Projects will require an Environmental Resources Program Information Management Systems (ERPIMS) database format submission. Contractors shall coordinate data submission requirements with the USACE Project Chemist to ensure all required data are captured and submitted accordingly. Specific EDD requirements shall be developed for each specific contract or task order. Hard copy (PDF) reports must be Level IV reports with summary forms for all method quality objectives required by the DoD QSM, as well as results, chromatographs, and manual integrations completed during analysis that might need to be validated.

The electronically and manually reviewed results, including the EDD submissions, are considered to be part of the analytical data package. Failure to meet deliverable deadlines will be considered a failure to meet appropriate standards of project performance. The final data set should reflect the full complement of qualifiers and corrections that result from the dialogue between the Contractor, the Government, and other Stakeholders.

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GEOLOGY SUPPLEMENT TO THE

SCOPE OF SERVICES

OR

PERFORMANCE WORK STATEMENT

REVISED: 13 NOVEMBER 2020

TABLE OF CONTENTS

1.0 INTRODUCTION

This supplement serves as the specifications for accomplishing the geology-related tasks identified in the Scope of Services (SOS) (or Performance Work Statement [PWS]), to which this supplement is attached. All work shall be performed in accordance with this supplement unless otherwise specified in the Site-Specific Section of the SOS. If there are any differences between this supplement and the Site-Specific Section of the SOS, the Contractor shall implement the Site-Specific instructions. If there are any differences between this supplement and the Contractor proposal, work plan, or other Contractor-produced document, the Contractor shall implement the work in accordance with this supplement.

- The *Contractor shall disregard* all sections of this supplement that do not apply to the tasks as outlined in the Site-Specific SOS. For example, if no new monitoring wells are to be installed, then the Contractor has no reason to refer to the sections on monitoring well installation, construction diagrams, etc.

- The Draft Project Report, Draft-Final Project Report, and Final Project Report referenced in this document shall be defined in the Site-Specific Section of the SOS. If there are any questions regarding this supplement, the Contractor shall contact the United States (U.S.) Army Corps of Engineers (USACE–Omaha District) Project Geologist for clarification.

- **Regulatory Requirements**. Field investigation procedures shall be conducted in accordance with all Federal, State, and local requirements. If the specifications as set forth in this SOS do not meet regulatory requirements, contact the USACE Contracting Officer's Representative (USACE–COR) for resolution of differences. The Contractor is responsible for determining applicable Federal, State, and local requirements.

2.0 QUALITY ASSURANCE/QUALITY CONTROL

2.1 Work Plans

A plan shall be submitted by the Contractor for approval before any fieldwork for the project is begun which addresses all quality assurance/quality control (QA/QC) procedures to be implemented in the field. This plan shall comply with the appropriate regulatory requirements as referenced in the SOS for this project. This plan shall include, at a minimum, the Contractor's methods, equipment, and procedures for carrying out all field work including drilling, sampling (soil, sediment, groundwater, soil vapor, surface water, etc.) monitoring well installation, well development, decontamination procedures, aquifer testing, geophysics, and surveying. This plan is not a separate document. This information shall be incorporated into the Contractor work plans, which address overall project QA/QC.

2.2 Qualified Personnel

The Contractor shall provide a qualified geologist or geological engineer who shall be on site and responsible for all logging and sampling during all soil/rock sampling activities. A qualified geologist/engineer shall be on site and responsible for all monitoring well drilling, installation, development and testing activities. A qualified geologist/geological engineer is defined as having a baccalaureate degree in a geological science or geological engineering from an accredited university and a minimum of two (2) years' experience in logging and/or analysis of subsurface conditions. The qualifications of the on-site geologist and/or geological engineer shall be included in the Contractor work plans. A person meeting these requirements shall be dedicated to each activity. The Contractor shall notify the USACE representative at least 2 weeks prior to the initiation of any field investigations so that a USACE representative can plan to be present for field oversight. The Contractor shall notify USACE–Omaha District of any changes in personnel from that specified in the work plan.

3.0 SOIL BORINGS AND MONITORING WELL BORINGS

Soil borings and monitoring wells may be required to investigate the vertical and horizontal extent of site-specific contaminants. Soil samples for chemical analysis may also be required from borings drilled for monitoring well installations, as directed in the Site-Specific Section of the SOS. Guidance for field activities may be obtained from USACE EM 1110-1-4000 (Nov. 98): *Monitoring Well Design, Installation, and Documentation at Hazardous, Toxic, and Radioactive Waste Sites*. All borings for soil sampling and monitoring well installations shall be drilled and sampled according to the requirements discussed in the following sections.

3.1 Utility Clearances and Permits

The Contractor shall be responsible for obtaining and coordinating all utility clearances and drilling/monitoring well permits. A copy of all monitoring well permits required by State or local regulations shall be included as an appendix in the Final Report. If it is necessary to move a boring in order to avoid utilities, the Contractor shall be responsible for relocating the boring to a suitable location that accomplishes the intent of the original location. The new location shall be as close as possible to the original location. Both locations shall be shown on the boring log. The Contractor shall take all reasonable precautions to protect persons and property near the drill site.

3.2 Drilling Methods

All borings shall be drilled by a method of the Contractor's choosing unless otherwise specified under the Site-Specific Section of the SOS. The method(s) shall be proposed by the Contractor and approved by the USACE–Omaha District Project Geologist prior to use. The method(s) shall be discussed in the Contractor work plans. If a boring will encounter groundwater, the drilling method must allow, or provisions must be made for, accurate determination of the depth to the groundwater surface. If a well is to be installed in a boring, the boring shall be of sufficient diameter to permit at least 2 inches of annular space between the boring wall and the sides of the centered riser and screen. The boring diameter shall be of sufficient size to allow for the accurate placement of the screen, riser, centralizers, filter pack, bentonite seal, and grout. The Contractor's drilling method shall maintain the integrity of the borehole (i.e., prevent collapse) during backfilling and/or well installation. No grease shall be used on drill pipe joints. The use of any lubricants shall be submitted for approval in the Contractor work plans and shall be noted on the boring logs. The Contractor shall provide documentation (brand name, chemical analysis of product composition, safety data sheets [SDS], etc.) for all materials introduced into the boring during drilling, for approval prior to use.

3.3 Aquifer Protection

If other than the uppermost water-yielding zone is penetrated during drilling, precautions shall be taken to prevent the downward (or upward) movement of any contaminants. The drilling method and procedure to be employed shall be described in detail in the work plans for USACE–Omaha District review and approval prior to field deployment.

3.4 Decontamination

Site-specific decontamination procedures shall be addressed in the Uniform Federal Policy for Quality Assurance Project Plan (UFP–QAPP) submitted for review and approval by USACE and appropriate regulatory agencies. All drill pipe, drilling tools, bits, etc. shall be free of potentially contaminating materials (i.e., grease, oil, paint, etc.) and shall be pressure steam cleaned prior to use at each well boring on a properly constructed decontamination pad using an industrial power washer. Drilling equipment that is used down hole or may potentially cross-contaminate samples, such as augers, auger center plugs, core barrels, clean out bits, downhole geophysical equipment, etc. shall be decontaminated between each boring location. Samplers (described below) shall be decontaminated between each sample. The drill rig shall be steam cleaned prior to use at each site if the project consists of more than one site. The rig shall be free of leaks and debris, which could contaminate the boreholes (e.g., hydraulic fluid, oil, gas, loose paint, etc.).

3.5 Geotechnical Sample Requirements

During drilling of all borings, soil sampling shall be performed at regular intervals to allow for accurate logging of the soil lithology and, when specified, to obtain material for geotechnical testing. Sampling may be performed using a split-spoon sampler or thin-wall (Shelby tube) sampler using the techniques given in ASTM D 1586 *Standard Test Method for Penetration Test and Split-Barrel Sampling of Soils* and ASTM D 1587 *Standard Practice for Thin-Walled Tube Geotechnical Sampling of Soils*, respectively. Other types of samplers (California split tube, hollow stem auger continuous sampler, etc.) may also be used if included in the Contractor's work plans for approval. All samplers used to collect samples for chemical analysis shall be stainless steel. Samples to be used only for logging and geotechnical testing may be taken with sampling devices that are not stainless steel.

3.5.1 Sampling Intervals

Unless otherwise indicated in the Site-Specific Section of the SOS, soil samples for lithologic logging shall be collected continuously for at least the first 10 feet and at least every 5 feet for the remaining depth of each boring. Material recovered from geotechnical sample intervals may also be utilized to meet the requirements for chemical sampling (i.e., a sample for geotechnical testing and a sample for chemical analysis may be taken from the same split spoon). Samples for chemical analysis shall be collected first.

3.5.2 Soil Classification and Testing

All soil samples shall be visually classified in the field using the Unified Soil Classification System (USCS) described in ASTM D 2488 *Standard Practice for Description and Identification of Soils (Visual-Manual Procedure)*. In order to verify the field classifications and to obtain additional data on the composition of the subsurface materials, the Contractor shall retain samples for laboratory geotechnical testing. Refer to the Site-Specific Section of the SOS for specific sampling and testing requirements. This testing shall consist of Grain Size Distribution (ASTM D 421 *Standard Practice for Dry Preparation of Soil Samples for Particle-Size Analysis and Determination of Soil Constants* & ASTM D 422 *Standard Test Method for Particle-Size Analysis of Soils*), Atterberg Limits (ASTM D 4318 *Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils*), and moisture content (ASTM D 2216 *Standard Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock*). If multiple borings are performed at a site, the Contractor shall attempt to select samples for geotechnical analysis that are representative of all materials on site. In monitoring well borings, one sample from the screened portion of the aquifer shall be tested to confirm validity of the screen design.

3.6 Logs

All drill logs shall adhere to the following requirements:

Logs shall be prepared in the field, as borings are drilled, by a qualified geologist or geological engineer. The preparer shall sign each log.

All log entries shall be printed. Photo reproductions shall be clear and legible. **Illegible or incomplete logs shall not be accepted.** One legible copy of each field log shall be completed and sent to the USACE–Omaha District within **5 days** of completion of each boring. The boring shall not be accepted by the USACE–Omaha District before the drilling logs are received and approved.

Borehole depth information shall be from direct measurements accurate to one-tenth of a foot.

Logs shall be prepared on the Hazardous, Toxic, and Radioactive Waste (HTRW) Drilling Log Form (Eng Form 5056-R), included as **Attachment A**, that accompanies this supplement.

All relevant information blanks in the log heading and log body shall be completed. If surveyed horizontal control is not available at the time of drilling, location sketches referenced by measured distances from prominent surface features, shall be shown on, or attached to the log. If vertical control is not available, the depth measurement shall be recorded as feet below ground (grade) surface. The surveyed coordinates and elevations shall be recorded on the final log.

Log scale shall be 1 inch = 1 foot, unless otherwise specified in the Site-Specific Section of the SOS.

Each and every material type encountered shall be described in column c of the log form. Material types are to be logged directly from samples and indirectly interpolated using professional judgment, drill cuttings, drill action, etc., between sampling intervals.

Unconsolidated materials shall be described as outlined below and in the following sequence:

- Descriptive USCS classification in accordance with ASTM D 2488;
- Consistency of cohesive materials or apparent density of non-cohesive materials;
- Moisture content assessment, e.g., moist, wet, saturated, etc.;
- Color;
- Other descriptive feature (minor constituents, bedding characteristics, organic materials, macrostructure of fine-grained soils - e.g., root holes, fractures, etc.);
- Depositional type (alluvium, till, loess, etc.)

Rock materials shall be described in the sequence outlined below and in accordance with ASTM C 294 and other standard geologic nomenclature including:

- Rock type;
- Relative hardness;
- Density;
- Texture;
- Color;
- Weathering;
- Bedding;
- Fractures, joints, bedding planes, and cavities, including any filling material and whether open or closed;
- Rock Quality Designation (RQD);
- Other descriptive features (fossils, pits, crystals, etc.).

Stratigraphic/lithologic changes shall be identified in column c by a solid horizontal line at the appropriate scale depth on the log, which corresponds to measured borehole depths at which changes occur, measured, and recorded to the nearest one-tenth of a foot. Gradational transitions, changes identified from cuttings or methods other than direct observation and measurement shall be identified by a horizontal dashed line at the appropriate scale depth based on the best judgment of the logger. All lines shall be drawn with a straight edge and not by free hand.

Logs shall clearly show in columns e and f, the depth intervals from which all samples are retained, complete with sample number.

Logs shall identify the depth at which water is first encountered, the depth to water at the completion of drilling and the stabilized depth to water. The absence of water in borings shall also be indicated. Stabilized water level data shall include time allowed for levels to stabilize and amount of borehole collapse.

Logs shall show borehole and sample diameters and depths at which drilling or sampling methods or equipment change.

Logs shall show total depth of penetration and sampling. The bottom of the hole shall be clearly identified on the log with a double line across all columns at the bottom depth of drilling and with the notation “Bottom of Hole.”

Logs shall identify any drilling fluid losses including the depths at which they occur, rate of loss and total volume lost.

Logs shall show drilling fluids used including, as appropriate:

- Source and volume of make-up water;
- Drill fluid additives by brand, product name, and mixture proportions; and
- Type of filter for compressed air.
- Logs shall show depths and types of any temporary casing used.
- Logs shall identify any intervals of borehole instability.

Intervals of lost bedrock core shall be shown in column e. Intervals of intact soil sampling attempts shall also be shown in column e, including depths from which attempts were made and length of sample recovered from each attempt. Bedrock coring information shall be recorded in consecutively numbered runs in column h and shall include the following:

- Start and stop time of each core run;
- Depth to top and bottom of each core run;
- Length of core recovered from each run;
- Size and type of coring bit and barrel; and
- Measured depth to the bottom of the hole after core is removed from each run.

Any special drilling or sampling problems shall be recorded on logs, including descriptions of problem resolutions.

Logs shall include all other information relevant to a particular investigation, including but not limited to;

- Odors;
- Photoionization detector (PID)/flame ionization detector (FID) measurements or other field screening or test results (column d); and
- Any observed evidence of contamination in samples, cuttings, or drilling fluids.

Copies of the handwritten field logs shall be included in the Draft Project Report and drafted boring logs shall be submitted in the Draft-Final and Final Project Reports unless otherwise specified in the Site-Specific Section of the SOS.

3.7 Backfilling

All borings shall be backfilled with a bentonite-cement grout, a 30% high-solids bentonite grout, or in accordance with the Site-Specific Section of the SOS. Grout backfill shall be placed consistent with paragraph **4.6 Annular Seal** of this supplement. Tamped cuttings may be used to backfill the borehole only if specified in the Site-Specific Section of the SOS. The borings shall be backfilled immediately after the sampling is completed unless saturated conditions have been encountered or a monitoring well is installed. In borings encountering saturated conditions, a 24-hour groundwater level and collapse depth shall be measured before backfilling. Borings left open overnight shall be covered to lessen the potential for injury to personnel and to minimize the potential for any surface drainage entering the boring.

3.8 Site Restoration

The site shall be restored to the condition the site was in prior to the beginning of fieldwork, and that is acceptable to the owner/base/facility. Site restoration will be finished within 5 days of the completion of the site investigation. **High-visibility areas or high-traffic areas shall be immediately restored upon completion of the work in that area of the site investigation**. Drums (if used) shall be staged at a pre-designated drum staging area specified by the owner as part of this site restoration. The drum staging area shall be identified in the work plans. The drums shall be placed on wooden pallets for temporary storage. Drums containing liquids shall have spill containment. The USACE–Omaha District shall provide the final approval of the site restoration.

4.0 WELL DESIGN AND INSTALLATION

The wells shall be constructed according to all applicable Federal, State, and local requirements. If the specifications as set forth in the SOS do not meet regulatory guidance or requirements, contact the USACE–COR for resolution of differences. The Contractor is responsible for determining all applicable regulatory agency requirements and for obtaining all required State and local well permits as well as submitting logs to the State or local authority once finalized, if required.

All well materials shall be steam cleaned immediately before installation and shall remain clean until installed in the boring or the material shall be steam cleaned again. Factory sealed well materials (screen and riser) do not require decontamination if the plastic wrap is intact, without holes or rips, and the materials are not removed until immediately before installation. The following specifications shall be followed except when site-specific requirements may be different where noted in the Site-Specific Section of the SOS. The Contractor shall provide documentation (brand name, sizes, etc.) for all well and seal materials that are to be used for well installation. This data shall be presented in the work plan.

4.1 Well Riser

Well risers shall consist of polyvinyl chloride (PVC) or stainless steel, unless stated otherwise in the Site-Specific Section of the SOS. PVC pipe (if used) shall be new, threaded flush-joint, and at a minimum, conform to the requirements of ASTM F 480 *Standard Specification for Thermoplastic Well Casing Pipe and Couplings Made in Standard Dimension Ratios* (e.g., Schedule 40 or Schedule 80). It shall bear markings that shall identify the materials and shall carry the seal of the National Sanitation Foundation. Stainless steel pipe (if used) shall consist of new, flush-jointed and threaded, type 304, corrosion-resistant steel, unless otherwise stated in the Site-Specific Section of the SOS. Threaded flush-joint couplings with chemically inert O-rings, to form watertight unions, shall join riser sections. Adhesives or solvents shall not be used to join the casing sections. The use of Teflon tape on threaded joints is not acceptable and shall not be used in the construction of monitoring wells. No lead shot or lead wool is to be employed in producing seals at any point in the well.

4.2 Well Screen

The Contractor shall have the responsibility of selecting the screened area of the borehole so that the completed monitoring well provides data that meets the project Data Quality Objectives (DQOs). Well screens shall be constructed of the same size and strength material as the well riser, unless specified otherwise in the Site-Specific Section of the SOS. The screen material shall be non-contaminating, non-clogging, *continuous slot, wire wrap design*. All screen sections shall be threaded, flush joint design. **Field slotted or factory slotted screen** is <u>**not**</u> **permitted**, unless otherwise specified in the site-specific requirements. The slot size shall be determined by the Contractor based upon available subsurface data and designed to be compatible with aquifer and gravel pack material. For water table wells, normal, seasonal fluctuations in the water table elevation shall be taken into consideration when placing the well screen so that monitoring shall be possible throughout an average year. Normal fluctuations shall be determined through a review of local well records and available literature. Sediment traps (sumps, tailpipe) shall not be used below the screened portion in monitoring wells unless directed by the USACE–Omaha District Project Geologist. The procedure to be used in the field for determining the screen placement shall be presented in the Contractor work plans.

4.3 Filter Pack

The annular space around the well screen shall be backfilled with clean, washed, well-rounded silica sand sized to perform as a filter between the formation material and the well screen. The grain size of the filter pack that is used shall be included in the Contractor work plans (with selection rationale) and shall be shown on the well construction diagram. A grain-size distribution curve for all filter pack material shall be submitted by the Contractor in the work plan and in all versions of the Project Reports along with the well construction diagrams. Unless otherwise specified in the Site-Specific SOS, the Contractor shall collect and test for grain size distribution a minimum of one representative sample of the filter pack material to assure compliance with the work plan. This sample shall be collected at the site. The filter pack material shall be tremied into place to avoid bridging and ensure a continuous filter pack throughout the screened interval of the well. The filter pack shall extend approximately 1 foot below, and 3 to 5 feet above the well screen. If the boring extends more than 1 foot below the bottom of the screen, the Contractor shall propose backfilling methods and materials in the Contractor work plan.

4.4 Well Plumbness and Alignment

All riser and screen shall be set round, plumb, and true to line. A 10-foot long section of pipe, ½ to ¾ inch less in diameter than the inner diameter of the well riser pipe (or screen), shall be run through the entire length of the well to check the alignment. The result of such test shall be recorded on the Daily Quality Control Reports (DQCRs) and the installation diagram. If the pipe does not pass freely for the entire depth of the well, the Contractor shall replace or repair the well at no additional cost to the Government, if so directed by the Contracting Officer. The pipe section shall be decontaminated with pressurized steam prior to the test. Adequate precautions shall be taken to prevent cross-contamination of wells by changing the rope attached to the pipe or decontaminating the cable prior to each alignment test.

4.5 Bentonite Seal

A 3 to 5 foot thick bentonite seal shall be placed in the annular space above the well screen and filter pack sand. The seal shall be composed of commercially manufactured, solvent-free, uncoated sodium-bentonite pellets, bentonite chips, or 30% high solids bentonite grout. “Coated” bentonite pellets shall not be used without prior approval from the USACE–Omaha District Project Geologist. Bentonite pellets shall not exceed 1/2-inch diameter. If the bentonite seal is positioned above the water table, the bentonite shall be installed in 1-foot lifts with each lift hydrated a minimum of 30 minutes before proceeding. Clean, potable water shall be added to hydrate the bentonite. After the placement of the final lift, the bentonite seal shall be allowed to hydrate for a minimum of an additional two hours before grouting begins. If 30% high solids bentonite grout is used for the seal, it shall be allowed to set overnight.

The bentonite seal shall be placed immediately after installing the filter pack, unless the well is going to be developed prior to placement of the seals, in which case, the seal shall be placed immediately upon completion of development.

4.6 Annular Seal

Grout shall be placed by pumping through a side discharging tremie pipe with the lower end of the tremie pipe located within 3 feet of the top of the bentonite seal. Pumping shall continue until undiluted grout flows from the boring at the ground surface. The annular seal shall be placed within 48 hours, but no sooner than two hours after the final lift of the bentonite seal installation.

4.6.1 Cement Grout

Cement grout shall be placed above the bentonite seal to the ground surface. The cement grout shall consist of a mixture of Portland cement (ASTM C 150) and water in the proportion of not more than 7 gallons of approved water per bag of cement (94 pounds). Additionally, 3 percent by weight of sodium bentonite powder shall be added unless prohibited by State or local regulations.

4.6.2 High-Solids Bentonite Grout

Commercially available 30% high-solids bentonite grout may be substituted for cement grout with USACE–Omaha District Project Geologist approval or if specified in the Site-Specific Section of the SOS. If approved, or specified, the grout shall be mixed in accordance with the manufacturer's instructions. The slurry shall consist of a mixture of bentonite and the manufacturer's recommended volume of water to achieve an optimal seal. The slurry shall contain at least 30% solids by weight and have a density of at least 9.4 pounds/gallon. The slurry weight shall be tested periodically with a mud scale to assure proper mixing.

4.7 Protection of Well

At all times during the progress of the work, precautions shall be taken to prevent tampering with the well or the entrance of foreign material into it. Run-off shall be prevented from entering the well during construction. Upon completion of the well, a suitable vented or loose fitting cap, such as a j-plug, shall be installed to prevent material from entering the well. The well riser shall be surrounded by a larger diameter protective non-corrosive steel or aluminum casing rising 2 to 3 feet above ground level and set an equal distance below the ground surface into the cement grout backfill. The casing shall be installed in a manner that does not hinder access to the monitoring well for purposes of cap removal, taking samples, or water level measurements. The outside of all protective casings shall be painted a color specified by the USACE–COR. Refer to the Site-Specific Section of the SOS for color requirements (the default color is blaze orange). The protective casing shall be provided with a locking cap and lock. The cap shall be designed to prevent water from entering the protective casing. All locks shall be brass (non-rusting) and keyed alike. Two (2) duplicate keys shall be provided to the USACE–COR, unless otherwise specified. A minimum 2 feet by 2 feet square by 4 inches thick concrete (with aggregate) pad, sloped away from the well, shall be constructed around the well casing with the top outer edge at the final ground level elevation. A weep hole of 1/8-inch diameter shall be drilled into the outer protective casing within 3 inches above the pad to permit drainage of fluids that may accumulate. Three 2-inch diameter or larger concrete-filled steel posts shall be equally spaced around the well and cemented in place a minimum of 3 feet below ground and 3 feet above ground, outside the concrete pad. Relief wells shall have three 4-inch diameter concrete-filled steel posts equally spaced around the well and installed a minimum of 4 feet below ground and 4 feet above ground. The ground immediately surrounding the top of the well pad shall be sloped away from the well.

4.7.1 Flush-Finish Completion

Some wells may be required to be finished flush with the ground or pavement if they are in areas of heavy traffic. This requirement shall be stipulated in the Site-Specific Section of the SOS or determined by the site owner. If this is required, the Contractor shall submit the proposed locations and flush-mounted well designs in the Contractor work plan for approval. Flush-finished wells shall also be equipped with a lock and shall be protected from the entry of surface fluids into the well. A minimum 2 feet by 2 feet square by 4 inches thick concrete (with aggregate) pad, shall be constructed around the flush-mount well cover with the outer edges at the final ground level elevation and the well cover raised slightly to provide for proper drainage away from the well. Protective posts shall not be required on flush-finished wells. Flush-finished wells completed in pavement shall be constructed so that snow plows do not catch the flush mount cover.

4.7.2 Cold Climate Completion

In climates with alternating freezing and thawing conditions, the well must be designed to minimize the potential for damage caused by frost heaving. The Contractor shall determine the frost heave potential and include damage minimizing surface completion design details, such as a gravel blanket in lieu of the concrete pad or constructing a joint separating the concrete pad from the protective casing and/or pavement, in the Contractor work plan.

4.8 Monitoring Well Installation Diagrams

Monitoring well construction diagrams detailing the as-built configuration of each monitoring well shall be prepared for inclusion in the Project Report on the attached form(s). A qualified geologist/geological engineer present during all drilling operations shall prepare the diagrams. A legible field copy of each well installation diagram shall be completed and sent to the USACE-Omaha District Project Geologist within **5 days** of completion of the well. The USACE-Omaha District Project Geologist shall not accept the well before the drill logs and installation diagrams are received and approved. Information provided on all diagrams shall include, but not be limited to the following:

- Project and site names, well number, and the total depth of completed well;
- Depth of any grouting or sealing, and the amount of cement and/or bentonite used, and the total boring depth;
- Depth, diameter, type of well casing, and location of any blank pipe installed in the well;
- Static water level upon completion of the well and after well development;
- Installation date or dates, and name of the geologist/geological engineer installing the well. The preparer shall sign each installation diagram;
- All pertinent construction details of monitoring wells, such as depth, volume and description of all backfill materials installed (such as gravel pack, bentonite, and grout); gradation of gravel pack; length, location, diameter, slot size, material (PVC, etc.), and manufacturer of well screen(s), position of centralizers, etc.;
- Source and volume of water added during drilling and well installation;
- Descriptions of surface completion, including protective steel casing, protective pipes, and concrete surface seal;
- A description of any difficulties encountered during well installation; and

- Surveyed coordinates and elevation of top of ground and top of well riser where groundwater is measured. A notch or mark on the casing where groundwater is measured should be noted. (Generally, a mark or notch should be made on the north side of the casing.)

4.9 Temporary Capping

Any well that is to be temporarily removed from service or left incomplete due to delay in construction shall be capped with a watertight cap and equipped with a “vandal proof” cover satisfying applicable State or local regulations or recommendations.

4.10 Identification of Wells

The Contractor shall securely affix a permanent corrosion resistant tag to the outer steel protective casing of each well, which clearly identifies the well number, depth, date of installation, the Contractor’s company name and the top of riser measuring/point elevation. The well shall also be clearly identified as a groundwater monitoring well (or other type of well as applicable) either on the tag or by other means which must be approved by the USACE–Omaha District Project Geologist. On flush-finished wells, the tag shall be fixed to the inside of the cover. The outside shall be labeled as a monitoring well, with the well number clearly identified.

4.11 Contractor Responsibility for Monitoring Wells

It is the responsibility of the Contractor to properly plan, design, install, develop, and test monitoring wells so that they are suitable to produce representative groundwater samples in sufficient quantity and quality for geochemical testing. The Contractor shall ensure that the intentions of this SOS and best construction practices are carried out.

4.11.1 Well Replacement

If the Contractor, due to inadequate design or construction, installs monitoring wells that are not suitable for their intended use or not in accordance with specifications, the Contracting Officer shall disapprove the well and direct the Contractor to repair or replace it at the Contracting Officer’s discretion. This work shall be done at no additional cost to the Government.

4.11.2 Abandoned Wells

If a monitoring well is disapproved by the USACE–COR or is abandoned by the Contractor for any reason, the well (or borehole) shall be abandoned in accordance with paragraph **6.0 Well Abandonment**. Such work shall be done at no additional cost to the Government.

4.12 Well Development

4.12.1 Procedures

Within one week after each well has been constructed, but no sooner than 48 hours after grouting is completed, the Contractor shall direct a program for the development of the well without the use of dispersing agents, acids, or explosives. The Contractor has the option of developing the well prior to placing the annular seal providing borehole stability can be maintained throughout the development and seal placement activities. This should be considered if significant settlement of the filter pack during development is anticipated. The objectives of well development are to: (a) assure that groundwater enters the well screen freely, thus yielding a representative groundwater sample and an accurate water level measurement, (b) remove all water that may have been introduced during drilling and well installation, (c) remove very fine-grained sediment in the filter pack and nearby formation so that groundwater samples are not highly turbid and so that silting of the well does not occur. Development shall consist of mechanical surging and bailing until little or no sediment enters the well. If not specified in the Site-Specific Section of the SOS, well development shall continue for a minimum of two (2) hours. Sediment that enters the well during this process shall be removed. At the end of that time, the well shall be continuously pumped using an electric submersible or pneumatic-drive, positive displacement bladder pump. Temperature, pH, specific conductivity, and turbidity shall be monitored during pumping (minimum of one reading per well volume). Pumping shall continue until these parameters have stabilized (less than 0.2 pH units, turbidity of less than 25 nephelometric turbidity units [NTUs] and less than 10% change for the other parameters between four consecutive readings) and the water is clear and free of fines. If these parameters have not stabilized after four (4) hours of continuous pumping, then the USACE–Omaha District Project Geologist shall be contacted for further direction. In the event that three consecutive readings below 25 NTUs cannot be achieved, the USACE–Omaha District Project Geologist should be contacted **<u>immediately</u>** for further instruction.

If the addition of water is required to facilitate surging and bailing, only formation water from that well shall be used. If this is not practical due to tightness of the formation, then only bailing shall be done. In all cases, the utmost care shall be taken not to collapse well screens during development activities and at least as much water as was introduced during drilling shall be removed from each well. The Contractor shall collect approximately 1 liter of the last water withdrawn from the well during development in a clear glass jar, label, immediately photograph it, and submit the photo as part of the well development form or appropriate project report. The photograph shall be a suitably back-lit, close-up that shows the clarity of the water. Fines remaining in the water shall not be allowed to settle out prior to taking the photograph. The thickness of any sediment that collects in the bottom of the jar after the sample is allowed to settle shall be noted on the Well Development Form. The nephelometric turbidity of the water shall be determined using a Photoelectric Nephelometer and shown on the Final Well Development Form. Part of well development should be the washing of the entire well cap and interior of the well casing above the water table using only water from that well. The result of this operation should be a well casing free of extraneous materials (e.g., grout, bentonite, sand, etc.). This washing should be conducted during development, not after development is completed. This washing should not be performed where free-phase contaminants (i.e. petroleum products) are present.

4.12.2 Well Development Records

A legible well development form shall be prepared and completed for each monitoring well installed. The geologist/geological engineer present during the well development operations shall prepare the form. A copy of the well development records, complete with original photos, shall be submitted to the USACE–Omaha District Project Geologist within **5 days** of completion of well development activities. A sample form shall be submitted in the Contractor work plan for USACE approval. Copies of the completed well development records shall be included in the Draft Project Report and Final Project Report. Information provided on the well development record shall include, but not be limited to the following:

- Name of project and site, well identification number, and date(s).
- Date, time, and depth to the static water level and bottom of well before development.
- Method used for development, to include equipment, size, type and make of bailer and/or pump used during development.
- Time spent developing the well by each method, to include the typical pumping rate if a pump was used in development.
- Volume and physical character of water removed, to include changes during development in clarity, color, particulates, and odor.
- Volume and source of any water added to the well, and chemical analysis of the added water.
- Volume and physical character of sediment removed, to include changes during development in color and odor.
- Clarity of water before, during, and after development, including a backlit photo, and thickness of any sediment which settles to the bottom of the jar containing the last one liter of water withdrawn from the well during development.
- Total depth of well and the static water level immediately after, and no sooner than the following day after development.
- Readings of pH, specific conductance, temperature, and turbidity taken before, during, and after development.
- Name(s) and job title of individual(s) developing well.
- Name and/or description of the disposal facility/area for the waters removed during development.
- Photograph.

4.13 In Situ Permeability Testing (Slug Testing)

Slug tests shall be performed for all new wells at each site **only if specified** in the Site-Specific SOS. After development and sampling of monitoring wells, the Contractor shall determine for each new well at each site the in situ permeability of the screened formation using an appropriate method. The Contractor shall propose the methods expected to be used and references for those methods in the Contractor work plans. No water or other liquid may be introduced into the well.

Both rising and falling head slug tests shall be performed; however, only the rising head portion of slug tests shall be analyzed in a well screened partially in the unsaturated zone. All instrumentation and materials placed into the well shall be decontaminated according to the requirements given for sampling equipment. If for any reason in situ tests cannot be completed at any well, the Contractor shall contact the USACE–COR immediately for instructions.

4.14 Water Source

Water for drilling, steam cleaning, and other necessary field activities shall be arranged by the Contractor and approved by the USACE–COR. Chlorine-free water shall be used if a suitable source is available. The Contractor shall be responsible for collecting and transporting all water to the drilling areas for required uses. The Contractor shall sample the water at each source and test it for the same parameters specified for groundwater samples under the Site-Specific Section of the SOS. In addition, a sample shall be obtained at the site from the delivery/transport vehicle and tested for the same parameters as the source sample. This information and documentation of the source of the water (i.e., fire hydrant location, etc.) which was used and any impact it may have on any of the analytical results performed under this SOS shall be included in the Draft, Draft-Final, and Final Project Reports. The Contractor shall be responsible for providing any deionized water required to perform this work.

5.0 SAMPLING TECHNIQUES-EQUIPMENT AND METHODS

5.1 Soil Sampling

The number and type of samples for chemical analysis is specified in the Site-Specific Section of the SOS. The sampling procedures and analytical methods are specified in the Site-Specific Section of the SOS. Sampling procedures shall meet all requirements outlined in the most recent version of Environmental Protection Agency (EPA) guidance (QA/G-5S, December 2002). Sampling procedures, equipment, and methods shall be addressed in the site-specific UFP–QAPP to ensure DQOs are established and met. The UFP–QAPP shall be submitted for review and approval by USACE and appropriate regulatory agencies.

Sampling for chemical analysis shall be performed using stainless steel sampling tools (e.g., split-spoon samplers, trowels, hand augers, etc.). Alternate sampling methods may be proposed for approval by the USACE–Omaha District Project Geologist in the Contractor work plans. Soil grab samples for volatile organic compounds (VOCs) or semivolatile compounds (SVOCs) analyses shall be obtained by sub-sampling the material retrieved in the split spoon. The portion of the split-spoon sample that represents slough shall not be sub-sampled. Sub-sampling shall be done immediately upon opening the split spoon and shall be done as soon as possible once the split-spoon sample is taken from the boring. When collecting samples with a hand auger, the VOC and SVOC sub-samples shall be collected immediately upon retrieval of the sample at the surface. The Contractor is responsible to recover adequate soil volume for all analytical requirements. If the sample volume of the first sample is not adequate, another sample shall be attempted from immediately below the previous sample or from the same depth in a boring drilled immediately adjacent to the boring in which the sample failed. This shall be done at no additional cost to the Government. The Contractor shall include in the Contractor work plans methods to be used to recover additional samples that are consistent with the project DQOs. Shallow soil samples for chemical analysis may be obtained with a stainless steel hand auger or a similar device if approved by the USACE–Omaha District Project Geologist in the Contractor work plans.

Homogenizing (mixing) of soil samples shall be performed in a stainless steel bowl using stainless steel stirring devices that have been decontaminated prior to each homogenizing procedure. Samples for VOCs or SVOCs shall not be homogenized unless specified in the Site-Specific Section of the SOS. Sampling equipment, sampling methods, and decontamination procedures shall be clearly indicated in the Contractor work plans.

5.2 Headspace Screening Method

The Contractor shall screen all soil samples collected above the water table for VOCs in the field at the time of sample collection. Field screening shall utilize either an organic vapor analyzer equipped with a PID or an FID. The PID lamp ionization potential (either a 10.6 electronvolt (eV) or 11.7 eV) shall be optimized for the contaminants of concern. The Contractor shall perform field screening in accordance with the following procedures unless alternate procedures are submitted and approved in the Contractor work plans.

- Immediately upon opening the split-spoon (or other sample retrieval device) and after collecting the VOC sample (if required), a representative portion of the sample shall be collected and placed in a new, clean, re-sealable plastic bag or a clean contaminant-free jar. (The sample may be placed in a new, clean, plastic sandwich bag inside a jar to minimize the number of new jars required. **If the plastic bag method is utilized, readings shall be taken inside empty bags to ensure no external contamination is being introduced**.)

- If the volume of sample recovered is insufficient for all analytical requirements, then the material used in the headspace readings could be utilized for any non-volatile sampling requirements (i.e., the headspace material could be used to fulfill the geotechnical requirements). **Note:** A headspace reading is not required from the additional sample that was retrieved immediately below the initial attempt due to insufficient sample volume.

- Seal the bag or seal each jar with at least one continuous sheet of aluminum foil, using the jar lid to secure the foil.

- Vigorously agitate the sample bag/jar for at least 15 seconds and then allow a minimum of 10 minutes (or as the environmental conditions dictate) for the sample to adequately volatilize.

- During cold weather, the samples shall be warmed to near room temperature prior to taking the headspace measurement.

- Re-shake the bag/jar and then pierce the bag (using the probe) or remove the jar lid and quickly insert the vapor sampling probe through the aluminum foil and record the maximum meter response (which should be within the first 2 to 5 seconds). Erratic responses should be evaluated in terms of high organic vapor concentrations or conditions of elevated headspace moisture.

- Record headspace screening data on the boring log and any other appropriate documentation (e.g. sample transmittals, field notebooks, etc.) as appropriate.

- The screening instrument shall be calibrated with the appropriate standard span gas at least once a day or according to manufacturer recommendations.

- If sample jars are to be re-used in the field, jars must be cleaned according to field decontamination procedures for cleaning of sampling equipment. In addition, headspace readings must be taken to ensure no residual organic vapors exist in the cleaned sample jars.

- Any deviation(s) from the approved procedures must be noted on the drill logs and the DQCR, with the basis for the deviation(s) stated.

5.3 Low-Flow Groundwater Sampling

The primary objective of low-flow (sometimes referred to as "low-stress") purging and sampling is to collect consistently representative groundwater samples without altering water chemistry (See EPA/540/S-95/504). Low-flow purging and sampling techniques help to reduce high turbidity levels that may adversely affect sample quality, which commonly occurs with conventional techniques that use bailers or high-speed pumps. Low-flow sampling also reduces purge water volumes. The Contractor shall provide all purging and sampling details, including equipment specifications, in the work plan. After development, all wells shall be allowed to stabilize for a minimum of 2 weeks prior to sampling. For all wells, the Contractor shall determine (measure and record) depth to water and the total well depth using an electronic water level probe to determine the well volume. Prior to purging, determine the presence of non-aqueous phase liquids (NAPLs) at the top and bottom of the water column. If NAPLs are present, contact the USACE–COR for further instructions. **Note:** when turbidity is a concern and DNAPLs are not suspected, <u>do not</u> measure the depth of the well prior to purging and sampling. Calculate well volume using the as-built depth, or the depth taken after the last round of sampling, and measure the actual well depth upon completion of sampling activities.

5.3.1 Well Purging Procedure

A well must be purged with a pump prior to sampling to assure that true formation water is sampled instead of stagnant casing water. Suitable pumps for low-flow (minimal drawdown) purging and sampling include bladder pumps, positive displacement pumps, peristaltic pumps, electrical submersible pumps, and gas driven pumps. Bladder pumps and other positive displacement pumps are preferred by the USACE–Omaha District when VOCs are to be sampled and the use of any other type of pump for VOC sampling **<u>must be pre-approved</u>** by the USACE–Omaha District Project Geologist and should be submitted in Contractor work plans with justification.

On sites without suspected PFAS impacts, well purging devices (e.g., bladders, pumps, bailers, and tubing) should be constructed of stainless steel, high-density polyethylene (HDPE), low-density polyethylene (LDPE), Teflon®, and other inert materials to reduce the chance of these materials altering the groundwater in areas were concentrations of the site contaminants are expected near detection limits. Teflon® tubing is preferred for sampling VOCs, but polyethylene tubing is acceptable for single use if it is demonstrated not to contribute contaminants to the samples. Disposable polyethylene tubing, which is discarded after its initial use, also decreases the possibility of cross-contamination between wells.

When sampling groundwater for per- and polyfluoroalkyl substances (PFAS), sampling materials constructed from Teflon® or LDPE are not to be used in order to prevent sample contamination. Consult the PFAS Scope of Services for additional information on PFAS sampling requirements.

Wells with low recharge rates may require the use of pumps capable of attaining very low pumping rates (bladder, peristaltic), and/or the use of dedicated equipment. If the recharge rate of the well is lower than extraction rate capabilities of currently manufactured pumps and the well is essentially dewatered during purging, then the well should be sampled as soon as the water level has recovered sufficiently to collect the appropriate volume needed for all anticipated samples (ideally the intake should not be moved during this recovery period). Samples may then be collected even though the indicator field parameters have not stabilized.

Water quality indicator parameters will be measured every 3 to 5 minutes by instruments contained in an in-line flow-through cell attached to the pump. Purging will be considered complete when parameters stabilize for at least 3 consecutive readings within the following limits:

- $\pm$ 1ºC for temperature,
- $\pm$ 0.1 for pH,
- $\pm$ 0.01 millisiemens per centimeter (mS/cm) or $\pm$ 3% (whichever is less) for specific conductivity,
- $\pm$ 10 millivolts (mV) or 10% (whichever is less) for oxidation-reduction potential (ORP),
- < 10 NTU for turbidity, or if purging has continued for more than 2 hours, $\pm$ 10% for turbidity after consultation with the USACE–Omaha District Project Geologist,
- $\pm$ 0.3 milligrams per liter (mg/L) or $\pm$ 10% (whichever is less) for dissolved oxygen.

Removal of a specific volume of water is not required, provided all water quality parameters are stable as noted above.

Wells will not be dewatered or purged dry, which can cause aeration as groundwater cascades back into the well. Water table wells (wells that straddle that water table) with slow recharge that results in significant drawdown (greater than 0.33 feet) while purging at the lowest possible rate will be pumped at a rate between 100 milliliters per minute (mL/min) to 200 mL/min (0.03 to 0.05 gallons per minute [gpm]) for a minimum of 1 hour, unless drawdown exceeds 2 feet. If a drawdown of >2 feet occurs in a water table well, purging will be stopped to allow the well to recover before sampling.

For wells screened below the water table (submerged screen), a greater drawdown during purging may be acceptable, as long as the screen is not exposed or at the discretion of the USACE–Omaha District Project Geologist. The USACE–COR will be notified if any wells produce less than 100 mL/min to discuss alternate sampling strategies.

Pertinent sampling measurements (intake depth and drawdown information from sampling event(s) for each well, etc.), shall be recorded. During subsequent sampling events, these relevant measurements and instrument settings (e.g., the intake depth, extraction rate, final pump dial setting information from previous event(s), drawdown levels, etc.) shall be duplicated, to the extent practicable.

5.3.2 Sample Collection

Sampling devices such as bailers and lift foot-valve samplers that cause repeated sediment disturbance and mixing of stagnant water in the casing with dynamic water in the screened interval are unacceptable.

All samples will be collected from the pump system unless Federal, State, or local regulations or guidance stipulate other methodology. After water quality indicator parameters stabilize, groundwater samples will be collected immediately. However, in-line monitoring equipment must be removed from the pump system prior to sample collection. During sample collection, the pumping rate will remain the same or lower than the purging rate to minimize aeration, bubble formation, or turbulent filling of sample bottles, especially when sampling for VOCs

During purging and sampling, the tubing should remain filled with water so as to minimize possible changes in water chemistry upon contact with the atmosphere. It is recommended that 1/4-inch or 3/8-inch (inside diameter) tubing be used to help ensure that the sample tubing remains water filled. If the pump tubing is not completely filled to the sampling point, use one of the following procedures to collect samples: (1) add clamp, connector (stainless steel or other inert material) or valve to constrict sampling end of tubing; (2) insert small diameter HDPE or silicone tubing into water-filled portion of pump tubing allowing the end to protrude beyond the end of the pump tubing, collect sample from small diameter tubing; (3) collect VOC samples first, then increase flow rate slightly until the water completely fills the tubing, collect sample and record new drawdown and flow rate.

In general, the sample collection sequence for various analytes shall begin with VOCs. If required, filtered samples for inorganics shall be collected utilizing in-line filters and obtained last from the pump stream. Samples shall be drawn directly into the appropriate sample bottles immediately upon receipt of water at the surface. The samples shall then be immediately placed in a cooler on ice and maintained at a temperature of 4 degrees Centigrade until received at the laboratory. Sample collection, packaging, and shipping procedures shall be specified in the Contractor's UFP–QAPP. Data generated during purging and sampling shall be presented in the project report, including flow rate, drawdown, water volumes, water quality parameter values, purge times, field instrument calibration data, sampling forms, and chain of custody forms.

5.4 Passive and Other Groundwater Sampling Methods

5.4.1 Passive Groundwater Sampling Methods

Passive sampling technology is evolving. Passive groundwater sampling methods shall be utilized only if specified in the Site-Specific Section of the SOS, otherwise the Contractor must propose to the USACE–COR and the procedure must be approved by the USACE Project Development Team (PDT) before employing passive sampling. Generally, passive sampling generates no purge water because the sample is obtained by diffusion or natural flow of groundwater. A sampling device is lowered into a well and allowed to equilibrate within the well water for a specified period of time. The device is then removed from the well and a sample is sent to the laboratory for analysis of target analytes. It should be noted that air-sensitive field parameters (e.g., ORP and dissolved oxygen) cannot be considered accurate when measured in open air since no flow-through cell is used during passive sampling. If these parameters are to be collected for natural attenuation scoring, then alternative data collection must be considered.

5.4.2 Other Groundwater Sampling Methods

Innovative sampling technology is also evolving. Innovative groundwater sampling methods shall be utilized only if specified in the Site-Specific Section of the SOS, otherwise the Contractor must propose to the USACE–COR and the procedure must be approved by the USACE PDT before employing innovative sampling.

5.5 Additional References for Groundwater Purging and Sampling

At a minimum, the Contractor should consult the following references prior to developing sampling procedures for wells.

- EPA, Region 1; "SOP GW 0001, Low Stress (Low Flow) SOP" Revision Number 2. July 30, 1996

- Puls, W.P. and M. J. Barcelona, April 1996, U.S. EPA Ground-Water Issue Paper: Low-Flow (Minimal Drawdown) Ground-Water Sampling Procedures, EPA/540/S-95/504, Washington, DC.

- Yeskis, Douglas, and Zavala, Bernard, May 2003, U.S. EPA Ground-Water Issue Paper: Ground-Water Sampling Guidelines for Superfund and RCRA Project Managers, EPA/542/S-02/001, Washington, DC.

- Saebom Ko1, Scott G. Huling and Bruce Pivetz, August 2012, USEPA Ground-Water Issue Paper: Ground Water Sample Preservation at In-Situ Chemical Oxidation Sites – Recommended Guidelines EPA/600/R-12/049

6.0 WELL ABANDONMENT

All well abandonment procedures shall be in accordance with this SOS and all Federal, State, and local requirements. If the specifications as set forth in the SOS do not meet State or local requirements, contact the USACE–COR for resolution of differences. The Contractor is responsible for determining applicable Federal, State, and local requirements. For each well abandonment, the documents outlined below shall be completed. The Contractor shall be responsible for submittal of all required documentation to the respective State agency and copies shall be provided to the USACE–Omaha District Project Geologist.

6.1 Well Abandonment Methods

A description of the methods and procedures to be used for well abandonment shall be submitted with the Contractor work plans. The plans shall include, but not be limited to the following:

- Applicable regulations (include copy of regulation in the work plan).
- Description of well abandonment procedures including drilling and placement of grout.
- Description of drilling equipment.
- Description of well abandonment material.
- Description of quality control procedures including depth measurements and placement of grout. Include also example forms for well abandonment logs and diagrams.

6.2 Well Abandonment Records

Well abandonment records summarizing the field performance of the items listed in paragraph **6.1 Well Abandonment Methods** shall be prepared by a qualified geologist/geological engineer present onsite during all well abandonment activities. Copies of these records, as well as any State/locally required submittals/approvals, shall be submitted in the Draft, Draft-Final, and Final Reports.

6.3 Abandonment Procedures

The following procedures shall be followed unless there are more stringent State or local regulations governing well abandonment:

6.3.1 Grout

Grout for well abandonment shall consist of the same mixture specified under paragraph **4.6 Annular Seal**, of this supplement.

6.3.2 Grout Placement

The grout shall be placed by tremie pipe, submerged in the grout at all times. The tremie pipe may be raised as the grout is placed as long as the discharge end remains submerged in the grout. The grout shall be placed from the bottom to the top of the hole in one continuous operation.

6.3.3 Casing Removal

Well casing (riser), protective casing, etc., shall be cut off a minimum of 3 feet below ground surface and the borehole backfilled with appropriate material (native soil, concrete, asphalt, etc.).

7.0 SURVEYS (GENERAL)

All sampling locations shall be staked to facilitate subsequent surveying. The Contractor shall perform all surveys required for this project and shall supply this office with the original or a legible reproducible copy of the surveys and field books. At a minimum, the surveys shall conform to the requirements stated in the following paragraphs.

7.1 Monitoring Wells

Coordinates and elevations shall be established for each monitoring well. The coordinates shall be to the closest 1 foot and referenced to the State Plane Coordinate System. If the State Plane Coordinate System is not available, an existing local grid system shall be used. A ground elevation to the closest 0.1-foot and an elevation for the top of the well riser to the closest 0.01-foot shall be obtained at each well. These elevations shall be referenced to Mean Sea Level, specifically to the North American Vertical Datum (NAVD) of 1988. If the 1988 Datum is not available, the National Geodetic Vertical Datum (NGVD) of 1929 shall be used. All positions and coordinates of all permanent points within the control traverse shall be shown. If not stated in the Site-Specific SOS, the Contractor shall coordinate with the USACE–Omaha District COR to determine what datum shall be used for the project. The Contractor shall state what datum was used upon the product delivery.

7.2 Soil Borings/Sampling Points

All soil sampling locations shall be located horizontally following procedures outlined in paragraph **8.1 Monitoring Wells**.

7.3 Physical Features

At each site, all aboveground and, where possible, underground physical features shall be either verified with previous mapping or be determined, if required. All aboveground physical features shall be located/verified to the nearest 1 foot. Permanent control monuments shall be placed in accessible locations within the limits of the work if existing permanent monuments are not located within 1000 feet of a site. One set of monuments is allowable for adjacent sites. These monuments shall be set no closer than 500 feet to each other.

7.4 Documentation

The location, identification, coordinates, and elevations of the wells and monuments shall be plotted on maps with a scale large enough to show their locations with reference to other structures at the individual sites. A tabulated list of the monitoring wells and monuments, copies of all field books, and all computation sheets shall be prepared and submitted to the USACE-COR. The tabulations shall consist of the designated number of the well or monument, the X and Y coordinates, and all the required elevations. These items shall be submitted to Omaha District no later than the Draft Project Report, and copies shall be included in the Reports as an Appendix.

7.5 GIS/GeoBase Spatial Data (Mapping) Requirements

All geospatial data shall be collected and maintained in accordance with (IAW) EM 1110-1-1005: *Control and Topographic Surveying* and EM 1110-1-2909: *Geospatial Data and Systems*. The data will be submitted to USACE for inclusion in their database. The Contractor will work with USACE to ensure all data has been validated and is accurate. The Contractor shall not establish new geographic information system (GIS) systems.

In furtherance of the environmental construction or restoration effort, the Contractor shall provide geospatial data and map(s) of installation features (historical, existing, or planned) altered or constructed as required to meet the objectives of the contract.

Source data and product data remain the property of the U.S. Government. The Contractor may be required to explain and demonstrate the company's process for protecting all geospatial data, including but not limited to, geometry, attributes, metadata, topologies, and relational database schemas and operations used in association with the contract. Further information about security and nondisclosure requirements should be obtained from the installation Geospatial Integration Office (GIO).

The Contractor shall provide data to update the GIS and/or computer-aided design and drafting (CADD) files as required to meet the objectives of the contract. Source data and product data remain the property of the U.S. Government.

The Contractor shall also ensure that GIS data is submitted in a format compatible with the USACE GIS program.

7.5.1 Metadata Requirements.

The National Spatial Data Infrastructure (NSDI) encompasses policies, standards, and procedures for organizations in the United States to cooperatively produce and share geospatial data. The Federal Geographic Data Committee (FGDC) has assumed leadership in the evolution of the NSDI in cooperation with the Department of Defense and other Federal agencies, State and local governments, academia, and the private sector. The FGDC has developed standards for collecting common information describing the content, quality, condition, and other characteristics of map and imagery data. These standards are collectively known as the *Content Standards for Digital Geospatial Metadata*. Executive Order 12906 *Coordinating Geographic Data Acquisition and Access: The National Spatial Data Infrastructure*, requires all Federal agencies to use the FGDC Standard to document all geospatial data that they produce (beginning in 1995).

7.5.1.1 Products Requiring Metadata Collection

The Contractor will collect and report metadata on all delivered products, including intermediate products such as breaklines, etc.

7.5.1.2 Helpful Metadata References with Internet Addresses

Information concerning FGDC's *Content Standards for Digital Geospatial Metadata* is available on the Internet at: https://www.fgdc.gov/standards/standards_publications/index_html

The FGDC's Draft *Content Standards for Digital Orthoimagery* product can be found on the Internet at:

https://www.fgdc.gov/standards/projects/FGDC-standards-projects/orthoimagery/orth_299.pdf

7.5.1.3 Required Metadata Format and Data Elements

Metadata will be submitted in an ArcXML based format capable of being utilized by ESRI's ArcGIS and at a minimum will include the following data elements:

• Identification Information	• Contact Information	• Metadata Date
• Time Period	• Data Quality	
• General Information	• Attribute Accuracy	
• Positional Accuracy	• Source Information	
• Process Steps	• Spatial Reference	
• General Information	• Horizontal Coordinate System	
• Vertical Coordinate System	• Metadata Reference	

8.0 GEOPHYSICAL SURVEYS

The primary objective for all geophysical investigations is to collect and record the appropriate geophysical survey data which will be used to meet the performance objectives as outlined in the SOS or PWS.

All geophysical investigation procedures shall be planned and conducted in accordance with EM-1110-1-1802: *Geophysical Exploration for Engineering and Environmental Investigations*. All geophysical survey objectives, plans, design specifications, Definable Features of Work (DFWs), Measurement Performance Criteria (MPCs), DQOs, Measurement Quality Objectives (MQOs), QA/QC plans, and other survey-specific details shall be specified in the Contractor's UFP-QAPP and approved by a USACE Geophysicist prior to the commencement of the survey.

Additional planning considerations for geophysical investigations are discussed in Chapter 2 of EM 1110-1-1802, ASTM D5753 – 18: *Standard Guide for Planning and Conducting Geotechnical Borehole Geophysical Logging*, and ASTM D6429 – 20: *Standard Guide for Selecting Surface Geophysical Methods*. Numerous additional ASTM manuals are also available for various specific geophysical investigation methods.

Geophysical deliverables and DFWs may include (but may not be limited to):

- Geophysical maps, cross-sections, and other figures which display the geophysical survey design, results, etc. Geophysical maps shall be submitted in their native format (e.g., Surfer®, Geosoft Oasis Montaj™, Intergraph, or ESRI ArcView format) and as raster bit-map images such as BMP, JPEG, TIFF, or GIF.

- Raw/pre-processed data collected IAW the approved UFP-QAPP. Raw field data will be stored in a logical file directory (folder) structure (e.g. Microsoft Access) to facilitate its management and dissemination to PDT members. Raw field data are defined as all digital data generated from the geophysical system and includes geophysical, positioning, heading, tilt, timestamps, and any other peripheral or instrument measurements collected or recorded during data acquisition.

- Metadata: all geophysical data will be accompanied by metadata in the form of a read-me file or a database (e.g. Microsoft Access) or spreadsheet table documenting the field activities associated with the data, the processing performed, and software required to utilize the data. Metadata will fully describe all measurements recorded in each data file and will include all information necessary to successfully associate all geophysical system measurements to their correct geographical location.

- QA/QC documentation IAW with the approved UFP-QAPP.

- Equipment calibration logs, as necessary, IAW with the approved UFP-QAPP and any guidance relevant to the geophysical data acquisition method employed (e.g. ASTM standards).

The Contractor will furnish for inspection all geophysical data, geophysical maps, and metadata via Internet using file transfer protocol, e-mail attachment for small files under 5 Mb, compact disk (CD)/digital video disk (DVD) or other approved method. Raw data shall be submitted in a standard format (e.g. ASCII), or at the discretion of the PDT, metadata for raw geophysical data shall include instructions for generating ASCII formatted data from all raw data.

All munitions response (MR) geophysical surveys shall be conducted IAW EM 200-1-15: *Technical Guidance for Military Munitions Response Actions*. Planning for MR projects shall adhere to the guidance provided in the MR-QAPP (IDQTF, 2020).

Geophysical surveys for geotechnical investigations shall be conducted IAW EM 1110-1-1804, *Geotechnical Investigations*.

All GIS and geospatial data associated with any geophysical investigation shall be collected, maintained, and submitted IAW EM 1110-1-1005: *Control and Topographic Surveying* and EM 1110-1-2909: *Geospatial Data and Systems*.

Revision 10
3/3/2020
Exp. 3/3/2021

UNITED STATES ARMY CORPS OF ENGINEERS

PFAS CHEMISTRY INSTRUCTIONS FOR SCOPES OF SERVICES

FOR CONTRACTED ENVIRONMENTAL STUDIES

March 2020

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LIST OF ACRONYMS

AFFF	Aqueous Film Forming Foam
COC	chain-of-custody
cm	centimeters
DoD	Department of Defense
ELAP	Environmental Laboratory Accreditation Program
ERPIMS	Environmental Resources Program Information Management Systems
FUDS	Formerly Used Defense Sites
HDPE	High-density polyethylene
IDW	investigation-derived waste
LDPE	Low-density polyethylene
m	meter
mL	milliliter
PFAS	per- and polyfluoroalkyl substances
PFOA	perfluorooctanoic acid
PFOS	perfluorooctane sulfonate
ppm	parts per million
ppt	parts per trillion
PVC	polyvinyl chloride
QA	Quality Assurance
QC	Quality Control
QSM	Quality Systems Manual
RCRA	Resource Conservation and Recovery Act
RSL	Regional Screening Level
SEDD	Staged Electronic Data Deliverable
UFP-QAPP	Uniform Federal Policy for Quality Assurance Project Plan
USACE	United States Army Corps of Engineers
USEPA	United States Environmental Protection Agency

1 PFAS Chemistry Supplement

The scope covers all requirements for acceptable sampling, analysis and validation of per- and polyfluoroalkyl substances (PFAS) for United States Army Corps of Engineers (USACE) Omaha District contract actions.

2 Background

PFAS, including perfluorooctane sulfonate (PFOS) and perfluorooctanoic acid (PFOA) comprise of either a short or a long carbon chain. The carbon chain is lipophilic while the head of the molecule is hydrophilic. The stability of these compounds is due to the strength of the carbon-fluorine bonds. Understanding the analytical implications of factors such as adsorption of PFASs to surfaces, effects of differing matrices, varying PFAS isomer response factors, potential bias effects of sampling, sample preparation, and analysis is critical to measuring highly fluorinated compounds at trace levels. PFAS can be transported to surface waters and groundwater (as a result of runoff and leaching) and are persistent in the environment. As a result, they can be transported long distances from the source site. Requirements for sampling various media (groundwater, soils, surface water and sediments) are discussed below. Also discussed are the analytical and validation requirements.

3 Sample Collection Protocol

PFAS are present in a wide variety of commercial products including common household items (fabric softeners, sunscreens, low density polyethylene containers, Gore-Tex, cosmetics, moisturizing lotions, etc.). Given the low detection limits associated with PFAS analysis and the many potential sources of trace levels of PFAS, field personnel will strictly adhere to the sampling equipment and protocols summarized in the table below.

USACE Omaha District has adopted with, minimal modifications, sample handling and processing methods as presented in Appendix A of Government of Western Australia, Department of Environmental Regulation, 2017, Interim Guideline on the Assessment and Management of Perfluoroalkyl Substances (PFAS), version 2.1, Contaminated Sites Guidelines, January. The following is a summary:

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

Prohibited Items	Acceptable Items
Field Equipment	
Teflon® containing materials	High-density polyethylene (HDPE) materials
Low density polyethylene (LDPE)	Polyvinyl chloride (PVC) or acetate liners
Aluminum foil	Silicon tubing
Waterproof field books	Loose paper (non-waterproof)
Plastic clipboards, binders, or spiral hard cover notebooks	Aluminum field clipboards or with Masonite
	Sharpies®, pens
Post-It Notes	
Field Clothing and Personal Protective Equipment (PPE)	
New cotton clothing or synthetic water resistant, waterproof, or stain- treated clothing, clothing containing Gore-Tex™	Well-laundered clothing, defined as clothing that has been washed 6 or more times after purchase, made of natural fibers (preferably cotton)
Clothing laundered using fabric softener	No fabric softener
Boots containing Gore-Tex™	Boots made with polyurethane and PVC
Tyvek®	Cotton Clothing
No cosmetics, moisturizers, hand cream, or other related products as part of personal cleaning/showering routine on the morning of sampling	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
Sample Containers	
LDPE or glass containers	HDPE or polypropylene
Teflon®-lined caps	Unlined polypropylene caps
Rain Events	
Waterproof or resistant rain gear	Gazebo tent that is only touched or moved prior to and following sampling activities
Equipment Decontamination	
Decon 90	Alconox® and/or Liquinox®
Water from an on-site well	PFAS-free water from a tested source
Food Considerations	
All food and drink, with exceptions noted on the right	Bottled water and hydration drinks (i.e., Gatorade® and Powerade®) to be brought and consumed only in the staging area

4 Sampling Methodology

Prior to sampling, the sampling personnel must don a clean, new pair of disposable nitrile gloves. A new pair of nitrile gloves must be worn for each sample collected.

Teflon®-coated materials and aluminum foil may not come into contact with the sample (refer to **Table 1**). Sample handling equipment or tools made of HDPE or stainless steel are acceptable, provided they are decontaminated prior to use via scrubbing and rinsing thoroughly in PFAS-free water to clean away any debris or material and then triple-rinsed in distilled (Grade 3 or better) or deionized water (Millipore water).

Sample containers must be comprised of polypropylene or HDPE (refer to **Table 1**). Glass containers with lined lids are prohibited. Prior to sampling, confirm sample container composition (polypropylene versus HDPE) with the selected analytical laboratory.

For each sample, the required minimum volume of drinking water, surface water, or groundwater is 125 milliliters (mL), and the required minimum amount of soil or sediment is at least 2 grams on a dry weight basis. If quantitation limits lower than 4 parts per trillion (ppt) are needed to meet data quality objectives, the required minimum volume of drinking water, surface water, or groundwater is 250mL. These sampling requirements may vary by laboratory. Prior to sampling, confirm sample size requirements with the selected analytical laboratory as the entire sample plus bottle rinsate must be extracted, with highly concentrated samples such as aqueous film-forming foam (AFFF) as the only exception. Sampling volume is determined by the analytical laboratory and should be adapted to expected PFAS levels and analytical capacities. The instrumental limit of detection is the main factor limiting the sensitivity and the volume should be enough to reach quantitation levels.

For chlorinated drinking water, each sample bottle may be required to contain a small amount (5g per liter) of Trizma®, a buffering reagent that removes free chlorine from chlorinated drinking water, or similar sample additive as specified by the selected analytical laboratory. Confirm the need for additive with the selected analytical laboratory and the USACE chemist.

The use of chemical or gel-based coolant products (e.g., BlueIce®) to maintain samples at less than 6°C following sample collection is prohibited. The acceptable alternative is wet ice which has been double-bagged (polyethylene plastic) and secured to avoid meltwater from contacting sample containers during overnight or same-day delivery to the analytical laboratory.

Table 1 should be reviewed to identify other products that may contaminate the sampling processing area. If in doubt about a particular product or item in contact with environmental media to be sampled or in close proximity to operations, collect and analyze a rinsate sample using laboratory-supplied PFAS-free water.

Support personnel that are within 2 to 3 meters (m) of the processing area are considered subject to the same restrictions related to precautionary measures for clothing and food, as applied to sampling personnel.

During sample processing and storage, minimize the exposure of the sample to light. Once collected, the samples will be properly preserved, packaged, placed on ice, and shipped under proper chain-of-custody (COC) procedures. The COC forms will be completed by the sampler and will accompany the samples from the field to the lab.

5 Soil Drilling and Surface Water and Sediment Sampling

Decontamination of soil drilling and sampling equipment and of sediment sampling equipment (cores, grabs) must avoid the use of detergents, other than those listed in **Table 1**. Equipment must be scrubbed with a plastic brush or steam cleaned and rinsed thoroughly in PFAS-free water to clean away any debris of material on exposed surfaces and then triple rinsed in distilled (Grade 3 or better) or deionized water (or Millipore water). Equipment that contacts soil, sediment, or surface water must not contain or be coated with Teflon® unless the Teflon® is internal to the equipment and does not contact the external environment.

Prior to sample collection, any personnel that handles decontaminated soil, sediment, or surface water sampling equipment that directly contacts the environmental media to be sampled must don a clean, new pair of disposable nitrile gloves. A new pair of nitrile gloves must be worn for each different sampling location. Donning a new pair of gloves is necessary if the old pair of gloves was compromised or if the personnel's ungloved hands touched items that may represent potential PFAS contamination (refer to **Table 1**) since last being washed.

Surface water must be collected by inserting a capped sampling container (polypropylene or HDPE) with the opening pointing down to avoid the collection of surface films. At the time of container opening, the container must be more than 10 centimeters (cm) from the sediment bed and more than 10cm below the surface water level and as close to the center of the channel as possible, where practicable. Point the container up to fill so that gloved hands, sample container, and sampler are downstream of where sample is being collected. Surface water shall not be filtered to remove suspended solids, either in the field or at the laboratory. Centrifuging of the sample at the laboratory is preferred, if phase separation is required.

Soil and sediment core samples must be collected directly from single-use PVC or acetate liners that must not be decontaminated or reused at different locations.

For aquatic samples collected from shore or via wading, ensure that waders are constructed of fabric that has not been treated with waterproofing coatings (refer to **Table 1**). **Table 1** should be reviewed to identify other products that may contaminate the sampling area or surface water, sediment, or soil sample. If in doubt about a particular product or item in contact with environmental media to be sampled or in close proximity to operations, collect and analyze a rinsate sample using laboratory-supplied PFAS-free water. Support personnel that handle any part of equipment that directly contacts surface water or aquatic sediment, personnel that are within 2 to 3m of the borehole during soil sampling, or personnel that are within 2 to 3m of the collection and processing area on aquatic vessels during sediment or surface water sampling, are considered subject to the same restrictions related to precautionary measures for clothing and food, as applied to sampling personnel.

In saltwater conditions, other measurements should also be collected: conductivity, salinity and total suspended solids. Filtration upon sample collection is not recommended since the filter may absorb PFAS or be a source of contamination. Centrifuging of the sample at the laboratory is preferred, if phase separation is required.

Grab samples are collected in glass or polypropylene containers. Sample containers and contact surfaces with polytetrafluoroethylene shall be avoided. As part of the overall quality assurance program for this test method, field blanks exposed to the same field conditions as samples are collected and analyzed according to this test method to assess the potential for field contamination. Samples shall be shipped on ice with a trip blank. Once received, the sample temperature is taken and should be less than 6 °C. If the receiving temperature is greater than 6 °C, the sample temperature is noted in the case narrative accompanying the data. Samples should be stored refrigerated between 0 and 6 °C from the time of collection until analysis. The sample should be analyzed within 28 days of collection. No holding time study has been done on the various soil matrices. Once collected, the samples will be properly preserved (if necessary), packaged, placed on wet ice, and shipped under proper COC procedures. The COC forms will be completed by the sampler and will accompany the samples from the field to the lab.

6 Groundwater Well Drilling, Development, and Sampling

Decontamination of drilling equipment must avoid the use of detergents. All equipment must be scrubbed with a plastic brush or steam cleaned and rinsed thoroughly in PFAS-free water to clean away any debris or material on exposed surfaces and then triple-rinsed in distilled (Grade 3 or better) or deionized water (or Millipore water). Sampling must include submission of sample(s) representing any water at the point of use (i.e., water truck or tank on-site) used by the driller for drilling purposes.

Equipment that contacts well water within the well (pumping equipment, water meters, etc.) must not contain or be coated with Teflon® unless the Teflon® is internal to the equipment and does not contact the external environment.

Prior to well development, any personnel that handles decontaminated well development equipment that directly contacts bore water must don a clean, new pair of disposable nitrile gloves. A new pair of nitrile gloves must be worn for each different well developed. Hand washing prior to donning the new pair of gloves is necessary if the old pair of gloves was compromised or if the personnel's ungloved hands touched items that may represent potential PFAS contamination (refer to **Table 1**) since last being washed.

Equipment recommended for obtaining groundwater samples includes low-flow peristaltic pumps using silicone or HDPE tubing or polypropylene HydraSleeves (or similar products). Sampling equipment decontamination and/or reuse at different locations must be minimized and substituted with disposable or dedicated equipment that comes in contact with the sampled media. If the depth to groundwater prevents the use of peristaltic pumps, then bladder pumps may be considered; however, bladders and other internal parts (i.e., check balls, o-rings, and compression fittings) must not be made of Teflon. Bladders must be changed between sample locations and it is recommended that o-rings also be changed between sample locations.

All sample ports or wells will be purged, as necessary, prior to sample collection. The approximate amount of purge water will be recorded. All purge water shall be collected and either treated or disposed of in accordance with all applicable local, state, federal, and USACE regulations. All samples shall be collected in appropriate containers for the requested analysis. Once collected, the samples will be properly preserved (if necessary), packaged, placed on wet ice, and shipped under proper COC procedures. The COC forms will be completed by the sampler and will accompany the samples from the field to the lab.

Table 1 should be reviewed to identify other products that may contaminate the well during drilling and development or obtaining the groundwater sample. If in doubt about a particular product or item in contact with environmental media to be sampled or in close proximity to operations, collect and analyze a rinsate sample using laboratory-supplied PFAS-free water.

7 Analytical Requirements

An accredited laboratory shall be contracted and shall ensure that the selected detection and reporting limits are sufficient to meet the project-established limits. Quality control (QC) samples should also be included: field duplicates (1/10 samples), matrix spikes/matrix spike duplicates (1/20), equipment blanks, and laboratory quality measures (per method). Results and evaluation of the QC program compared to the Project QAPP specifications shall be provided in a Quality Control Summary Report.

The laboratory to be used by the Contractor shall be Department of Defense Environmental Laboratory Accreditation Program (DoD ELAP) accredited. The Contractor shall ensure that the selected laboratory meets all state and federal requirements. The Contractor shall select a laboratory that complies with the requirements of their current accreditation of the DoD Quality Systems Manual (QSM), currently at version 5.3. DoD ELAP accredited laboratories for PFAS analysis may be found at: https://www.denix.osd.mil/edqw/accreditation/accreditedlabs.

In the absence of specific permitting or state requirements, analysis for all matrices (i.e., drinking water, groundwater, surface water, soil, and sediment) shall be performed by a DoD ELAP accredited laboratory using a liquid chromatography tandem mass spectrometry (LC/MS/MS) isotope dilution method that is on the laboratory's DoD ELAP scope of accreditation and is compliant with the requirements in the DoD QSM for

Environmental Laboratories, Table B-15, unless project specific requirements differ. All PFAS analytes in **Table 2** must be reported. Additional PFAS may be added if determined to be site-specific constituents of concern (e.g., HFPO-DA, ADONA, F-53B major and minor, etc.). All compounds to be reported should be on the laboratory's DoD ELAP scope of accreditation. DoD QSM allows for commercial PFAS standards that are available as salts providing the measured mass is corrected to the neutral acid concentration. Results shall be reported as the neutral acid with appropriate CAS number. The preferred nomenclature of the target analyte for reporting purposes will be the conjugate acid (i.e., sulfonic acid instead of sulfonate). Laboratories should be capable of converting concentrations from the conjugate base to the conjugate acid based on the molecular weight, as necessary based on stock standards purchased. As data is referenced in project reports, the text shall refer to the base conjugates (i.e., sulfonate instead of sulfonic acid) with associated concentrations displayed as the acid conjugate, with a note to clarify the differences. If analytes that are not listed in the DoD QSM **Tables C-44 or C-45** are requested, laboratory in-house control limits must be approved by USACE.

Table 2: PFAS Analyte List

Analyte	CASRN	Acronym
4:2 Fluorotelomer sulfonic acid	75124-72-4	4:2 FTS
6:2 Fluorotelomer sulfonic acid	27619-97-2	6:2 FTS
8:2 Fluorotelomer sulfonic acid	39108-34-4	8:2 FTS
N-ethyl perfluorooctanesulfonamidoacetic acid	2991-50-6	NEtFOSAA
N-methyl perfluorooctanesulfonamidoacetic acid	2355-31-9	NMeFOSAA
Perfluorobutanesulfonic acid	375-73-5	PFBS
Perfluorobutanoic acid	375-22-4	PFBA
Perfluorodecanesulfonic acid	335-77-3	PFDS
Perfluorodecanoic acid	83-89-6	PFDA
Perfluorododecanoic acid	307-55-1	PFDoA
Perfluoroheptanoic acid	374-85-9	PFHpA
Perfluoroheptanesulfonic acid	375-92-8	PFHpS
Perfluorohexanesulfonic acid	355-46-4	PFHxS
Perfluorohexanoic acid	307-24-4	PFHxA
Perfluorononanoic acid	375-95-1	PFNA
Perfluorononanesulfonic acid	68259-12-1	PFNS
Perfluorooctanesulfonamide	754-91-6	PFOSA
Perfluorooctanesulfonic acid	1763-23-1	PFOS
Perfluorooctanoic acid	335-67-1	PFOA
Perfluoropentanoic acid	2706-90-3	PFPA
Perfluoropentanesulfonic acid	2706-91-4	PFPS
Perfluorotetradecanoic acid	376-06-7	PFTeDA
Perfluorotridecanoic acid	72629-94-68	PFTriDA
Perfluoroundecanoic acid	2058-94-8	PFUnA

As required by permit or the state only, drinking water analysis for PFAS shall be performed using DoD ELAP accredited laboratories and shall use United States Environmental Protection Agency (USEPA) Method 537.1, Version 1.0, November 2018 or USEPA Method 533, November 2019. USEPA Method 533 focuses on "short chain" PFAS with carbon chain lengths of 4 to 12. USEPA Method 533 is preferred as it utilizes isotope dilution techniques. All PFAS analytes that are available through either method should be reported. In addition, the fluorotelomer sulfonates considered to be the principal raw materials in PFAS should also be reported. See **Table 3** for the list of analytes to be reported for drinking water analysis by USEPA Method 533 or 537.1, or the most current versions. In the event that additional analytes are added to either method in the future, the new analytes shall be reported if determined to be constituents of concern on a site-specific basis. All compounds to be reported should be on the laboratory's DoD ELAP scope of accreditation.

Table 3: USEPA Drinking Water Methods PFAS Analyte List

Analyte	CASRN	Acronym	Method 533	Method 537.1
11-Chloroeicosafluoro-3-oxaundecane-1-sulfonic acid	763051-92-9	11Cl-PF3OUdS	X	x
9-Chlorohexadecafluoro-3-oxanonane-1-sulfonic acid	756426-58-1	9Cl-PF3ONS	X	x
4,8-Dioxa-3H-perfluorononanoic acid	919005-14-4	ADONA	X	x
Hexafluoropropylene oxide dimer acid	13252-13-6	HFPO-DA	X	x
Perfluorobutanesulfonic acid	375-73-5	PFBS	X	x
Perfluorodecanoic acid	335-76-2	PFDA	X	x
Perfluorododecanoic acid	307-55-1	PFDoA	X	x
Perfluoroheptanoic acid	375-85-9	PFHpA	X	x
Perfluorohexanoic acid	307-24-4	PFHxA	X	x
Perfluorohexanesulfonic acid	355-46-4	PFHxS	X	x
Perfluorononanoic acid	375-95-1	PFNA	X	x
Perfluorooctanoic acid	335-67-1	PFOA	X	x
Perfluorooctanesulfonic acid	1763-23-1	PFOS	X	x
Perfluoroundecanoic acid	2058-94-8	PFUnA	X	x
1H,1H, 2H, 2H-Perfluorohexane sulfonic acid	757124-72-4	4:2FTS	X	
1H,1H, 2H, 2H-Perfluorooctane sulfonic acid	27619-97-2	6:2FTS	X	
1H,1H, 2H, 2H-Perfluorodecane sulfonic acid	39108-34-4	8:2FTS	X	
Nonafluoro-3,6-dioxaheptanoic acid	151772-58-6	NFDHA	X	
Perfluorobutanoic acid	375-22-4	PFBA	X	
Perfluoro(2-ethoxyethane)sulfonic acid	113507-82-7	PFEESA	X	
Perfluoroheptanesulfonic acid	375-92-8	PFHpS	X	
Perfluoro-4-methoxybutanoic acid	863090-89-5	PFMBA	X	
Perfluoro-3-methoxypropanoic acid	377-73-1	PFMPA	X	
Perfluoropentanoic acid	2706-90-3	PFPeA	X	
Perfluoropentanesulfonic acid	2706-91-4	PFPeS	X	
N-ethyl perfluorooctanesulfonamidoacetic acid	2991-50-6	NEtFOSAA		x
N-methyl perfluorooctanesulfonamidoacetic acid	2355-31-9	NMeFOSAA		x
Perfluorotetradecanoic acid	376-06-7	PFTA		x
Perfluorotridecanoic acid	72629-94-8	PFTrDA		x

There are no promulgated soil extraction methods in USEPA publication, Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, also known as SW-846. The laboratory shall process and analyze soil or sediment according to DoD QSM Table B-15. The Contractor should evaluate laboratory standard operating procedures for industry standard expectations. The entire soil or sediment sample received by the laboratory must be homogenized prior to subsampling. For low concentrations required to meet sensitivity needs, a larger initial volume sample size and three serial extractions are required.

It should be noted that PFAS analysis is improving and method revisions, new methods, or new state requirements are likely to come into existence in the near future. In all cases, the laboratory must be DoD ELAP accredited, have the method and reported analytes (as the acid conjugate versions) on the laboratory's DoD ELAP scope of accreditation, and be in compliance with the version of the DoD QSM to which the laboratory is accredited.

8 PFAS-specific Laboratory Analysis Specifications

During communication with the selected analytical laboratory prior to sampling or during pre- project communications with candidate analytical laboratories, it is recommended to confirm the following:

The laboratory uses polypropylene or HPDE sample containers with polypropylene lids, and if there is a preference for either sample container type. Identify the laboratory preferred container size and initial volume requirements. The laboratory is required to use the entire aqueous sample volume provided plus bottle rinstate.

Standards containing both branched and linear isomers must be used when commercially available. PFAS method analytes may consist of both branched and linear isomers, but quantitative, technical grade standards that contain the linear and branched isomers do not exist for all method analytes. For PFAS that do not have a quantitative branched and linear standard, identify the branched isomers by analyzing a qualitative standard that includes both linear and branched isomers and determine retention times, transitions and transition ion ratios. Quantitate samples by integrating the total response (i.e., accounting for peaks that are identified as linear and branched isomers) and relying on the initial calibration that uses the linear isomer quantitative standard. Technical grade standards cannot be used for quantitative analysis. Sample results will represent the sum of the linear and branched isomers for each PFAS. It must be confirmed that these peaks will be integrated and the areas summed such that the result represents the concentration of the sum of the linear and branched isomers. Laboratories must also note in their analytical reports the type of analytical standards used (linear and/or branched) and the approach used in quantitation.

The chemical derivation of the ion transitions must be documented. A minimum of two ion transitions (Precursor → quant ion and precursor → confirmation ion) and the ion transitions ratio per analyte are required for confirmation, except for PFBA and PFPeA where two transitions do not exist. In-house acceptance criteria for evaluation of ion ratios will not exceed 50 to 150%. Ion ratios must be evaluated for PFAS identification and summarily reports in the data deliverables. Ion Ratio is calculated by dividing the quantitation ion abundance by the confirm ion abundance.

A laboratory must use the DoD QSM Appendix C Limits for batch control if project limits are not specified. If the analyte(s) are not listed, the use of in-house laboratory control spike limits will be referenced if project limits are not specified. The contractor should verify that in-house generated limits are reasonable.

Reagent or ultra-pure water used in the laboratory will be confirmed to be free of PFAS above the detection limit during the analyses and that this water can be provided in HPDE containers with polypropylene lids for use at the site for conducting equipment rinsate sampling (as needed).

9 Data Validation

The current version of the DoD QSM can be found at the following website: https://www.denix.osd.mil/edqw/documents/manuals/. The Contractor shall be responsible for assessing the environmental data's quality by performing data validation against criteria established within the analytical method, the DoD QSM, the DoD General Data Validation Guidelines, and the project specific Uniform Federal Policy for Quality Assurance Project Plan (UFP-QAPP). Validation shall be performed to a 90% Stage 2b standard and a 10% Stage 4 standard with recalculation of appropriate data, including DoD QSM, Table-B15 requirements. Additionally, validation shall be performed to a 100% Stage 4 standard for all domestic drinking water in which the individual or combined concentrations of PFOS/PFOA exceed 70 ppt or the properly promulgated state standard (the drinking water results that are validated to a 100% Stage 4 standard may count towards the 10% of total results that must be validated to a Stage 4 standard). Documentation is evaluated from sampling logs, sample shipment records, the sample's condition upon receipt at the lab and through the analytical process, as well as the various method quality control samples and instrument parameters. Descriptions of the different Stages of validation can be found in the General Data Validation Guidelines (11/04/2019) created by the Environmental Data Quality Workgroup.

Deviations from standard data review procedures may be required, due to the nature of PFAS investigations. For example, drinking water samples that are associated with blank contamination may not be qualified as non-detect due to the associated blank contamination. A conservative approach will be implemented so that the associated drinking water sample will be reported with the original result, but qualified as estimated due to a possible high bias. Data verification, data validation, data qualification schema, and data usability assessment methodology shall be described in the UFP-QAPP.

10 Reporting

Support for specific programs may also mandate the submission of chemical and/or sampling data in electronic formats for archival/retrieval within an agency-specific database systems. Analytical data generated from the laboratory shall be submitted as Microsoft® excel, staged electronic data deliverable (SEDD) file, and/or an Environmental

Resources Program Information Management System (ERPIMS) file, depending on the requirements of the project and full electronic PDF Level IV data packages. For example, AFCEC requires ERPIMS; IMCOM requires DOEHRS, and Formerly Used Defense Sites (FUDS) requires FUDSChem format submissions.

11 Investigation Derived Waste

Waste containing PFAS is not classified as a characteristic or listed hazardous waste based solely on the presence of PFAS chemicals; however, given the potential for future liability, it is recommended that project teams design investigations to minimize generation of investigation derived waste (IDW).

For liquid IDW, a sample shall be analyzed prior to disposal. If the combined concentration of PFOS/PFOA is less than the USEPA Lifetime Health Advisory (LHA) of 70 ppt or state promulgated standard, and assuming that no other contamination is present and no state or local regulation prohibits it, the water may be returned to the source location at the point of generation or discharged to the sanitary sewer after disclosing the nature and concentrations of PFAS constituents contained in the liquid IDW to the local wastewater authority and obtaining a recordable authorization from the authority. Liquid IDW with a combined PFOS/PFOA concentration greater than the USEPA LHA or state promulgated standard shall be treated on-site prior to discharge or held pending written authorization by the facility director of an approved, permitted treatment plant that will receive the liquid.

For soil and/or sediment IDW, a sample shall be analyzed prior to disposal. If the combined concentration of PFOS/PFOA is less than the approved Regional Screening Level (RSL), which is currently 1.26 parts per million (ppm), and assuming that no other contamination is present and no state or local regulation prohibits it, small quantities of the soil and/or sediment may be returned to the source location at the point of generation. Soil and/or sediment IDW with a combined PFOS/PFOA concentration greater than the approved RSL (currently 1.26 ppm) or state promulgated standard may be returned to the source location at the point of generation only with approval from the facility director. Otherwise, the soil and/or sediment shall be incinerated at an approved permitted facility or treated on-site prior to discharge via other available technology. On-site treatment options for soils and other solids is currently limited. Soil-washing and thermal desorption technologies are undergoing validation and may provide a cost-effective option in the near future. Soils may be held on-site pending written authorization by the facility director of an approved, permitted treatment plant that will receive the soil and/or sediment.

If no treatment facility is available, then disposing PFAS-containing IDW as non-hazardous waste at an USEPA approved Subtitle D Industrial Waste Landfill or equivalent facility capable of processing non-hazardous waste should be considered, and written authorization and acceptance of the PFAS containing IDW should be obtained from the landfill.

Personal protective equipment, other debris, and spent treatment media may be disposed at a Resource Conservation and Recovery Act (RCRA) Subtitle D landfill. Spent treatment media contaminated with PFAS at high concentrations or PFAS products must be incinerated or thermally destructed at sustained temperatures above 1700 degrees Fahrenheit, disposed at a RCRA Subtitle C landfill, or solidified then disposed at a RCRA Subtitle D landfill.

PFAS are NOT classified as a hazardous waste by definition because PFAS are not regulated by RCRA. However, individual states have been and can be more stringent than the USEPA. Waste should be labeled as a "Non-Regulated Waste" or other state mandated labeling requirements with special instruction to the treatment, storage, and disposal facility to use thermal destruction as the means to destroy waste. This classification can change depending on individual state definitions. Due to the uncertainty in the regulatory and legal environment surrounding PFAS, this guidance is subject to frequent updates.

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Appendix B

Laboratory SOPs and Certifications

(Provided as a separate file)

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Appendix C

Quality Control Plan

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Appendix C
Quality Control Plan

Programmatic Uniform Federal Policy Quality Assurance Project Plan

Remedial Investigations for PFAS at
Multiple Air National Guard Installations

Joe Foss Field, South Dakota
Truax Field, Wisconsin
Volk Field, Wisconsin

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December 2021
Contract No. W9128F18D0026, Task Order No. W9128F20F0325
EA Project No. 6332106

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LIST OF TABLES

LIST OF ACRONYMS

AFFF	Aqueous Film Forming Foam
ANG	Air National Guard
APP	Accident Prevention Plan
CRP	Compliance Restoration Program
CQCS	Contractor Quality Control Supervisor
DFW	definable feature of work
DoD	Department of Defense
DQCR	Daily Quality Control Report
EA	EA Engineering, Science, and Technology, Inc., PBC
ID	Identification
ITR	Independent Technical Review
LC/MS/MS	Liquid Chromatography Tandem Mass Spectroscopy
NGB/A4VR	National Guard Bureau/Environmental Restoration Branch
PFAS	Per- and Polyfluoroalkyl Substances
PM	Project Manager
PWS	Performance Work Statement
RI	Remedial Investigation
RPM	Restoration Program Manager
QA	Quality Assurance
QC	Quality Control
QCP	Quality Control Plan
QMP	Quality Management Plan
QSM	Quality Systems Manual
SOP	Standard Operating Procedure
STR	Senior Technical Reviewer
UFP-QAPP	Uniform Federal Policy – Quality Assurance Project Plan
USACE	U.S. Army Corps of Engineers

1. INTRODUCTION

This document presents the Quality Control Plan (QCP) for Remedial Investigations (RIs) for per- and polyfluoroalkyl substances (PFAS) resulting from aqueous film-forming foam (AFFF), non-AFFF, and secondary PFAS releases at multiple Air National Guard (ANG) installations. The ANG installations include Joe Foss Field in South Dakota (SD), and Truax Field and Volk Field in Wisconsin (WI).

1.1 AUTHORITY

This QCP was prepared by EA Engineering, Science, and Technology, Inc., PBC (EA). EA is the prime contractor under United States Army Corps of Engineers (USACE) - Omaha District Contract W9128F-18-D-0026, Task Order No. W9128F20F0325.

1.2 PURPOSE AND SCOPE

The purpose of this QCP is to ensure quality control (QC) during execution of the defined scope of work, as described in the Performance Work Statement (PWS) issued with TO award, over the duration of the TO. This QCP describes procedures for control, verification, and acceptance testing for each definable feature of work. The Three Phases of Control (Preparation, Initial, and Follow-up) will be used to prevent problems and deficiencies in implementation of the required work elements and to achieve the project performance objectives.

1.3 BACKGROUND

In December 2008, the Office of the Under Secretary of Defense issued a memorandum establishing the Environmental Restoration Account as the sole source of funding for cleanup of contaminated sites regardless of the date the site was contaminated. In January 2009, the Air Force directed the Air Force Center for Environmental Excellence and ANG to identify sites eligible for cleanup under the One Cleanup Program. The One Cleanup Program was then renamed the Compliance Restoration Program (CRP). All of the CRP sites have now been incorporated into the Air Force Installation Restoration Program and are being tracked by ANG as Newly Eligible Restoration Sites.

The project objective consists of RIs at Joe Foss Field, SD, Truax Field, WI, and Volk Field, WI to characterize the site including delineation of the nature and extent of PFAS resulting from AFFF, non-AFFF, and secondary PFAS releases; update or development of a conceptual site model; and risk assessment. Delineation of the nature and extent of PFAS as part of the RI includes the lateral and vertical extent of PFAS in all PFAS-impacted media. Specific remedial investigative activities include, but are not limited to, records review, sampling and analysis of soil, groundwater, sediment, and surface water; installation of lysimeters and groundwater monitoring wells where required; data validation and interpretation; generation of analysis reports and supplemental materials; and groundwater monitoring.

This work is being conducted pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act, the Defense Environmental Restoration Program statute, and the National Contingency Plan.

2. QUALITY MANAGEMENT

2.1 OVERALL APPROACH

EA follows and implements a Corporate Quality Management Program (QMP). The mission of the program is to establish, maintain, and continually improve the efficiency of quality assurance (QA) and QC procedures that are developed with contract- and project-specific requirements. EA's QMP provides an integrated approach to advance a total quality system. EA's quality management approach involves the following:

- Use of a systematic planning process to develop acceptance or performance criteria for the collection, evaluation, or use of data and other information. This includes selection of project staff with the technical skills and knowledge to complete the work and preparation of project planning documentation.

- Ensuring that all work is conducted in accordance with approved plans and QC steps. This includes the use of Standard Operating Procedures (SOPs) as a means of performing technical work consistently and use of status reporting and tracking methods to maintain management oversight and control of work.

- Use of assessment tools to monitor and ensure that all work meets internal and external quality standards. These include Senior Technical Review (STR), engineering design reviews, data validation, data quality assessment, project/program reviews, and audits.

- Continuously striving for improvement, utilizing assessment tools to identify components that are functioning properly and those that may require corrective action.

2.2 ROLES AND RESPONSIBILITES

EA's quality management personnel, roles, and responsibilities for this TO are identified and described below.

2.2.1 Program Manager

The Program Manager provides program-level management oversight, supports the Project Manager with TO execution, and oversees coordination between USACE, EA, and subcontractors. The Program Manager participates in project reviews, including with USACE as required, and works to resolve contractual matters.

2.2.2 Contractor Quality Control Supervisor

The Contractor Quality Control Supervisor (CQCS) communicates with the Program Manager on quality-related matters and works to ensure that work is conducted in accordance with quality standards and that quality products are delivered to USACE. The CQCS or designee is independent of EA project management responsibilities and has the authority to review all aspects of project completion and has the authority to stop work if deficiencies in the work are noted. Duties of the CQCS or designee include:

- Overall implementation of the QCP;
- Identifying and reporting all nonconforming items;
- Making recommendations for any corrective actions;
- Inspecting, and documenting sampling activities;
- Assisting in monitoring site safety activities;
- Conducting training to ensure that all staff are cognizant of site QC objectives;
- Monitoring site activities for overall compliance including work (field and reporting) conducted by subcontractors;
- Ensuring that all analytical tests are in accordance with project requirements; and
- Interfacing with the PM to keep him abreast of overall project quality.

2.2.3 Project Manager

The Project Manager (PM) is responsible for coordinating with the CQCS to ensure QC procedures are being implemented as proposed in this QCP. In the event of non-compliance, the PM will work with the CQCS on how the issue can be corrected. The PM will be responsible for overseeing the implementation of QC activities and corrective actions as they occur. The PM will also coordinate with the Program Manager and USACE / National Guard Bureau/Environmental Restoration Branch (NGB/A4VR) as QC issues arise.

2.2.4 Field Supervisor(s)

The Field Supervisor(s) will be responsible for QC procedures during sampling/testing at individual ANG installations. The Field Supervisor(s) will ensure that sampling collection and sample shipping is completed in accordance with SOPs presented in the Programmatic Uniform Federal Policy – Quality Assurance Project Plan (UFP-QAPP). The Field Supervisor(s) will oversee instrument calibration, health and safety compliance, and sample collection handling and shipment procedures.

2.2.5 Senior Technical Reviewer(s)

The designated STR will be assigned and involved in project planning and remain engaged throughout project execution, offering advice and providing technical direction. The STR is responsible for reviewing deliverables, independent of day-to-day work. The STR spot checks data and serves as a mentor for project staff.

2.3 QUALITY CONTROL PROCESS

All members of the project team are responsible for QC related to their work assignment. Individual team members are expected to employ QC procedures during execution of their normal duties. The EA QC program includes detail checking and independent/senior technical review. Detail checking is used to verify information in project deliverables for correctness, completeness, and technical accuracy. Independent technical review is an evaluation of the significant opinions, conclusions, and recommendations that are produced during the project work and presented in deliverables. The procedures used to develop project results are reviewed to confirm the validity and suitability of results. Independent technical reviews are completed by senior EA personnel that are pre-qualified, including annual re-certification.

On-site QC will be performed by the Field Supervisor and/or Project Geologist to ensure that project processes and systems meet the project QC requirements. Through a continual improvement process, project staff at all levels will be encouraged to provide recommendations for improvements in established work processes and techniques. Where the improvement would necessitate a change to the work plan, a field change request will be initiated and approved by USACE / NGB/A4VR prior to implementation.

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3. PRODUCT DEVELOPMENT

3.1 PRODUCT REVIEWS

Project document checks (e.g., for work plans, reports, tables, drawings, and appendices) will be performed by each discipline as an extension of the document preparation process. An individual qualified in the appropriate discipline will perform such checks. Checked computations, analyses, and drawings will be annotated to show the initials of the designer/originator and the checker. It is the responsibility of the product developer to coordinate the checks and to select a checker with the concurrence of the EA PM. The experience level of the checker will be commensurate with the level of complexity and risk.

3.2 INTERDISCIPLINARY REVIEWS

This process encompasses the day-to-day coordination between the product development team members throughout the product development process. The interdisciplinary check ensures that the portion of the product developed by one discipline does not conflict or interfere with the portion developed by another discipline. In addition, these checks provide an opportunity for each member of the product development team to review the entire product. Project documents that are included in the review process include the following:

Table 3-1. Quality Control of Documents

Document	Prepared By	Reviewed By
Planning Documents	Project Manager	STR
Field Documentation	Field Supervisor/Project Geologist	CQCS/PM
Daily Quality Control Reports (DQCRs)	Field Supervisor/Project Geologist	CQCS/PM
RI Report	Project Manager	STR

3.3 INDEPENDENT TECHNICAL REVIEW

The independent technical review (ITR) is a formally conducted and documented review at the completion of various stages of product development. The ITR process assigns senior staff with significant experience in technical, managerial, and client activities to review specific portions of a product as the STR. The STRs are not involved with the day-to-day direction of the work product, however, input is solicited from these individuals at critical points in the development and performance of an assignment to ensure the product meets the client's needs and expectations. A signed certification will be provided that has the signatures of the ITR team and states that an ITR was accomplished and all comments resulting from that review have been incorporated into the documents.

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4. FIELD SAMPLING AND ANALYSIS QUALITY CONTROL

4.1 FIELD SAMPLING AND ANALYSIS

Sample collection will be performed using procedures outlined in the *Draft Final Programmatic Uniform Federal Policy-Quality Assurance Project Plan, PFAS Remedial Investigations at Multiple Air National Guard Installations* (December 2021). Procedures for standard activities including sample collection are included in the field sampling portion(s) of the Programmatic UFP-QAPP.

The Programmatic UFP-QAPP also contains information concerning the sample analyses procedures and QA/QC that will be used during the project. EA will subcontract to Eurofins Environment Testing America as the primary laboratory for analysis by liquid chromatography tandem mass spectroscopy (LC/MS/MS) compliant with Department of Defense (DoD) Quality Systems Manual (QSM) Version 5.3 (or more recent), Table B-15. Pace Analytical will be used as a secondary laboratory. The list of analyses, respective analytical method reference and detection limits will be provided in the installation-specific UFP-QAPP.

The following are to be completed daily during each sampling event by EA's Field Supervisor and/or Project Geologist:

- Sample collection field sheet(s) (Appendix F of the Programmatic UFP-QAPP)
- Required Safety field form(s) (Attachment D of the APP)
- Field Notes

At the conclusion of the sampling event, the Field Supervisor and/or Project Geologist will complete and sign the field notes and appropriate forms. Sampling procedures shall be in accordance with the instructions contained in the Programmatic UFP-QAPP, including the SOPs.

4.2 SAMPLING LOCATIONS AND FREQUENCY

Sampling location, frequency, and analyses shall be in accordance with the Programmatic UFP-QAPP and site-specific addenda.

4.3 FIELD QUALITY CONTROL

EA's Field Supervisor and/or Project Geologist will be responsible for QC procedures during sampling events. The Field Supervisor and/or Project Geologist will ensure that;

- Depth to groundwater measurements are being collected from the appropriate wells and using the appropriate reference point on the well casing.

- Stratigraphic changes are being appropriately logged during drilling and sampling activities and recorded at the correct depths.

- Equipment calibrations are being completed according to manufacturer's instructions.

- Multi-parameter water quality measurements are being determined and documented correctly by the field crew.

- Health and safety requirements from the APP are being followed and adhered to by all field crew members.

- Sample collection, handling, QA/QC, and shipment procedures are being followed.

The following field forms are to be completed daily during each sampling event:

- DQCR – To be completed daily by the Field Supervisor and/or Project Geologist and provided to the EA PM via e-mail that same night. The EA PM will review and edit the DQCR in consultation with the CQCS, followed by forwarding the final DQCR to the USACE PM and the NGB/A4VR Restoration Program Manager (RPM) by the following day (an example of a DQCR is included in Attachment A).

- Chain-of-Custody Form (provided by the laboratory).

- Field Notes.

4.4 DATA EVALUATION

The laboratory will analyze samples for the analytes designated in the Programmatic UFP-QAPP and site-specific addenda. The laboratory will provide analytical results to EA within 14 business days of receipt of the last field sample. If any delay occurs, EA shall notify the USACE PM and NGB/A4VR RPM immediately followed by written confirmation in two working days stating the problem, cause, impact, and proposed remedy.

Laboratory analysis shall be performed in accordance with United States Environmental Protection Agency or other industry standard analytical methodologies and laboratory standard operating procedures as appropriate and as specified in the Programmatic UFP-QAPP. Variances from the procedures and protocols specified in these methods shall be documented and reported. The laboratory shall maintain DoD Environmental Laboratory Accreditation Program certification as well as any required state level certification, as appropriate.

The data generated during this project will be in accordance with the DoD QSM for Environmental Laboratories Version 5.3 (or higher), Table B-15. Data deliverables from the laboratory will be provided in both hard copy data packages and electronic data deliverable format. The electronic data will be maintained in EQuIS® Environmental Data Management system and final validated data will be uploaded to Environmental Resource Program Information Management System. The data packages from the laboratory will be Level IV and meet DoD QSM Version 5.3 (or higher), Table-15 requirements to support data validation. alidation shall be performed to a 90% Stage 2b and 10% Stage 4 standard, including DoD QSM Appendix B table requirements.

Data validation results will be further verified by the program chemist for accuracy and completeness. The data evaluation procedures discussed above will ensure that the data are of sufficient quality for use in the RIs. Any validation issues noted for the data will be evaluated by the project team during the data usability assessment.

4.5 QUALITY CONTROL SUMMARY

The analytical data shall be assessed, validated and the results of the validation will be summarized in the RI reports. The QC summary shall include, among other items as listed below, summary tables of analytes measured above detection limits ("positive detections") as well as other required items. The QC summary will contain:

- A sample detail table per laboratory data package (sample delivery group), which relates field sample identifications (IDs) to laboratory sample IDs, sampling date, analysis date, and analytical batch. This type of table may include more than one sample delivery group, listed sequentially;
- A summary table of detected analytes per method, matrix, and sampling location, with final qualifiers;
- A table of all analytical results (including non-detects) per method, matrix, and sampling location, with final qualifiers;
- A table of laboratory QC elements per method and matrix;
- A table of QC element outliers per method and matrix;
- A table summarizing qualified analytes per sample, method, and matrix, with rationales for final qualifiers;
- A data qualification scheme table.

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5. CONSTRUCTION QUALITY CONTROL

5.1 THREE PHASE CONTROL SYSTEM

The three phases of control (i.e., preparatory phase, initial phase, and follow-up phase) will be used for QC of construction activities (e.g., water treatment system) for definable features of work (DFW). The PM will oversee the implementation and documentation process. Worksheets for each phase of QC inspection are contained in Attachment A.

5.1.1 Preparatory Phase Inspection

The preparatory phase comprises the planning and design process leading up to the actual field activities. The Field Supervisor will perform a preparatory phase inspection before constructing each DFW. The purposes of this inspection are to review applicable specifications and plans to verify that the necessary resources, conditions, and controls are in place and compliant before work activities start. The preparatory phase inspection will also verify that the APP adequately identifies all hazards associated with actual field conditions and that the APP promulgates the appropriate safe work practices. Upon completion of the inspection, the Field Supervisor will complete the preparatory phase inspection checklist.

To perform the inspection, the Field Supervisor will review work plan documents and operating procedures. The Field Supervisor will verify that required plans and procedures have been approved and are available to the field staff; field equipment is appropriate, available, functional, and properly calibrated for its intended/stated use; staff responsibilities have been assigned and communicated; staff have the necessary knowledge, expertise, and information to perform their jobs; arrangements for support services have been made; training in accordance with the requirements of the work plan has occurred; and the prerequisite mobilization tasks have been completed. As part of the preparatory phase inspection, the Field Supervisor will verify that lessons learned during previous similar work have been incorporated, as appropriate, into the project procedures to prevent recurrence of past challenges. Project staff must correct or resolve discrepancies between existing conditions and the approved plans/procedures identified by the PM during the preparatory phase inspection. The Field Supervisor will verify that unsatisfactory and/or nonconforming conditions have been corrected in the work plan before beginning work.

5.1.2 Initial Phase Inspection

The initial phase occurs at the startup of construction activities associated with a DFW. At the onset of the operation, the PM will perform an initial phase inspection and complete the initial phase inspection checklist. The main objectives of the inspection are to check preliminary work for compliance with procedures and specifications, establish an acceptable level of workmanship, check for omissions, and resolve differences of interpretation. Should results of the inspection be unsatisfactory, the initial phase inspection will be rescheduled and performed again.

During the initial phase inspection, the Field Supervisor will ensure that discrepancies between site practices and approved plans or specifications are identified and resolved. The resolution of discrepancies is a critical step in the initial phase inspection. As applicable, the appropriate senior technical consultant (e.g., Contractor Quality Control Supervisor, Corporate Health and Safety Supervisor) will guide the PM and project team members in resolving discrepancies. If discrepancies arise in establishing the baseline quality for a project task, the responsibility for resolution falls to the PM. If the discrepancy cannot be resolved in a manner that satisfies the project requirements, it will be elevated to the program level (i.e., to the program manager) and a nonconformance report will be issued. With concurrence of the project team, the appropriate senior technical consultant may direct a cessation of work activity if an unresolved discrepancy jeopardizes the results of the task or puts the project at risk of non-conformance.

5.1.3 Follow-Up Phase Inspection

Completion of the initial phase inspection of QC activity leads directly into the follow-up phase, which is used to verify continuity of work quality through completion of a DFW. The Field Supervisor will remotely perform a follow-up phase inspection at regular intervals while a particular task is performed. This inspection ensures continuous compliance and verifies an acceptable level of workmanship. To conduct and document these inspections, the Field Supervisor will complete the follow-up phase inspection checklist. The Field Supervisor will remotely monitor onsite practices and operations taking place and verify continued compliance with the specifications and requirements of the work plan and approved amendments. The Field Supervisor will verify that daily health and safety inspections are performed and documented as prescribed in the APP. Discrepancies between site practices and approved plans/procedures will be resolved and corrective actions for unsatisfactory and nonconforming conditions or practices will be resolved by the Field Supervisor before continuing work.

5.2 NON-CONFORMANCE AND CORRECTIVE ACTIONS

The EA PM or his designee will be responsible for identification of any project non-conformance and implementation of corrective action. Upon identification of any non-conformance, the non-conformance form contained in Attachment B will be completed and provided to the EA PM; the USACE PM and NGB/A4VR RPM will also be provided an electronic copy of the non-conformance form within 24 hours.

Corrective actions arising from identification of non-conformances will be rectified by first completing a corrective action request form (Attachment B); the form will be completed according to its contained instructions on sheet number 2 of the form. A corrective action plan form (Attachment B) will also be completed according to the contained instructions. Both forms will be supplied to the recipients noted within their respective instructions; in addition, a copy of the forms will be provided to the USACE PM and NGB/A4VR RPM within 24 hours.

After sufficient time has passed for implementation of the corrective action for the non-conformance, a follow-up inspection will be made by the Field Supervisor to ensure that corrective actions have been undertaken. If corrective actions have not been undertaken, the Field Supervisor has the authority to stop work until such corrective actions have been made. At any time, if non-conformance results in a potential threat to on-site or off-site personnel, the Field Supervisor may stop work until the non-conformance has been corrected.

6. SUBCONTRACTOR QUALITY CONTROL

Subcontractors will report to EA, who is responsible for overall project quality. The EA PM and Field Supervisor and/or Project Geologist will ensure that activities completed by EA field subcontractors will be in conformance with project requirements; in addition, the EA CQCS and Program Chemist will ensure that laboratory analytical services conducted in support of the project meet all project quality objectives in accordance with the Programmatic UFP-QAPP and site-specific addenda. Field subcontractors will provide employees who will be properly trained before being allowed to complete any work onsite. Subcontractors are responsible for completing work in a professional, timely, and ethical manner. EA assumes responsibility for the services of subcontractors onsite and will maintain a close working relationship with the subcontractors utilized.

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Attachment A

Phase Inspection Forms and Daily QC Report

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PREPARATORY PHASE INSPECTION CHECKLIST

PROJECT: ____ DATE:___________________

TITLE AND NO. OF THE TECHNICAL SECTION:

____

____

____

WORK PLAN REFERENCE:____

A. ATTENDANTS:

NAME **POSITION** **COMPANY**

1. ____

2. ____

3. ____

4. ____

5. ____

6. ____

7. ____

8. ____

9. ____

10. ____

11. ____

12. ____

B. SUBMITTALS REQUIRED TO BEGIN WORK:

ITEM	SUBMITTAL NO.	ACTION CODE
1.		
2.		
3.		
4.		
5.		
6.		

C. EQUIPMENT TO BE USED IN EXECUTING WORK:

1. ______________________________
2. ______________________________
3. ______________________________
4. ______________________________
5. ______________________________
6. ______________________________

D. WORK AREAS EXAMINED TO ASCERTAIN THAT ALL PRELIMINARY WORK HAS BEEN COMPLETED:

____
____
____

E. METHODS AND PROCEDURES FOR PERFORMING QUALITY CONTROL, INCLUDING SPECIFIC TESTING REQUIREMENTS:

____
____
____

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PART II

A. PERSONS IN ATTENDANCE: SEE MEETING ATTENDANCE SHEET (ATTACHED)

1. ____

2. ____

3. ____

4. ____

5. ____

6. ____

7. ____

8. ____

9. ____

10. ____

11. ____

12. ____

I HEREBY CERTIFY, THAT TO THE BEST OF MY KNOWLEDGE AND BELIEF, THAT THE ABOVE REQUIRED MATERIALS DELIVERED TO THE JOB SITE ARE THE SAME AS THOSE SUBMITTED AND APPROVED.

NAME OF PROJECT QC INSPECTOR: ____

DATE:___________________________

SIGNATURE OF PROJECT QC INSPECTOR:____

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INITIAL PHASE INSPECTION CHECKLIST

PROJECT: ____ DATE:___________________

TITLE AND NO. OF THE TECHNICAL SECTION:

____

____

____

DESCRIPTION AND LOCATION OF WORK INSPECTION

____

____

A. KEY PERSONNEL PRESENT:

NAME	POSITION	COMPANY

1. ____
2. ____
3. ____
4. ____
5. ____
6. ____

B. MATERIALS BEING USED ARE IN STRICT COMPLIANCE WITH THE CONTRACT SPECIFICATIONS: YES ☐ NO ☐

IF NOT EXPLAIN BELOW:

____

____

____

____

C. PROCEDURES AND/OR WORK WITNESSED ARE IN STRICT COMPLIANCE WITH THE CONTRACT SPECIFICATIONS: YES ☐ NO ☐

IF NOT EXPLAIN BELOW:

____

____

____

____

D. WORKMANSHIP IS ACCEPTABLE : YES ☐ NO ☐

STATE WHERE IMPROVEMENT IS NEEDED:

____

____

____

____

E. WORKMANSHIP IS FREE OF SAFETY VIOLATIONS : YES ☐ NO ☐

IF NO, CORRECTIVE ACTION TAKEN:

____

____

____

____

NAME OF PROJECT QC INSPECTOR: ____

DATE:__________________________

SIGNATURE OF PROJECT QC INSPECTOR:____

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FOLLOW-UP PHASE INSPECTION CHECKLIST

DATE:_______________________________________

COMPANY/CONTRACTOR:____

PROJECT:____

Y=YES; N=NO; SEE REMARKS BLANK=NOT APPLICABLE	
WORK COMPLIES WITH WORK PLAN AS APPROVED IN INITIAL PHASE	

IDENTIFY DEFINABLE FEATURE OF WORK, LOCATION, AND LIST PERSONNEL PRESENT

INSPECTION PERFORMED & WHO PERFORMED TEST

NAME OF PROJECT QC INSPECTOR: ____

DATE:___________________________

SIGNATURE OF PROJECT QC INSPECTOR:____

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FINAL INSPECTION CHECKLIST

PROJECT____ DATE:_____________________

AREA OF INSPECTION :

____

____

____

____

A. TASK: STATUS OF

INSPECTION:____

____

____

____

____

____

____

____

I HEREBY CERTIFY, THAT TO THE BEST OF MY KNOWLEDGE AND BELIEF, THAT THE WORK INSPECTED IS COMPLETE AND ALL MATERIALS AND EQUIPMENT USED AND WORK PERFORMED WERE COMPLETED IN ACCORDANCE WITH THE APPROVED PLANS.

NAME OF PROJECT QC INSPECTOR: ____

DATE:___________________________

SIGNATURE OF PROJECT QC INSPECTOR:____

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and Technology, Inc., PBC

FINAL INSPECTION CHECKLIST
MEETING ATTENDANCE LIST

MEETING:		DATE:
NAME	**ORGANIZATION**	**PHONE NUMBER**

INSPECTION SCHEDULE AND TRACKING FORM

Project:	Project Manager:	Project QC Inspector/Staff:

		Preparatory		Initial		Follow-Up		Completion		
Reference Number	Definable Feature of Work/Task	Date Planned	Actual Date	Date Planned	Actual Date	Planned Begin/End	Actual Date	Planned Begin/End	Actual Date	Status

Remarks:

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RIs at Multiple Air National Guard Installations

Daily Quality Control Report (DQCR)

SITE:

DATE:

Contract No.: W9128F-18-D-0026,

EA Project No.: 6332106

Task Order: W9128F20F0325

Weather:

Work Performed:

Other Notes:

Safety Meeting Issues:

Certification: I certify that the above report is complete and correct and that I, or my authorized representative, have inspected all work performed this day by the Prime Contractor and each subcontractor and have determined that all materials, equipment, and workmanship are in strict compliance with the plans and specification, except as may be noted above.

Signature: ______________________________ **Date:** ____________________

Attachment B

Field Change and Corrective Action Forms

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NON-CONFORMANCE REPORT

PROJECT: NCR NO. DATE:
TO:

ORIGINAL TO EA CORPORATE QC MANAGER

ITEM: ____
WORK PLAN REFERENCE
REQUIREMENT:____

NONCONFORMANCE:

ISSUED BY: NAME: TITLE: ORGANIZATION:

DATE:

DISPOSITION: _________ACCEPT ________REJECT

DISPOSITION APPROVALS:

TASK MANAGER DATE	FCR REQUIRED? ☐ YES ☐ NO
PROJECT MANAGER DATE	DISTRIBUTION

REMARKS:

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CORRECTIVE ACTION REQUEST (CAR)

PART A: TO BE COMPLETED BY PROJECT MANAGER OR DESIGNEE

(1) PROJECT:		
(2) PROJECT MGR:	(3) QC MGR/STAFF:	
(4) CAR NO (S)AND DATE (S) ISSUED		
(5) DEFICIENCY DESCRIPTION AND LOCATION		
(6) PLANNED ACTIONS	(7) ASSIGNED RESPONSIBILITY	(8) COMPLETION DUE DATE
(9) PROJECT MANAGER SIGNATURE:	DATE:	

PART B TO BE COMPLETED BY CQCS OR DESIGNEE

(10) CAP REVIEWED BY	DATE
(11) REVIEWER COMMENTS	
(12) CAP DISPOSITION: (CHECK ONLY ONE AND EXPLAIN STIPULATIONS, IF ANY. ☐ APPROVED WITHOUT STIPULATIONS ☐ APPROVED WITH STIPULATIONS ☐ APPROVED DELAYED, FURTHER PLANNING REQUIRED COMMENTS:	
(13) CQCS SIGNATURE	DATE

CORRECTIVE ACTION REQUEST (CAR) INSTRUCTION SHEET

(1) Task Manager: Verify that the total number of pages includes all attachments.

(2) Task Manager: Fill in CAR number from CAR log.

(3) CQCS: Fill in appropriate priority category. High priority indicates resolution of deficiency requires expediting corrective action plan and correction of deficient conditions noted in the CAR and extraordinary resources may be required due to the deficiencies impact on continuing operations. Normal priority indicates that the deficiency resolution process may be accomplished without further impacting continuing operations.

(4) CAR Requestor: Fill in date CAR is initiated.

(5) CAR Requestor: Identify project name, number, CTO, and WAD.

(6) CAR Requestor: Identify Project Manager

(7) CAR Requestor: Identify CQC System Manager.

(8) CAR Requestor: Identify project organization, group, or discrete work environment where deficiency was first discovered.

(9) CAR Requestor: Identify line manager responsible for work unit where deficiency was discovered.

(10) Task Manager: Identify responsible manager designated to resolve deficiency (this may not be work unit manager).

(11) CAR Requestor: Identify source of requirement violated in contract, work planning document, procedure, instruction, etc; use exact reference to page and, when applicable, paragraph.

(12) CAR Requestor: Identify problem as it relates to requirement previously stated. Identify location of work activities impacted by deficiency.

(13) Task Manager: Identify if Corrective Action Plan (CAP) is required. CAP is typically required where one or more of the following conditions apply: CAR priority is High; deficiency requires a rigorous corrective action planning process to identify similar work product or activities affected by the deficiency; or deficiency requires extensive resources and planning to correct the deficiency and to prevent future recurrence.

(14) Task Manager: Identify date by which proposed corrective action is due to QC for concurrence.

(15) Task Manager: Sign and date CAR and forward to responsible manager identified in (10) above.

(16) Responsible Manager: Initial to acknowledge receipt of CAR.

(17) Responsible Manager: Complete corrective action plan and identify date of correction. Typical corrective action response will include statement regarding how the condition occurred, what the extent of the problem is (if not readily apparent by the problem description statement in [12]), methods to be used to correct the condition, and actions to be taken to prevent the condition from recurring. If a CAP is required, refer to CAP only in this section.

(18) Responsible Manager: Sign and date corrective action response.

(19) Task Manager: Initial to identify concurrence with corrective action response from responsible manager.

(20) Task Manager: Check appropriate block to identify if corrective action process is complete so that CAR may be closed. Add close-out comments relevant to block checked.

(21) Task Manager: Indicate document closeout by signing and dating.

EA Engineering, Science, and Technology, Inc., PBC

CORRECTIVE ACTION PLAN

(2) CAR#	(3) PRIORITY: HIGH ☐ NORMAL ☐	(4) DATE PREPARED:

PART A: NOTICE OF DEFICIENCY

(5) PROJECT:	
(6) PROJECT MGR:	(7) QC MGR/STAFF:
(8) CONSTRUCTION MGR:	(9) TASK MANAGER:
(10) ISSUED TO (INDIVIDUAL & ORGANIZATION)	
(11) REQUIREMENT & REFERENCE	
(12) PROBLEM DESCRIPTION & LOCATION: (13) CAP REQUIRED? YES ☐ NO ☐ (14) RESPONSE DUE:	
(15) ISSUED BY (PRINTED NAME & TITLE) SIGNATURE: DATE:	(16) MANAGEMENT CONCURRENCE:

PART B CORRECTIVE ACTION

(17) PROPOSED CORRECTIVE ACTION/ACTION TAKEN	
(18) PART B COMPLETED BY (NAME & TITLE) DATE	(19) QC CONCURRENCE

PART C

(20) CAR VERIFICATION AND CLOSE OUT: (CHECK ONLY ONE & AND EXPLAIN STIPULATIONS, IF ANY)

☐ APPROVED FOR CLOSURE WITHOUT STIPULATIONS

☐ APPROVED FOR CLOSURE WITH FOLLOWING STIPULATIONS

COMMENTS/STIPULATIONS:

(21) CLOSED BY (PRINTED NAME AND TITLE)

SIGNATURE: DATE:

EA Engineering, Science, and Technology, Inc., PBC

CORRECTIVE ACTION PLAN INSTRUCTION SHEET

(1) Task Manager: Verify that the total number of pages includes all attachments.

(2) Task Manager: Fill in CAR number from CAR log.

(3) CQCS: Fill in appropriate priority category. High priority indicates resolution of deficiency requires expediting corrective action plan and correction of deficient conditions noted in the CAR and extraordinary resources may be required due to the deficiencies impact on continuing operations. Normal priority indicates that the deficiency resolution process may be accomplished without further impacting continuing operations.

(4) CAR Requestor: Fill in date CAR is initiated.

(5) CAR Requestor: Identify project name, number, CTO, and WAD.

(6) CAR Requestor: Identify Project Manager

(7) CAR Requestor: Identify CQC System Manager.

(8) CAR Requestor: Identify project organization, group, or discrete work environment where deficiency was first discovered.

(9) CAR Requestor: Identify line manager responsible for work unit where deficiency was discovered.

(10) Task Manager: Identify responsible manager designated to resolve deficiency (this may not be work unit manager).

(11) CAR Requestor: Identify source of requirement violated in contract, work planning document, procedure, instruction, etc; use exact reference to page and, when applicable, paragraph.

(12) CAR Requestor: Identify problem as it relates to requirement previously stated. Identify location of work activities impacted by deficiency.

(13) Task Manager: Identify if Corrective Action Plan (CAP) is required. CAP is typically required where one or more of the following conditions apply: CAR priority is High; deficiency requires a rigorous corrective action planning process to identify similar work product or activities affected by the deficiency; or deficiency requires extensive resources and planning to correct the deficiency and to prevent future recurrence.

(14) Task Manager: Identify date by which proposed corrective action is due to QC for concurrence.

(15) Task Manager: Sign and date CAR and forward to responsible manager identified in (10) above.

(16) Responsible Manager: Initial to acknowledge receipt of CAR.

(17) Responsible Manager: Complete corrective action plan and identify date of correction. Typical corrective action response will include statement regarding how the condition occurred, what the extent of the problem is (if not readily apparent by the problem description statement in [12]), methods to be used to correct the condition, and actions to be taken to prevent the condition from recurring. If a CAP is required, refer to CAP only in this section.

(18) Responsible Manager: Sign and date corrective action response.

(19) Task Manager: Initial to identify concurrence with corrective action response from responsible manager.

(20) Task Manager: Check appropriate block to identify if corrective action process is complete so that CAR may be closed. Add close-out comments relevant to block checked.

(21) Task Manager: Indicate document closeout by signing and dating.

Field Change Request (FCR) Form	
FCR #:	**DATE:**
PROJECT NAME:	**TASK MANAGER:**
1. Description (Items involved, submit sketch, if applicable): (Use continuation sheet if necessary)	
2. Reason for Change (Use continuation sheet if necessary)	
3. Recommended Disposition (Submit sketch, if applicable): (Use continuation sheet if necessary)	

Preparer of FCR (Print name and sign)	Preparer's Title	Date
PM- Reviewed (Print name and sign)	Accepted (Y/N)	Date
QC – Reviewed (Print name and sign)	Accepted (Y/N)	Date
Field Manager – Reviewed (Print name and sign)	Accepted (Y/N)	Date
USACE – Reviewed (Print name and sign)	Accepted (Y/N)	Date
NBG/A4VR – Reviewed (Print name and sign)	Accepted (Y/N)	Date

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Field Change Form

Project Name and Location	**Project/Task Order Number**	**Client Name**
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.		
Regulatory PM	NBG/A4VR RPM	USACE PM
Date	Date	Date

Appendix D

Accident Prevention Plan (APP)

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Appendix D
Accident Prevention Plan

Programmatic Uniform Federal Policy Quality Assurance Project Plan

Remedial Investigations for PFAS at Multiple Air National Guard Installations

Joe Foss Field, South Dakota
Truax Field, Wisconsin
Volk Field, Wisconsin

Prepared for:

ANG Readiness Center, NGB/A4VR
3501 Fetchet Avenue
Joint Base Andrews MD 20762-5157

Under Contract to:

U.S. Army Corps of Engineers, Omaha District
1616 Capital Avenue, Suite 9000
Omaha, NE 68102-4901

Prepared by:

EA Engineering, Science, and Technology, Inc., PBC
221 Sun Valley Boulevard, Suite D
Lincoln, NE 68528

December 2021
Contract No. W9128F18D0026, Task Order No. W9128F20F0325
EA Project No. 6332106

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ATTACHMENTS

LIST OF ACRONYMS

ABIH	American Board of Industrial Hygiene
AFFF	Aqueous film-forming foam
AHA	Activity Hazard Analysis
ANG	Air National Guard
ANGS	Air National Guard Station
APP	Accident Prevention Plan
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CFR	Code of Federal Regulations
CIH	Certified Industrial Hygienist
COR	Contracting Officer's Representative
COVID-19	Novel coronavirus
CPR	Cardiopulmonary resuscitation
CSP	Certified Safety Professional
dBA	decibels
DPT	Direct push technology
EA	EA Engineering, Science, and Technology, Inc., PBC
EC	Electrical conductivity
EM	Engineer manual
EMR	Experience modification rate
EPA	Environmental Protection Agency
HPT	Hydraulic profiling tool
IDW	Investigation derived waste
MSDS	Material Safety Data Sheet
MW	Monitoring well(s)
NGB/A4VR	National Guard Bureau/Environmental Restoration Branch
OSHA	Occupational Safety and Health Administration
PFAS	Per- and Polyfluoroalkyl Substances
PM	Project Manager
PPE	Personal protective equipment
QC	Quality control
RAC	Risk assessment codes
RI	Remedial Investigation
RPM	Restoration Program Manager

LIST OF ACRONYMS (con't)

SDS	Safety Data Sheets
SOW	Statement of Work
SSHO	Site Safety and Health Officer
SSHP	Site Safety and Health Plan
TBD	to be determined
USACE	U.S. Army Corps of Engineers

INTRODUCTION

This Accident Prevention Plan (APP) has been prepared by EA Engineering, Science, and Technology, Inc., PBC (EA) to provide services to perform a Remedial Investigation (RI) for per- and polyfluoroalkyl substances (PFAS) contamination resulting from aqueous film-forming foam (AFFF), non-AFFF, and secondary PFAS releases at multiple Air National Guard (ANG) installations. Work conducted under this contract will be performed in accordance with applicable federal, state, and local safety and occupational health laws and regulations, including Occupational Safety and Health Administration (OSHA) standards (e.g., 29 Code of Federal Regulations [CFR] 1910 and 29 CFR 1926) and the United States Army Corps of Engineers (USACE) Safety and Health Requirements Manual (Engineer Manual [EM] 385-1-1, 30 November 2014). The contents of the APP are subject to review and revision as new information becomes available.

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1. SIGNATURE SHEET

Plan Preparer:

This APP has been prepared by a qualified, Competent Person.

Name:	Ashley Schroeder	Date: 7 December 2020
Title:	Environmental Scientist	
Company:	EA	
Telephone:	402-476-3766	

Plan Approvals:

This APP has been prepared under the supervision of, and has been reviewed and approved by, a Certified Industrial Hygienist (CIH) certified by the American Board of Industrial Hygiene (ABIH).

Name:	Pete Garger, CSP, CIH ABIH No. 3118, CSP No. 20560	Date: 01 May 2021
Title:	Health and Safety Manager	
Company:	EA	
Telephone:	410-527-2425	

Certification/Concurrence:

Project and Program Management have concurred with the elements of this APP, Site worker concurrence will be documented through signature on a Programmatic APP/Site Safety and Health Plan (SSHP) review form.

Name:	Cybil Boss, P.E.	Date: 10 May 2021
Title:	Project Manager	
Company:	EA	
Telephone:	402-817-7613	

1.1 INSTALLATION SPECIFIC ADDENDA

Installation specific information will be included in an Installation Specific Addenda to this APP prior to the start of field activities at each installation. Changes in the Scope of Work (SOW), field changes, or unanticipated site conditions may require Site Specific Addenda APP modification and approval in order to retain field safety. Changes to the APP shall be prepared, approved, and concurred by the same personnel who signed this APP. The revisions will also be submitted to USACE for acceptance.

2. BACKGROUND INFORMATION

This section presents a brief description of the project, SOW, key personnel, and phases of work.

2.1 CONTRACTOR INFORMATION

EA Engineering, Science, and Technology, Inc., PBC
225 Schilling Circle, Suite 400
Hunt Valley, MD 21031
(410) 584-7000

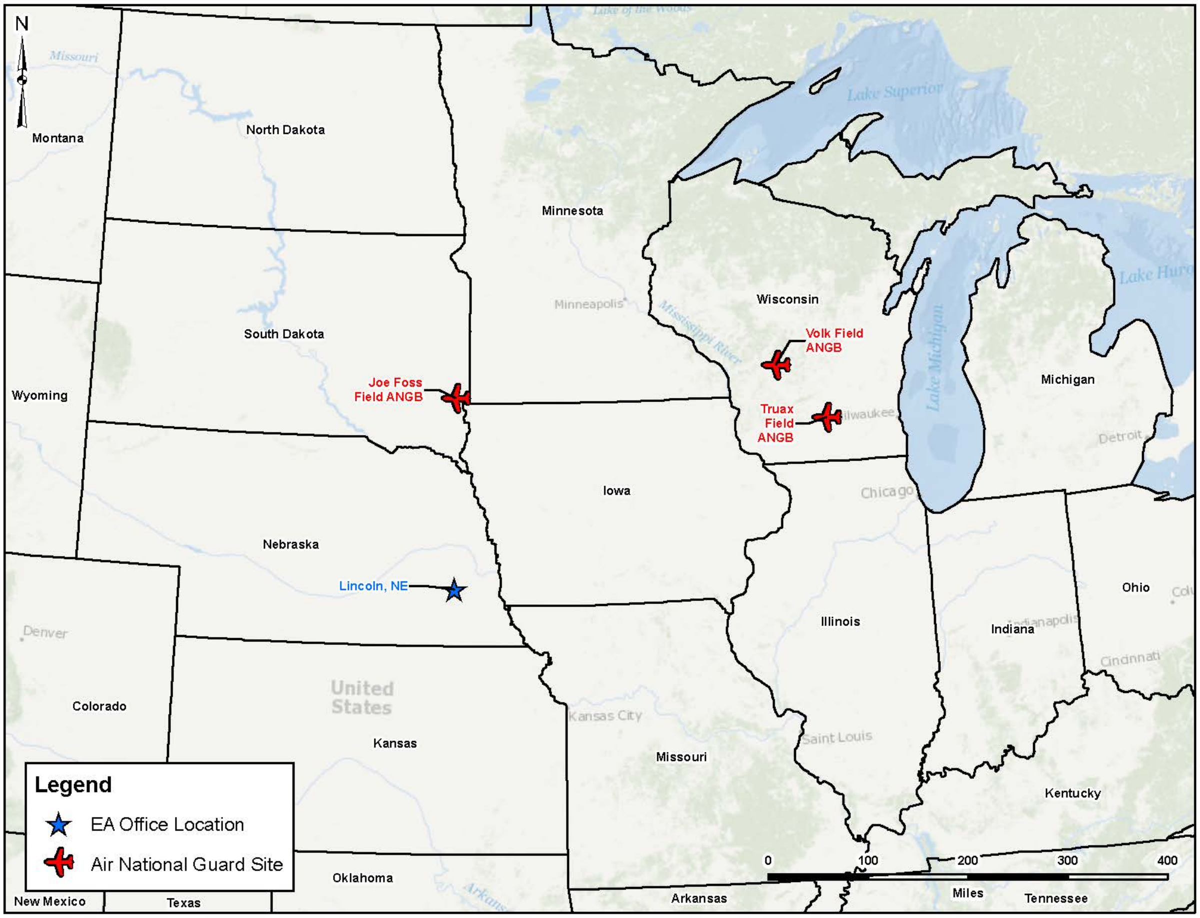
2.2 CONTRACT NUMBER

EA Engineering, Science, and Technology, Inc., PBC (EA) is the prime contractor under United States Army Corps of Engineers (USACE) - Omaha District Contract W9128F-18-D-0026, Task Order No. W9128F20F0325.

2.3 PROJECT DESCRIPTION

The USACE Omaha District has contracted EA to perform RIs for PFAS contamination resulting from AFFF, non-AFFF, and secondary PFAS releases at multiple ANG Installations. The ANG installations include Joe Foss Air National Guard Station (ANGS) in South Dakota; Truax Field and Volk Field in Wisconsin. These installation locations are shown on Figure 1. Remedial investigative activities include, but are not limited to: records review, sampling and analysis of soil, groundwater, sediment, and surface water; installation of lysimeters where required; data validation and interpretation; generation of analysis reports and supplemental materials; and semiannual groundwater monitoring. EA will be contracting local subcontractors and overseeing work in coordination with USACE Omaha District and the National Guard Bureau/Environmental Restoration Branch (NGB/A4VR).

Figure 1. ANG Installations



2.4 SCOPE OF WORK

Brief descriptions of the work associated with the PFAS RIs at multiple ANG Installations are presented in the following sections. Detailed descriptions of the work are presented in the Uniform Federal Policy-Quality Assurance Project Plan developed for this project. Any significant changes or additional tasks that may be identified in the future will be submitted as addenda to this APP for review and approval by USACE and NGB/A4VR.

The Activity Hazard Analyses (AHAs) and novel coronavirus (COVID-19) are listed in Table 2-1 for tasks associated with the RI activities and are presented in further detail in Attachment A. Task-specific required equipment is listed in each AHA. Risk Assessment Codes (RACs) for the AHAs required to complete this task order do not indicate that high risk activities are to be completed.

General SOW includes the following:

- Mobilization and demobilization

- Synoptic groundwater level measurement
- Baseline groundwater sampling of existing monitoring wells (MWs)
- Complete direct-push technology (DPT) investigation with completion of hydraulic profiling tool (HPT)/electrical conductivity (EC)
- Install new MWs and geotechnical analysis
- Collect soil, groundwater, sediment, and surface water samples
- Investigation-derived waste (IDW) disposal
- Install lysimeters
- Data validation and interpretation of all analytical results.

Table 2-1. Scope of Work and Site-Specific Activity Hazard Analyses

Work Phase	Site Mobilization	Groundwater Sampling	Well Installation	Soil Sampling	Sediment Sampling	Surface Water Sampling	IDW Handling	Site Demobilization
Mobilization/Demobilization	✓							✓
COVID-19 Hazard Mitigation	✓	✓	✓	✓	✓	✓	✓	✓
Drilling and Well Installation	✓		✓				✓	✓
Groundwater Sampling		✓					✓	✓
Sediment Sampling					✓		✓	✓
Soil Sampling				✓			✓	✓
Surface Water Sampling						✓	✓	✓

NOTE:
IDW = Investigation-derived waste.

2.5 CONTRACTOR SAFETY INFORMATION

OSHA-recordable incident rate and lost-workday rates are comparable with the industry average. In addition, the insurance industry has developed an experience-rating system as an equitable means of determining premiums for Workers' Compensation Insurance (the experience modification rate [EMR]). This rating is based on a comparison of firms doing similar types of work, with the employer rated against the average expected performance in each work classification. For over 10 years, EA has been below the industry average. EA's EMR and recordable incident rate for the past 5 years are summarized in Table 3-2. The current OSHA Form 300 and 300A are included in Attachment B.

Table 2-1. Summary of EA Safety Information

EA	2020	2019	2018	2017	2016
EMR	0.66	0.66	0.67	0.78	0.74
Number of Recordable Cases	6	4	2	7	5
Total Recordable Incident Rate	1.15	0.55	0.38	1.31	0.95
Lost Time Incident Rate	0.16	0	0	0	0.19
Total Hours Worked	1,216,771	1,123,596	1,062,015	1,072,638	1,055,170

Safety and health information will be maintained onsite by the Installation Specific Site Safety and Health Officer (SSHO). It is not anticipated that a work trailer will be necessary for the site work. Therefore, the information will be contained in a mobile file located in the SSHO's vehicle and available to all workers and oversight personnel. The information will include a map illustrating the route to the nearest hospital, emergency phone numbers, a copy of the APP that includes copies of AHAs, OSHA Form 300A, Safety and Occupational Health Deficiency Tracking Log, and field logbooks, documenting daily health and safety meetings.

3. STATEMENT OF SAFETY AND HEALTH POLICY

3.1 EA'S CORPORATE SAFETY AND HEALTH POLICY

EA considers the safety and health of its employees, clients, and visitors and the prevention of work-related accidents and illnesses and property loss to be of the highest priority. Proactively implemented, a comprehensive and systematic safety and health program will result in more efficient and profitable operations by improving employee health and morale, and by reducing Worker's Compensation costs, lost time, fire and liability insurance premiums, and property damage.

The objectives of EA's Safety and Health Program for this contract are to ensure:

- Sound safety and health practices and conditions necessary for the protection of the health and welfare of employees, subcontractors, clients, and visitors.

- Compliance with this APP and federal and state safety and health regulations and standards.

- Effective safety and fire prevention practices necessary for protection of company-owned or operated and site property.

EA is committed to the overall goal of having no workplace injuries or safety incidents. A summary of EA's safety statics over the last several years are presented and discussed as part of our annual safety training program; which are detailed in Section 2.5 and Table 2-2.

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4. RESPONSIBILITY AND LINES OF AUTHORITY

EA is responsible for implementing a safety and occupational health program for protection of employees in the workplace and, as addressed in this APP and the Installation Specific Addenda APP, on project sites. As such, EA has established roles and responsibilities for implementing the safety program at the corporate, project management, and field/task levels. This APP presents the site-specific requirements that will ensure compliance with EA's corporate program while maintaining compliance with federal and client requirements. EA retains full responsibility for the implementation of this APP. Site personnel are responsible for adherence to this APP during the performance of their work. No person may work in a manner that conflicts with the intent of, or the inherent safety and environmental precautions expressed in, these procedures. Furthermore, employees working onsite have the authority to stop work if unsafe conditions exist.

4.1 IDENTIFICATION AND ACCOUNTABILITY OF PERSONNEL

Corporate, management, technical, and safety personnel are required for completion of the scope of services to be performed under this APP. The key roles and personnel filling those roles for the proposed work are presented in the sections below. As demonstrated in the responsibilities required of each role, and as discussed in Section 4.4, EA maintains separate lines of authority for installation specific task management and safety in order to limit conflicts of interest between the need to maintain project deliverables, budget, schedule, and safety.

4.1.1 Program Manager

Ms. Brenda Herman is the EA Program Manager, and she will be responsible for communicating directly with the USACE-Omaha District Contracting Officer's Representative (COR), USACE Project Manager (PM), the NGB/A4VR Restoration Program Manager (RPM), the EA PM, and installation specific task managers and subcontractors with respect to programmatic issues that include but are not limited to:

- Ensuring safety and health measures and installation-specific plans have been prepared and properly reviewed prior to beginning the project.
- Ensuring safety and health measures and installation-specific plans are implemented during the execution of a project.
- Communicating with the PM (Cybil Boss) and corporate level safety personnel (Pete Garger) to correct deficiencies that may be identified by staff, subcontractor, or client personnel.

4.1.2 Corporate Health and Safety Supervisor

Mr. Pete Garger, a CIH, and Certified Safety Professional (CSP), is an EA Health and Safety Manager. Mr. Garger will be the designated Safety and Health Manager for the duration of the project and his duties include:

- Establishing and administering a Safety and Health Program designed to ensure compliance with USACE, EM 385-1-1 and safe work practices.
- Reviewing Safety and Health Program progress and periodically reporting significant problems and accomplishments to management.
- Conducting an annual evaluation of the effectiveness of the Safety and Health Program, submitting any recommended changes to the President of EA for review and comment.
- Establishing procedures to ensure that periodic safety and health inspections are conducted at EA locations and for company vehicles.
- Assisting Program Managers and PM, Safety and Health Coordinators, and Operations Managers in training, safety promotion, employee motivation, and project audits.
- Reviewing proposed facility, process, and procedure changes, and major equipment requests to determine if there are any safety or health implications.
- Meet with Program Managers and Operations Managers to designate Regional Safety and Health Coordinators to develop, maintain, and oversee the implementation of APP/SSHP by:
    - Visit project sites, as needed, to audit the effectiveness of the APP/SSHP and Installation Specific Addenda to the APP/SSHP.
    - Remain available for project emergencies.
    - Develop modifications to the APP/SSHP, as needed.
    - Evaluate occupational exposure monitoring/air sampling data and adjusting APP/SSHP requirements as necessary.
    - Serve as a quality control (QC) staff member.
    - Approving the APP/SSHP by signature.
- Ensuring that procedures are established which provide for the availability of essential medical and first aid personnel and emergency medical equipment.
- Evaluating reported hazardous conditions and directing corrective actions as appropriate.
- Reviewing/investigating work-related injuries and illnesses to ensure that appropriate corrective action have been implemented.
- Ensuring Safety and Health Coordinators, Operations Managers, and Corporate Officers are kept up to date on safety and health issues by timely dissemination of information.
- Ensuring that employees that require medical surveillance, per EM 385-1-1 (for hazardous and toxic waste activities), are examined annually or biennially as per EA's designated Medical Director.
- Exercising his authority to stop work if unsafe conditions exist.

4.1.3 Project Manager

Ms. Cybil Boss is the EA PM whose duties include:

- Ensuring that this APP is developed in accordance with EM 385-1-1 and is accepted by USACE-Omaha District prior to initiating site activities.
- Ensuring that resources (personnel, equipment/materials, budget, and time) are properly allocated to the project to allow for development and implementation of this APP.
- Evaluating reported hazardous conditions and directing corrective actions as appropriate.
- Reviewing/investigating work-related injuries and illnesses to ensure that appropriate corrective actions have been taken.
- Reporting accidents and incidents in accordance with Section 8.

4.1.4 Site Safety and Health Officer

The SSHO will be identified in the Installation Specific Addenda to this APP. The Site Safety and Health Officer will be designated as a Competent Person who is capable of, and responsible for, performing activities required of the SSHO. No work shall be performed unless he or she is present onsite. SSHO responsibilities will include:

- Ensuring onsite adherence to the APP.
- Ensuring all personnel have the required training and certifications to complete field work.
- Ensuring that personnel are trained in the use, calibration, and maintenance of safety equipment.
- Recognizing and predicting unsafe conditions/hazards.
- Stopping work if unsafe conditions exist.
- Mitigating unsafe conditions.
- Ensuring that assigned safety and monitoring equipment is properly used, calibrated, and maintained.
- Taking the lead on initial, onsite investigation of accidents, near misses, and occupational illnesses, and providing copies of incident reports to the Corporate Health and Safety Supervisor and PM.
- Ensuring that personnel onsite (employees and subcontractors) have the required training and appropriate medical surveillance/clearance to perform site tasks.
- Ensuring that air sampling or air monitoring is conducted for appropriate field operations.

- Reviewing Installation Specific APPs and SSHPs.
- Performing onsite safety related briefings, training, and inspections.
- Providing copies of inspections, as needed, to the Field Supervisor, PM, and Corporate Health and Safety Supervisor.
- Investigating employee reports of hazardous conditions and taking actions as appropriate.
- Coordinating with the Corporate Health and Safety Supervisor for issues that cannot be resolved.

An alternate SSHO will be identified in the event the SSHO is not available.

4.1.5 Field Supervisor

The Field Supervisor for field activities will be identified in the Installation Specific Addenda to this APP. During the execution of field tasks, this role may be passed to a qualified alternate. Field Supervisor duties include:

- Reporting to PM on progress of work and potential quality or safety issues.
- Ensuring adherence to the requirements of the Quality Control Plan and documenting non-compliance issues (quality or safety) and reporting to the PM.
- Coordinating activities with the SSHO and documenting safety activities and inspections
- Instruct and train employees in the hazards of anticipated job activities, and the appropriate safe work practices.
- Periodically monitor employee activities to ensure conformance with safe work practices.
- Investigate and report accidents, injuries, and occupational illnesses as required.
- Investigate employee reports of hazardous conditions, taking actions as appropriate.

4.1.6 Field Technicians and Subcontractors

These members of the project will:

- Follow safety and health rules, regulations, and procedures and use necessary controls and safety devices, including personal protective equipment (PPE).
- Immediately notify the Field Supervisor, PM, or SSHO of suspected safety or health hazards.
- Report any accidents, injuries, occupational illnesses, and nears misses to his or her supervisor, or, if on a project site, to the SSHO.

4.2 COMPENTENT AND/OR QUALIFIED PERSON(S)

Personnel designated as Competent Persons for completion of the scope of services at each installation will be included in the Installation Specific Addenda to this APP. The relevant certifications of the designated qualified and/or Competent Persons for safety related tasks will be presented in the Addenda as well.

4.3 REQUIREMENTS FOR PRE-TASK SAFETY AND HEALTH ANALYSIS

Prior to conducting field activities, the site work will be evaluated by the Corporate Health and Safety Supervisor to determine potential hazards associated with the activities. The hazards are documented in AHAs. The Installation Specific AHAs for the installations will be provided in the Installation Specific Addenda. The programmatic AHAs are included in Attachment A.

4.4 LINES OF AUTHORITY

Safety personnel have the authority to require and implement changes with regard to site safety. The SSHO will report safety issues to the Corporate Health and Safety Supervisor. The SSHO has the authority to stop work and can require changes to the APP. The SSHO will inform the Program Manager and PM of the required changes. If there is disagreement between safety and management at the SSHO and Project Management level, the disagreement will be elevated to Corporate Health and Safety Supervisor and the Program Manager for resolution. The Corporate Health and Safety Supervisor and the Program Manager have the ability to elevate safety issues to the President and Chief Executive Officer, if required for resolution. Work related to the identified safety issue or hazard will not resume until a safe resolution is agreed upon. The USACE COR and PM and NGB/A4VR RPM will be notified of safety issues that result in a work stoppage or require changes to the APP. Contact information and figures demonstrating the lines of authority and communication will be provided in the Installation Specific Addenda.

4.5 NON-COMPLIANCE WITH SAFETY REQUIREMENTS

EA expects and requires that employees and subcontractors will adhere to this APP and associated supplemental plans. Progressive disciplinary action is used to deal with noncompliance issues. For EA employees, this includes the following:

- First offense will warrant a verbal warning, explanation of why the activity was noncompliant, and what section of the APP the activity was not compliant with.
- A second offense, if it is of the same nature, will warrant a written warning and may lead to removal from the job site. If the second offense is not the same non-compliance issue as the first, additional explanation of why the activity was non-compliant will be discussed and the employee will be required to re-review the APP.
- A third offense will lead to removal from the job site.
- If additional offenses are perpetrated on other project sites, the employee may be suspended or terminated.

If subcontractors are non-compliant with safety requirements, they will be given verbal and written warnings for the first two offenses. If additional offenses occur, the subcontractor may be removed from the project site.

4.6 COMPANY PROCEDURES FOR MANAGER AND SUPERVISOR ACCOUNTABILITY

EA's commitment to safety and health is documented, and requirements addressed, from the time an offer of employment is made to a job applicant. Managers and supervisors are made responsible for enforcing safety and health as part of their job descriptions. They are ultimately responsible for protecting the health and welfare of the employees, as well as minimizing the potential liability associated with on the job or work-related accidents. A manager or supervisor has the authority to assign and direct personnel on project tasks. As such, the PM, SSHO, and Field Supervisor will possess knowledge of the correct safe procedures for tasks that will be performed under their supervision. If there is question as to the appropriate safety measures, the SSHO, Field Supervisor, or PM will seek assistance from the Corporate Health and Safety Supervisor. If the task cannot be accomplished safely, it will not be attempted.

In addition, at a minimum of once per year, each employee's performance is formally evaluated in the following areas: personal commitment to safe work practices; adherence to established health and safety plans and programs, ability to recognize safety hazards, communication skills, acquisition and proper use of PPE and monitoring equipment, and proper budgeting for health and safety aspects in projects. Unsatisfactory performance in any of the above areas by supervisors or managers is addressed through implementation of performance-improvement plans, mandatory additional training, lower overall compensation, and, if appropriate, termination.

5. SUBCONTRACTORS AND SUPPLIERS

5.1 IDENTIFICATION OF SUBCONTRACTORS AND SUPPLIERS

The following subcontractors have been identified to support the PFAS RIs at Multiple ANG Installations:

- **To be determined (TBD):** Surveyor to perform surveying of MWs and locations of environmental samples.
- **Plains Environmental Services:** Direct-push technology for HPT, EC and groundwater samples
- **Midwestern Drilling:** Direct-push technology for soil sampling.
- **Environmental Works:** Sonic drilling services for MW installation.
- **Eurofins Environmental Testing America (Lancaster):** Laboratory for analyses of environmental samples.
- **Eurofins Environmental Testing America (Sacramento):** Laboratory for analyses of environmental samples.
- **Pace Analytical Mobile Services:** Mobile PFAS laboratory for screening-level, expedited on-site analysis of environmental samples.
- **Eurofins Environmental Testing America (Sacramento):** Secondary laboratory for analyses of environmental samples.
- **Laboratory Data Consultants (LDC):** Data validation of laboratory analytical results.
- **TBD:** Disposal of IDW generated during RI.

Additional subcontractors and associated competent/qualified persons (if necessary) will be identified prior to the start of the activity being performed and will follow the requirements of this document. Coordination and safety responsibilities of subcontractors are presented below. Offsite work conducted by subcontractors is not covered by this APP.

5.2 SAFETY RESPONSIBILITIES OF SUBCONTRACTORS

Subcontractors providing onsite services will be required to review and abide by this APP. Specific responsibilities of subcontractors include:

- Complying with the requirements of their SOW

- Maintaining a safe and healthy work environment

- Complying with contract requirements, laws, regulations, and EM 385-1-1

- Reviewing this APP to ensure that the safety and health requirements of their specific tasks are satisfied

- Performing work in accordance with the APP requirements

- Providing trained and experienced workers for the specific work activities
- Providing documentation of training to EA
- Participating in the Daily Safety Tailgate meetings
- Identifying additional training needs for unique tasks
- Participating in, and documenting, routine equipment and site inspection activities
- Ensuring equipment brought to the site is in good condition, routinely inspected, and maintained in safe working order
- Ensuring the SSHO, or designee, is aware of materials and equipment brought to the site and that the equipment is in good condition, routinely inspected, and maintained in safe working order.

6. TRAINING

Prior to commencement of field activities, EA employees and subcontractors engaged in field operations will be informed of the nature and degree of exposure to chemical, physical, and biological hazards that are likely to result from participation in field operations. EA will accomplish this by ensuring that personnel entering the site have received the appropriate site-specific training prior to participation in site activities. Training will be conducted prior to site mobilization and will meet all applicable OSHA regulations following American National Standards Institute Z490.1. Site-specific training will be held at the time of site mobilization and will be reinforced during the daily safety briefings, which site workers will be required to attend. OSHA-required training will be conducted prior to site mobilization and is documented through the certificates presented in Attachment C.

During the sampling events, EA will conduct daily safety briefings summarizing site-specific activities and the training required to complete the onsite work. Site workers will have received the required training prior to the start of involvement in site activities and are required to attend daily safety briefings. Documentation of training, update frequency of training, time of initial training, training types, and personnel receiving the training are presented in Table 6-1.

The SSHO will ensure that all EA and subcontract personnel are briefed on site hazards and controls. All EA and subcontract personnel will be required to sign a visitor log. Subcontract personnel will be escorted by EA personnel (under the direction of the SSHO or designee), as appropriate, depending on site activity.

Table 6-1. Mandatory Training and Certifications

Personnel	Training	When	Update Frequency[a]	Documentation
Personnel[b]	Safety and Occupational Health Training (29 CFR 1910.120 (e)-compliant 40-hour HAZWOPER)	Upon hire	8-hour refresher	Corporate files
Personnel[b]	Medical clearance (medical monitoring)	Upon hire	Annually	Corporate files
Personnel (including Supervisors)[b]	Annual Health and Safety Refresher (29 CFR 1910.120 (e)-compliant 8-hour HAZWOPER refresher training)	One year after initial training	Annually after 40-hour HAZWOPER	Corporate files
At Least 2 onsite employees	First aid/CPR (in person, not online)	Initially	Biannually	Corporate files
First Aid/CPR providers	OSHA 1910.1030-compliant bloodborne pathogens	Prior to onsite work	Annually	Corporate files
SSHO (non-construction)	8-hour Supervisor Training (includes 8-hour HAZWOPER Supervisor Training)	Prior to mobilization	Does not expire	Corporate files Attachment C

Table 6-1. Mandatory Training and Certifications

Personnel	Training	When	Update Frequency[a]	Documentation
SSHO (non-construction)	At least 1-year experience implementing safety and occupational health procedures at HAZWOPER sites	Aggregate training requirement	Minimum 1-year experience	Corporate files
Selected Personnel	Use of Fire Extinguishers	Annually and prior to onsite work	Annually	Corporate files
Selected Personnel	Personal Protective Equipment	Annually and prior to onsite work	Annually; prior to onsite work	Personal Protective Equipment Training form
Selected Personnel	Pre-Entry Site Briefing	Prior to onsite work	Not applicable	APP Review form
Selected Personnel	Daily Tailgate Safety Meeting	Daily	Not applicable	Daily Tailgate Safety form
Visitors and Authorized Entrants	Visitor briefing (by SSHO or designee) (escort by or SSHO or designee)	Prior to observing onsite work	Once per visit	Visitor's Log

a. Currently, EA utilizes an automated system to notify the Corporate Safety Officer and the employee when a training or certification is about to expire. Employees are required to communicate their plan to update the training/certification with the Corporate Safety Officer and will be provided with resources to meet training/certification requirements.
b. Retraining requirements are at the discretion of health and safety personnel.

NOTES:
APP = Accident prevention plan.
CFR = Code of Federal Regulations.
CPR = Cardiopulmonary resuscitation.
HAZWOPER = Hazardous Waste Operations and Emergency Response.
OSHA = Occupational Safety and Health Administration.
SSHO = Site Safety and Health Officer.
USACE = U.S. Army Corps of Engineers.

6.1 INSTALLATION SPECIFIC TRAINING AND CERTIFICATION

The Installation Specific Addenda to this APP will include a list of installation specific training and certification required, if modified from the list in Table 6-1.

7. SAFETY AND HEALTH INSPECTIONS

Safety and health inspections will be completed systematically to:

- Identify potential hazards.
- Identify potential deficiencies in the implementation of this APP.
- Provide management with summary of site conditions and deficiencies.
- Aid management in the establishment of abatement priorities based on potential risk.

Periodic safety and health-related inspections are required at the installations during field activities. Inspections will be conducted at the time of drilling and sampling. Each drilling or sampling location will be inspected, and any safety concerns will be noted in the field logbook and appropriate safety field forms (Attachment D). The SSHO will conduct the required onsite pre-entry briefing, including review of the location of required onsite documentation (i.e., the location of the APP and Safety Data Sheets (SDS), directions to the nearest hospital, etc.), and observe site activities to ensure compliance with the APP.

As part of the safety and health program, unscheduled, periodic monitoring of project sites are sometimes conducted by the Corporate Safety Officer. The inspections will be random. Findings with be immediately reported to the SSHO, Program Manager, and PM for correction, if necessary.

7.1 INSPECTION DOCUMENTATION

The Health and Safety Logbook will be completed by the SSHO or designee. Pertinent health and safety information, to include the names of subcontracting personnel working onsite and the names of visitors to the site, will be entered. At a minimum, the following information is required to be put in the Logbook on a daily basis:

- Daily Tailgate Health and Safety meeting forms
- Visitors to the site
- Upgrading or downgrading of PPE levels
- Instances of job-related injury or illness
- Health and safety issues
- Health and safety deficiencies (violations)
- Emergencies.

Should a deficiency be identified, the SSHO will perform a follow-up inspection to ensure that it has been corrected and is not recurring. If a deficiency is noted that cannot be immediately corrected, the SSHO will monitor the progress in correcting the deficiency and will document the following:

- Date the deficiency was identified
- Description of the deficiency
- Name of the responsible personnel

- Projected date of correction
- Date the deficiency was corrected.

This information will be documented by the SSHO in the field logbook. The status of resolution will be included in the daily tail gate briefings to ensure site personnel are aware of the deficiency and status in correcting the deficiency. Table 7-1 summarizes inspectors, frequency of the inspections, and documentation. Any mishaps due to deficiencies will be reported according to Section 8. No external inspections or certifications are required to complete the work covered by this contract.

Table 7-1. General Safety and Health Inspection Requirements

Personnel[a]	Inspection	Timing/ Frequency	Documentation[c]
SSHO or designee	General site conditions (e.g., vehicles, documents, etc.)	Daily	Tailgate Safety Meeting, Daily Safety Inspection Report
All employees	PPE	Initial and Daily	Tailgate Safety Meeting, Daily Safety Inspection Report
Selected Personnel	Emergency Equipment • Fire extinguisher • First aid kit • Eye wash	Initial	Tailgate Safety Meeting, Daily Safety Inspection Report
All Employees	PPE	Before use	None. Dispose of PPE, if faulty
Corporate Safety Officer	Fire Prevention Plan Survey	Annual	Fire Prevention Plan Audit
Corporate Safety Officer	Safety and Health Audits	Random	EA Corporate Audit forms
All Employees	Tools and equipment	Before Use	None. Dispose of faulty equipment/supplies.

a. Personnel associated with titles are presented in Section 4.
b. Monitoring frequency is weather-dependent and presented in the Site Safety and Health Plan (Attachment E).
c. Field forms provided in Attachment D.

NOTES:
PPE = Personal protective equipment.
SSHO = Site Safety and Health Officer.

7.2 AUDITS

As part of the safety and health program, unscheduled, periodic monitoring of project sites are sometimes conducted by the Corporate Health and Safety Supervisor. The inspections will be random and could be performed at any of the ANG installations. Findings with be immediately reported to the SSHO, Program Manager, and PM for correction, if necessary.

8. ACCIDENT REPORTING

8.1 REPORTABLE ACCIDENTS

An accident investigation will be conducted for the following:

- Job-related injuries and illnesses.
- Accidents resulting in significant loss or damage to property.
- Accidents involving vehicles whether or not they result in damage to property or personnel.
- Accidents in which there may have been no injury or property damage, but which have a high probability of recurring with at least a moderate risk to personnel or property (Near Miss).

8.2 EXPOSURE DATA

Work-related incidents occurring to EA employees will be reported for statistical purposes. Recordable incidents count against EA's USACE recordable incident experience whenever they occur, either to an employee or a subcontractor working under the direct supervision of EA's Task Manager. Personnel man-hours will be defined as hours worked by persons assigned to the project, including subcontractor employees under direct supervision of EA. These man-hours will be annotated in the daily sign in sheet (which also indicates time of departure). The total exposure man-hours will be tallied from the sign in log. The EA Task Manager will document the potential exposure hours versus the man-hours worked per day by subtracting out the time that personnel were not participating in tasks with the potential for exposure to site media. These man-hours worked will be reported to the USACE PM as requested.

8.3 ACCIDENT INVESTIGATION PROCEDURES

Accident investigation procedures will include the following:

- Identify, without placing blame, the basic causal factors that contribute directly or indirectly to accidents.
- Suggest corrective action alternatives for a given accident.
- Identify deficiencies in the APP and supplemental plans.
- Provide information needed to identify trends and problem areas.
- Satisfy Workers' Compensation, USACE, and OSHA requirements for recordkeeping and reporting.

8.4 ACCIDENT REPORTING PROCEDURES

Employees will immediately report accidents to their supervisor, or if on the project site, to the SSHO and Field Supervisor and will immediately notify the Health and Safety Manager (Pete Garger, 410-527-2425). The PM will be notified immediately after the Health and Safety Manager. The USACE COR will be notified by the EA PM as soon as possible and within 24 hours of the incident. A written report will be forwarded to USACE within 5 business days.

The SSHO will:

- Render assistance and attempt to limit further injury and damage.
- Arrange for appropriate medical treatment.
- Report the accident to the PM.
- Establish the sequence of events leading to the accident.
- Observe the accident scene and involved property and provide sketches or photographs, if necessary, to clearly present the sequence of events and possible contributing factors.
- Complete an accident/loss report as soon as possible, no later than 24 hours after the accident occurred.
- Forward the report through his or her supervisor to the Health and Safety Manager.
- The collected information will be analyzed and a corrective action/plan will be developed to eliminate future accidents, if possible.

The Health and Safety Manager will:

- Review the reports for accuracy and thoroughness.
- If necessary, return the report to the Supervisor for further investigation or corrective action.
- After appropriate review and comment, forward Accident Investigation Reports to Program Management, which after management review will then be forwarded to the USACE COR within 24 hours of the incident. Form DD3394 “USACE Accident Investigation Report” will be used for this action.
- Follow up to see that corrective action has been implemented and forward report to the USACE COR within 5 business days.
- Prepare an annual summary of accidents to be distributed project wide. The purpose of this summary is to identify accident trends and to evaluate the effectiveness of the APP.
- Maintain the Company OSHA 300 log.

USACE will be notified immediately of accidents resulting in death, permanent disability, or hospitalization of three or more people from a single occurrence; or property damage in excess of $200,000. Accidents that result in a fatality will be reported within 8 hours to the Department of Labor. In-patient hospitalizations, amputations, or loss of an eye will be reported within 24 hours to the Department of Labor. Subcontractors will be responsible for their reporting to the Department of Labor.

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9. SUPPLEMENTAL PLANS

The SOW listed in Table 2-1 have been evaluated to determine the applicability of plans required by Appendix A of EM 385-1-1. Table 9-1 summarizes the findings of this evaluation and indicates the location of required plans.

Table 9-1. Summary of EM 385-1-1 Plan Evaluation

Plans	Rationale for Inclusion or Exclusion	Location (if included)
Fatigue Management Plan	Work shifts at the site will not exceed 10 hours per day for more than 4 consecutive days; therefore, a Fatigue Management Plan is not required.	Not applicable.
Emergency Plans	Applicable to all operations.	9.1
Plan for Prevention of Alcohol and Drug Abuse	Applicable to all operations.	9.2
Site Sanitation and Housekeeping Plan	Applicable to all operations.	9.3
Blood-Borne Pathogen Program	Applicable to all operations.	9.4
Automatic External Defibrillator Program	Defibrillators are located at the ANG Installations, along with operation instructions.	Not applicable.
Site Layout Plan	Not required under the SOW.	Not applicable.
Access and Haul Road Plan	Not required under the SOW.	Not applicable.
Hearing Conservation Program	Applicable to potentially loud operations.	9.5
Respiratory Protection Plan	Not required under the SOW.	Not applicable.
Health Hazard Control Program	Applicable to all operations.	9.6
Hazard Communication Program	Applicable to operations with hazardous chemicals.	9.7
Process Safety Management Program	Not required under the SOW.	Not applicable.
Lead Compliance Plan	Not required under the SOW.	Not applicable.
Asbestos Abatement Plan	Not required under the SOW.	Not applicable.
Radiation Safety Program	Not required under the SOW.	Not applicable.
Abrasive Blasting Procedures	Not required under the SOW.	Not applicable.
Heat Stress Monitoring Plan	Applicable.	Attachment E
Cold Stress Monitoring Plan	Applicable.	Attachment E
Indoor Air Quality Management	Not required under the SOW.	Not applicable.
Mold Remediation Plan	Not required under the SOW.	Not applicable.
Chromium (VI) Exposure Evaluation	Not required under the SOW.	Not applicable.
Crystalline Silica Evaluation	Not required under the SOW.	Not applicable.
Lighting Plan for Night Operations	Not required under the SOW.	Not applicable.
Traffic Control Plan	Not required under the SOW.	Not applicable.
Fire Prevention Plan	Applicable.	9.8
Wild Land Fire Management Plan	Not required; Installations not prone to wild land fire.	Not applicable.
Arc Flash Hazard Analysis	An arc flash plan is not required.	Not applicable.
Assured Equipment Grounding Control Program	All 120-volt, single phase, 15- and 20-ampere receptacle outlets to be used by EA employees and subcontractors, shall have approved ground fault circuit interrupters for personnel protection, therefore an assured equipment ground control plan is not required.	Not applicable.
Hazardous Energy Control Program and Procedures	Not required under the SOW.	Not applicable.
Standard Pre-Lift Plan – Load Handling Equipment	Not required under the SOW.	Not applicable.

Table 9-1. Summary of EM 385-1-1 Plan Evaluation

Plans	Rationale for Inclusion or Exclusion	Location (if included)
Critical Lift Plan – Load Handling Equipment	Not required under the SOW.	Not applicable.
Naval Architecture Analysis – Load Handling Equipment (Floating)	Not required under the SOW.	Not applicable.
Floating Plant Inspection and Certification	Not required.	Not applicable.
Severe Weather Plan for Marine Activities	Not required.	Not applicable.
Emergency Plan for Marine Activities	Not required.	Not applicable.
Man Overboard/Abandon Ship Activities	Not required.	Not applicable.
Float Plan for Launches, Motorboats, and Skiffs	Not required.	Not applicable.
Fall Protection and Prevention Plan	Not required under the SOW.	Not applicable.
Severe Weather Contingency Plan	Applicable.	Attachment E
Demolition/Renovation Plan	Not required under the SOW.	Not applicable.
Rope Access Work Plan	Not required under the SOW.	Not applicable.
Excavation and Trenching Plan	Not required under the SOW.	Not applicable.
Fire Prevention and Protection Plan for Underground Construction	Not required under the SOW.	Not applicable.
Compressed Air Work Plan for Underground Construction	Not required under the SOW.	Not applicable.
Erection and Removal Plan for Formwork and Shoring	Not required under the SOW.	Not applicable.
Precast Concrete Plan	Not required under the SOW.	Not applicable.
Lift-Slab Plan	Not required under the SOW.	Not applicable.
Masonry Bracing Plan	Not required under the SOW.	Not applicable.
Steel Erection Plan	Not required under the SOW.	Not applicable.
Explosives Safety Site Plan	Not required under the SOW.	Not applicable.
Blasting Plan	Not required under the SOW.	Not applicable.
Dive Operations Plan	Not required under the SOW.	Not applicable.
Safe Practices Manual for Diving Activities	Not required under the SOW.	Not applicable.
Emergency Management Plan for Diving	Not required under the SOW.	Not applicable.
Tree Felling and Maintenance Program	Not required under the SOW.	Not applicable.
Aircraft and Airfield Construction Safety and Phasing Plan	Not required under the SOW.	Not applicable.
Aircraft and Airfield Safety Plan Compliance Document	Not required under the SOW.	Not applicable.
SSHP	Applicable.	Attachment E
Confined Space Entry Procedures	Not required under the SOW.	Not applicable.
Confined Space Program	Not required under the SOW.	Not applicable.

NOTES:
APP = Accident Prevention Plan.
SSHP = Site Safety and Health Plan.
SOW = Scope of work.

9.1 EMERGENCY RESPONSE PLAN

Installation specific Figures and details shall be included in the Installation Specific Addenda. An emergency is defined as a situation that requires calling outside help onto a job site. Field personnel will immediately stop work and report to the Task Manager and SSHO under the following situations:

- Medical emergency
- Fire emergency
- Spill emergency
- Discovery of unanticipated hazards (e.g., drums, heavily contaminated materials, etc.)
- Heavy equipment accident
- Overexposure of personnel to onsite contaminants requiring emergency medical support
- Heat/cold-related injury or heat/cold stress requiring emergency medical support.

9.1.1 Procedures and Tests

Prior to work startup, personnel will be familiar with this Emergency Response Plan. A test of cellular phone coverage will be conducted across the entire work site area prior to mobilization to ensure that emergency services can be alerted in the event of an emergency.

The Task Manager and/or the SSHO will make this plan available for review and photocopying. Emergency telephone numbers and directions to the nearest hospital are presented in this section and will be posted in the APP which is to be maintained in site vehicles. Emergencies will be handled by offsite emergency support personnel, such as the fire department, ambulance squad, or police dependent on the nature of the emergency. Initial response and first aid treatment, however, will be available through trained onsite personnel. In the event of an emergency, the information available at that time will be evaluated and the appropriate steps will be taken to implement the emergency response procedures. The SSHO will assume command of the situation. He or she will call the appropriate emergency services, evacuate personnel to the pre-designated evacuation location as needed, and take other steps necessary to gain control over the emergency.

The following information will be provided when reporting an emergency:

- Name and location of person reporting
- Location of accident/incident
- Name and affiliation of injured party
- Description of injuries, fire, spill, or explosion
- Status of medical aid and/or other emergency control efforts
- Details of chemicals involved
- Summary of accident, including suspected cause and time it occurred
- Temporary control measures taken to minimize further risk.

This information is not to be released to parties other than those listed in this section and emergency response team members. After emergency response agencies have been notified, the PM will be notified immediately.

If a neck or back injury is suspected, the victim will not be moved without medical personnel stabilizing the neck and back in accordance with first aid procedures.

9.1.2 Spill Emergency Response Plan

Emergency response for spills is not in the anticipated scope of services for this project. Spill response materials (e.g., sorbent pads and sorbent materials such as kitty litter) will be kept with EA vehicles if required. Small quantities of fuel may be utilized onsite and have the potential to be spilled.

In case of a hazardous materials emergency, the Task Manager will assume control and direction of the emergency until arrival of the emergency response Incident Commander. The Incident Commander will work with the SSHO and the Regional Safety and Health Coordinator to identify and evaluate hazards. Emergency responders and communications will be coordinated and controlled through the Incident Commander.

Local emergency services will be called to address anything other than small spills. Emergency contact numbers will be included in Installation Specific Addenda to this APP. Small incidental spills which do not cause injury to personnel or the environment will be cleaned as quickly as possible. Waste will be containerized and disposed of properly and labeled accordingly. SDSs, presented in Attachment F, will be reviewed prior to addressing the spill. If the spill is large enough that site evacuation is required, the rally points identified in Emergency Response Plan shall be used. The SSHO will be responsible for identifying if any site personnel did not gather at the rally point.

The SSHO will coordinate first aid efforts if required, prior to arrival of emergency medical support. The Task Manager will notify the EA PM. Although not anticipated at this site, spills involving chemicals which exceed the reportable quantity will require reporting to the appropriate federal, state, and local agencies.

9.1.3 Fire Emergency Response Plan

The Emergency Response Firefighting Plan will be described to site workers by the SSHO as part of the pre-mobilization training. The Corporate Health and Safety Supervisor, EA's designated authority for fire prevention and emergency response, prepares the fire hazard evaluation program, which is reviewed by EA employees during annual training.

As part the plan, the SSHO will evaluate the operations and type(s) of equipment/materials to determine potential fire or explosion hazards and will convey this information to the onsite personnel. Emergency response training will be included in the Installation Specific Addenda to this APP.

A fire and/or explosion will be immediately recognized as an emergency. Emergency services (Fire, Police, and Ambulance) will immediately be notified by the. A copy of the emergency numbers will be included in the site support vehicle. Only persons properly trained in fire suppression and other emergency response procedures will attempt to deal with these situations. Site personnel will not attempt to handle a fire/explosion emergency.

The SSHO will take measures to reduce injury and illness, primarily by evacuating personnel as quickly as possible. The Field Supervisor may assist in this role. The Field Supervisor will then notify the PM. Site personnel will evacuate the area and gather/meet at the determined onsite rally point. If a rally point is required, the rally points identified in Emergency Response Plan shall be used. The SSHO will be responsible for identifying if any site personnel did not gather at the job-site entrance. Should a person be unable to evacuate the area to the site entrance, only emergency service personnel (Fire, Police, and Ambulance) will attempt the rescue the person. Site personnel with current first aid/cardiopulmonary resuscitation (CPR) training will perform first aid and/or CPR on persons needing this level of support. Medical services beyond first aid/CPR will be performed by emergency services personnel (Fire, Police, and Ambulance). Should information or clarification be necessary, emergency service personnel (Fire, Police, and Ambulance) will be directed to speak to the SSHO and the Field Supervisor. If additional information is required, the PM and Health and Safety Manager will be contacted for information.

Cleanup after such events may require specialized services. The PM will establish proper cleanup actions through coordination with the Field Supervisor and emergency services personnel. Site personnel will not resume work during or after a fire/explosion incident until the emergency services coordinator has directed that the incident is over and work may resume. During the incident, site personnel will remain outside the incident area and obey the instructions of the emergency services personnel. Emergency contact numbers will be presented in the Installation Specific Addenda.

9.1.4 Posting of Emergency Telephone Numbers

Emergency telephone numbers will be distributed to site personnel by the SSHO. These copies will be kept in the site support vehicles. The SSHO will always have this emergency numbers on his or her person. Emergency contact numbers will be presented in the Installation Specific Addenda.

9.1.5 Medical Support

Less than 100 personnel will be required onsite to complete this job. Therefore, onsite medical support is not required for this project. However, personnel will be alert for signs and symptoms of illnesses related to chemical, physical, and disease factors onsite. Severe injuries resulting from accidents will be recognized as emergencies and treated as such.

A minimum of two onsite personnel will be trained in administering first aid and CPR. These personnel will be introduced during a pre-entry briefing held prior to initiating site work. Certifications for personnel with current first aid and CPR will be included in the Installation Specific Addenda.

Personnel currently trained in first aid will evaluate the nature of the injury, decontaminate the victim if the victim can be moved safely, and initiate first aid assistance immediately. First aid will be administered to limit further injury and stabilize the victim. The local Emergency Medical Services will be notified immediately if needed. Emergency contact numbers will be presented in the Installation Specific Addenda. Personnel will not transport victims to emergency medical facilities unless the injury does not pose immediate threat to life, and transport to the emergency medical facility can be accomplished without the risk of further injury. Directions and route to the nearest hospital are presented in the Installation Specific Addenda.

First aid equipment will be available in company vehicles. Accident reporting will be performed in accordance with Section 8.

9.2 PLAN FOR PREVENTION OF ALCOHOL AND DRUG ABUSE

EA believes that providing employees with a safe, healthy, and productive environment is essential to delivering quality services to our clients. The presence of illegal or improperly used drugs or other mood-altering substances threatens the attainment of this goal. We support and will take appropriate steps, as described in this policy, to maintain a drug-free work environment.

Our objectives are to maintain business integrity and professionalism within the community and industry at large, to maintain high levels of performance and productivity, and to encourage current employees with substance abuse problems to seek professional assistance.

9.2.1 Policies

Employees are strictly prohibited from any activity related to using, possessing, manufacturing, selling, transporting, distributing, storing, concealing, and/or dispensing any controlled or illegal substances, as defined by federal or state law, on the premises of EA (including, but not limited to, EA offices and laboratories, vehicles, boats, field locations, parking lots, and client-owned or client-controlled property), while conducting EA business (including travel), during EA sponsored activities, or in off-the-job activities. This includes places of public accommodation or recreation, restaurants, and common carriers. Violation of this policy will result in immediate removal from the premises and appropriate disciplinary action, up to and including termination of employment.

Non-authorized use or dispensing of prescription drugs will also constitute a violation of this policy and violators will be subject to disciplinary action, up to and including termination of employment.

The use or possession of alcoholic beverages on company premises, except for authorized social events, is prohibited. Similarly, reporting to work or performing one's job assignments while under the influence of alcohol or other illegal substance is cause for disciplinary action, up to and including termination.

9.2.2 Fitness to Perform Work

As a condition of employment, it is the responsibility of every employee to report to work in appropriate mental and physical condition. It is the responsibility of the employee's Supervisor to determine "fitness for work" and to hold employees accountable for their performance. A Supervisor who has reason to believe that an employee is not "fit-for-work" due to a suspected breach of this policy may require the employee to report to a designated hospital or clinic for a "fitness-for-duty" examination. This examination will be on company time, at company expense, and will include urine and/or blood testing to determine whether drugs or other controlled substances are present in the employee's system. Employees who refuse to submit to a "fitness-for-duty" examination will be deemed to be in violation of this policy, removed from the workplace, and subject to appropriate disciplinary action, up to and including termination of employment. An employee concerned about another employee's "fitness for work" should contact the employee's immediate Supervisor or Corporate Human Resources.

9.2.3 Accountability for Job Performance

EA believes that holding an employee accountable for his or her performance is an important supervisory responsibility. When the use of drugs, alcohol, or other controlled or mood-altering substances interferes with an employee's job performance, the job performance of other employees, or is detrimental to the business, the situation will be dealt with as any other performance problem.

9.2.4 Testing

It is EA's policy not to generally engage in the random drug testing/screening of its employees. However, the extent and criteria under which certain testing may occur shall be based on the following:

- **Pre-Employment**—EA will conduct pre-employment drug screening for job candidates following the candidate's written acceptance of an official offer of employment. EA reserves the right to withdraw its offer of employment to any job candidate who does not test negative or who refuses to submit to the test. Job candidates who fail to test negative will be allowed to reapply for employment with EA after 12 months and must successfully pass the pre-employment drug screen. Results from all pre-employment testing will be treated in a confidential manner and released only on a need-to-know basis.
- **Client Contract**—Employees in specific positions, as designated by EA's contract with a client, may be subject to pre-employment drug screening, and unannounced and/or random substance testing on a periodic basis as required by the client contract. Employees who are subject to such client testing will be made aware of the detailed requirements prior to any testing.

- **Conditional Employment**—After an employee's successful completion of a substance abuse treatment program, a drug screening shall be conducted to provide assurance of continued compliance or as otherwise provided by laws, regulations, or ordinances.
- **Upon Reasonable Suspicion that an Employee may be in Violation of this Policy**—Reasonable suspicion may arise in a variety of ways. These include, but are not limited to, observed physical indications; unusual behavior; a decline in job performance and/or conduct; and/or other circumstances contributing to any accident, injury, or incident occurring on EA's premises (or EA client-owned or controlled premises), while conducting EA business (including travel), or during other EA activities. In the event this serves as the basis for testing, EA's Corporate Health and Safety Supervisor shall be contacted in conjunction with EA's Chief Counsel and Corporate Human Resources.
- **Government-Required Testing**—Workplace drug testing requirements may be altered or changed for those employees whose activities are regulated by guidelines issued by the Departments of Transportation, Energy, or Defense, defense contractors, or other federal, state, or local governmental agencies. Affected employees will be notified of such changes in testing requirements by the PM. Additional notifications are to be forwarded to Corporate Human Resources and the appropriate Contract Administrator within three working days. The EA drug policy statement and drug testing procedures for federally mandated drug testing will be published as a separate document, in accordance with federal regulations.
- **Post-Accident**—EA may require an employee who is involved in any type of job-related accident to take a drug and alcohol screening test to determine whether a breach of this policy may have contributed to the accident. The appropriate Supervisor shall notify Corporate Human Resources or the Corporate Health and Safety Supervisor immediately of accidents/incidents involving employees and/or vehicles. Guidance will be provided by Corporate Human Resources or the Corporate Health and Safety Supervisor to determine if drug and alcohol screening should be performed.

9.2.5 Search

As part of this policy and to prevent the use, possession, sale, distribution, manufacture, or transportation of illegal or controlled substances on EA s premises, employees are advised that they are to have no expectation of privacy with respect to any property brought onto any EA premises and that the following areas are subject to search by a company representative, such as the employee's immediate Supervisor, Business Unit Director/Profit Center Manager, or Corporate Human Resources:

- Any vehicle brought onto company, client-owned, or client-controlled premises (limited to items or possessions in plain view).
- Employee's packages, purse, briefcase, lunch box, or any other container brought onto the premises.

- Any desk, file (including computer files), locker, or other stationery container provided by the company or located on company, client-owned, or client-controlled premises.

Any employee who refuses to consent to or cooperate with a search will be considered to have violated this policy and may be subject to disciplinary action, up to and including termination of employment.

9.2.6 Rehabilitation, Treatment, and Assistance

EA recognizes that substance abuse is treatable and will assist employees experiencing substance abuse problems in obtaining appropriate medical assistance. Employees participating in a rehabilitation program may be eligible for short-term disability benefits, time off without pay, and group insurance benefits to assist in the treatment and rehabilitation process. Specific information can be obtained from Corporate Human Resources. Rehabilitation will not be available to employees found to be in violation of the provision of this policy prohibiting the manufacture, sale, distribution, or transport of drugs or other illegal or controlled substances. Violation of this provision of the policy will result in immediate termination of employment.

9.2.7 Disciplinary Actions

Employees in violation of this policy will be subject to disciplinary action, which may include termination. EA management retains the right to exercise flexibility in the disciplinary process. For example, EA reserves the right to mandate an employee’s active participation in the company’s medical substance abuse program, if applicable. Supervisory personnel and Corporate Human Resources will work together to determine appropriate corrective and/or disciplinary actions.

Employees who voluntarily request rehabilitation services for a substance abuse problem without intervention from EA due to a violation of this policy will not be disciplined for making such a request. Employees determined to be in violation of this policy and who are directed into a rehabilitation program will be subject to periodic drug testing as a condition of continued employment.

9.2.8 Notification of Conviction

Employees are required to notify their Supervisor of any criminal statute conviction within 5 days of the conviction. Failure to notify one’s Supervisor of a criminal conviction may result in disciplinary action up to and including termination of employment.

9.2.9 Cooperation with Law Enforcement Agencies

EA management will cooperate fully with law enforcement agencies in the detection, arrest, and prosecution of any employee involved in illegal drug activity.

9.2.10 Effects on Other Policies

Nothing in this policy grants employees contract rights or changes their status as "at-will" employees. The purpose of this policy is limited to providing information about EA's current practices with regard to alcohol, drugs, and substance abuse. EA may change this policy at its sole discretion with or without prior notice to employees. While EA will endeavor to carefully follow the provisions of this policy, failure to follow this policy by EA or any of its agents shall not give any employee any rights against EA or its agents.

9.2.11 Drug and Substance Abuse Testing Procedures

An employee who is requested to submit a urine specimen, other than as part of a random test, will be required to report to the collection site and provide the specimen immediately. If random testing is required, employees selected for screening will be required to submit a specimen to the collection site within 48 hours of the request, or in accordance with the terms and conditions of the contract.

In most instances, a urine specimen will be collected at a medical facility or in a physician's office. In some cases, trained laboratory personnel may collect the specimen at an EA facility.

Drug testing will be conducted by a laboratory approved by the National Institute of Drug Abuse. Applicants for employment or employees may disclose any prescription drugs to Health Resources that he or she may be taking. The impact of such drugs on the screening process will be determined by the All One-Health Resources Medical Director.

In the event of an accident requiring medical treatment or resulting in injury or property damage, a blood sample may be drawn and tested for blood alcohol level at the discretion of the physician.

The National Institute of Drug Abuse-approved laboratory will use a drug-screening test approved by federal guidelines. When an initial drug screen indicates a positive result, a more sophisticated, confirmation test such as gas chromatograph/mass spectrometry will be conducted.

9.3 SITE SANITATION PLAN

9.3.1 Housekeeping

In general, throughout all work conducted, good housekeeping practices will be conducted in order to maintain safe and sanitary conditions.

9.3.2 Drinking Water

Adequate bottle drinking water will be provided to all site workers and will be stored in designated coolers inside the field trucks. The bottles will be cooled as necessary depending on weather conditions.

9.3.3 Non-Potable Water

All containers used to store non-potable water will be labeled as such.

9.3.4 Toilets

In general, personnel will utilize restroom facilities at each installation. The Installation Specific Addenda will include additional information if installation restroom facilities are not readily available.

9.3.5 Washing Facilities

In general, personnel will utilize hand washing facilities located at each installation. Each vehicle will also be furnished with a bottle of hand sanitizer.

9.3.6 Showers

Shower facilities are not necessary for completion of this statement of work.

9.3.7 Changing Rooms

Changing rooms are not necessary for completion of this statement of work.

9.3.8 Clothes Drying Facilities

Clothes drying facilities are not necessary for completion of this statement of work.

9.3.9 Food Service

Food service will not be provided onsite. Food and beverages will be consumed in areas outside of the work areas.

9.3.10 Waste Disposal

All non-investigation-derived waste (municipal wastes) will be removed from the site in EA vehicles in a timely manner as to not create a health hazard.

9.4 BLOOD-BORNE PATHOGEN PROGRAM AND EXPOSURE CONTROL PLAN

Based on a review of the SOW for the project site, only site personnel providing first aid/CPR will potentially be exposed to blood-borne pathogens. Universal precautions and PPE will be used by providers of first aid/CPR to prevent contact with blood or other potentially infectious materials when working with employees who have an injury or in areas where the injury may have contaminated surfaces.

PPE required for the program will include a breathing barrier, nitrile gloves, masks, and eye protectors. First aid/CPR providers will don the appropriate PPE based on the injury or illness prior to administering first aid and/or CPR. No decontamination of PPE will occur; all PPE will be disposed of. Employees using PPE must wash hands immediately or as soon as feasible after removal of gloves or other PPE. Following any potential exposure mishap employees will wash their hands or skin with soap and water and/or flush mucous membranes with water.

Work areas will be kept clean and sanitary and will be decontaminated after contact with blood/potentially infectious materials with a dilute bleach solution (i.e., 10 percent [minimum] solution of chlorine bleach). The bleach solution will be left in contact with the contaminated work surface for at least 10 minutes prior to cleaning.

Information pertaining to the Hepatitis B vaccination series; post-exposure reporting, evaluation, and follow-up procedures; and recordkeeping practices and requirements are presented in the EA Corporate Blood-Borne Pathogen Exposure Control Plan, which is present online and will be present in site vehicles. Training requirements are presented in Section 6 of this APP.

This site-specific plan will be applied in conjunction with the EA Corporate Blood-Borne Pathogen Exposure Control Plan and OSHA 29 CFR 1910.1030, which will be available for consultation by site employees when necessary. This plan applies to personnel who will potentially be providing first aid/CPR, as the SOW will not expose other site personnel to blood-borne pathogens. OSHA definitions relating to blood-borne pathogens are covered during training.

9.5 HEARING CONSERVATION PROGRAM

EA will evaluate the workplace for noise hazards initially and regularly during the course of work. The hearing conservation program applies to all employees who are exposed to hazardous noise or ototoxic chemicals during work tasks described in Table 2-1.

Workers will be made aware of potential noise hazards prior to the start of tasks with noise hazards. Medical surveillance (Section 6 of the SSHP [Attachment E]) includes pre-employment and end-of-employment testing.

9.5.1 Noise Hazard Identification

Noise measurements shall be made whenever there is difficulty in communicating at distances greater than 2 feet, upon worker complaint of excessive noise, or whenever hazardous noise levels are suspected. Noise assessments and/or measurements shall be performed and documented when any new facility or new equipment is placed in service and when areas that in the past were not noise hazardous become noise hazardous for any reason.

9.5.2 Assessment of Noise Hazards

Workplaces known or suspected to include hazardous noise will be surveyed initially, annually, and whenever site conditions change impacting noise generation. The following will be followed for the assessment of noise hazards:

- For continuous (steady-state) noise and impact (impulse) noise, the instrument settings shall be in accordance with Table 9-3.

- If necessary while in proximity to drilling operations, dosimeters may be used to measure the entire employee's work shift to be considered full-shift sampling.

- Calibration of noise-measuring equipment shall be in accordance with manufacturer's instructions.

Table 9-2. Settings for Noise Measuring Equipment

Feature	Dosimeter (ACGIH)	Dosimeter (Department of Defense and USACE) [(a)]	Type 2 (or better) Sound Level Meter for Continuous Noise (USACE) [(a)]	Type 1 Sound Level Meter for Impulse Noise (USACE) [(a)]
Criterion time	8 hours	8 hours	8 hours	8 hours
Criterion level	85 dBA	85 dBA	85 dBA	85 dBA
Weighting	A	A	A	Unweighted, linear, or Z
Peak weighting	Unweighted	Unweighted, linear, or Z	Unweighted, linear, or Z	Unweighted, linear, or Z
Threshold level	80 dBA	80 dBA	80 dBA	140 dBA
Upper bound on integration	130 dBA	None	None	None
Time weighting	Slow	Slow	Slow	Impulse
Exchange rate	5 dBA	3 dBA	3 dBA	3 dBA

a. When used for the purposes of delineating noise hazardous areas or evaluating noise exposures to personnel.

NOTES:
ACGIH = American Conference of Governmental Industrial Hygienists.
dBA = Decibel.
USACE = U.S. Army Corps of Engineers.

9.5.3 Exposure Standards

Work using heavy equipment often creates excessive noise. Noise can cause workers to be startled, annoyed, or distracted; it can cause physical damage to the ear, pain, and temporary and/or permanent hearing loss; and it can interfere with communication. For impact (impulse) noise, personnel exposures may not exceed 140 decibels (dBA) (unweighted) without effective hearing protection devices.

If workers are subjected to noise exceeding an 8-hour time-weighted average sound level of 85 dBA (decibels on the A-weighted scale), hearing protection will be provided with an appropriate noise reduction rating to comply with 29 CFR 1910.95 and reduce noise levels below 85 dBA. Workers involved in heavy machinery operation activities are likely to be subjected to noise exceeding sound levels of 85 dBA peak sound pressure. At this level, hearing protection will be selected by the SSHO with an appropriate Noise Reduction Rating to reduce noise levels below these values (Table 9-4).

Table 9-3. Non-Department of Defense Continuous Noise Exposures (OSHA Standards)

Duration per day (hours)	Permissible Sound Pressure Level (dBA)
8	85
4	88
2	91
1	94
0.5 = 30 minutes	97
0.25 = 15 minutes	100

NOTES:
dBA = Decibel.

When the daily noise exposure is composed of two or more periods of noise exposure of different levels, the combined effects must be considered. Exposure to different levels for various periods of time shall be computed according to the following formula:

$$Cn = T1 / L1 + T2 / L2 + \ldots + Tx / Lx$$

where

Cn = Combined noise exposure factor.

T = Total time of exposure at a specified sound-pressure level (in hours).

L = Total time of exposure permitted at that level (in hours), from Tables 9-3 or 9-4, as appropriate. If the sum exceeds 1, the mixture of exposure periods exceeds the threshold limit value.

9.5.4 Noise Controls

Hearing protection will be worn whenever noise exposures exceed the standards discussed in this section. PPE specific to hearing protection has been included in SSHP Section 5.1.1.

Noise hazardous areas include all areas where the noise values exceed the standards in this section and will be posted to indicate the presence of hazardous noise levels and the requirements for hearing protection. Equipment identified as noise hazardous will be labeled as a noise hazard requiring the use of hearing protection. If noise hazards impact personnel working in adjacent areas, the individuals in the adjacent areas shall be notified of the noise values and offered hearing protection.

If noise exposure to employees cannot be reduced to below the required standards, operating time limits may be imposed.

9.5.5 Health Hazard Control Program

The presence of hazards will be assessed through identifying work phases and potential physical, chemical, biological, and radiological hazards associated with those work phases. The associated hazards were assessed by the Corporate Health and Safety Supervisor during development of this APP and are described in AHAs included in Attachment A.

Health hazards are minimized through assessing and controlling the hazard through use of engineering controls and PPE. To understand potential hazards associated with each required activity, AHAs are reviewed by onsite personnel prior to performing site tasks.

9.6 HAZARD COMMUNICATION PROGRAM

The purpose of this Hazard Communication Program is to ensure that important information regarding hazardous chemicals used, handled, or stored during the conduct of business is transmitted to employees and other affected persons as appropriate. EAs Hazard Communication Program is in compliance with the Globally Harmonized Hazard Communication Standard.

It is each individual's "Right-To-Know" the chemical identities and chemical hazards with which they are working. When employees have information about the chemicals being used, they can take steps to reduce exposures, substitute less hazardous materials, and establish proper work practices. Through these efforts and the implementation of this plan, the prevalence of chemically related occupational illnesses and injuries will be minimized. Access to chemical hazard information as outlined in this program is fundamental to protecting the safety, health, and welfare of our employees, subcontractors, and other affected persons.

A hazardous chemical means any chemical that is either a physical hazard or health hazard and includes hazardous chemicals generated during work operations. Chemical hazard information will be made available to employees and other affected persons, as appropriate, through the implementation of this comprehensive program which includes container labeling and other forms of warning, the collection and compilation of SDS, and training. A summary of the hazard communication program, as it pertains to this statement of work, is presented as follows.

9.6.1 Chemicals Included in the Hazard Communication Program

The program applies to hazardous chemicals that are known to be present in the workplace and used or stored in such a manner that employees may be exposed under normal conditions of use or in a foreseeable emergency.

It is the responsibility of the Regional Safety and Health Coordinator and the SSHO to ensure that chemical materials meet the provisions of this Hazard Communication Program. If there are any questions regarding the applicability of these program requirements to a particular material or situation, the Corporate Health and Safety Supervisor will be consulted.

For this project, use of chemicals will consist of sample preservation within sample collection bottles, and small quantities (less than 5 gallons) of fuel for generators. Onsite storage or use of other chemicals is not anticipated.

9.6.2 Chemicals and Materials Exempt from the Hazard Communication Program

The following materials are exempt from requirements of the program:

- Hazardous waste as defined by the Resource Conservation and Recovery Act when subject to regulations issued under the United States Environmental Protection Agency (EPA).
- Hazardous substances as defined by Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) when subject to regulations issued under CERCLA by the EPA.
- Tobacco or tobacco products.
- Wood or wood products which will not be processed. Wood treated with a hazardous chemical and wood which may be sawed or cut, generating dust, are covered.
- Articles which are a manufactured item, other than a fluid or particle; which are formed to a specific shape or design during manufacture; which have end use functions dependent in whole or in part upon their shape or design during end use; and which, under normal conditions or use, do not release more than minute or trace amounts of a hazardous chemical and do not pose a physical hazard or health risk to employees.
- Any drug when it is in solid, final form for direct administration such as over-the-counter drugs and first aid supplies.
- Cosmetics.
- Any consumer product or hazardous substance, where it can be demonstrated that it is used in the workplace for the purpose intended by the chemical manufacturer or importer of the product, and the use results in a duration and frequency of exposure which is not greater than the range of exposures that could reasonably be experienced by consumers when used for the purpose intended.
- Nuisance particulate where the chemical manufacturer or importer can establish that they do not pose any physical or health hazard.
- Ionizing and non-ionizing radiation.
- Biological hazards.

9.6.3 Lists of Hazardous Chemicals

The PM and/or the SSHO will develop and maintain the hazardous chemical list for the work being performed under the statement of work. The list of hazardous chemicals will be kept current and updated by the Corporate Health and Safety Supervisor or the Task Manager and/or SSHO. The list will be updated as new hazardous chemicals are brought onsite.

Currently, chemicals anticipated to be used on this project include gasoline to fuel equipment and sample preservatives. Chemicals used for sample preservation (i.e., sulfuric acid) will be located within sample collection bottles that will be stored in coolers located in a secured site support vehicle. Small quantities (less than 5 gallons) of fuel may also be stored temporarily onsite for equipment and generator use during groundwater sampling activities. Onsite storage of chemicals beyond that needed for the immediate task at hand is not anticipated. SDSs are included in Attachment F and will be updated if new chemicals are brought onsite. Attachment F will be updated as needed (i.e., when new hazardous and non-hazardous chemicals/materials are brought onsite).

9.6.4 Labels and Other Forms of Warning

Site personnel will rely upon the original product labels to the extent practical. When labels must be applied to a temporary container, they will be printed in English and contain the following information:

- Identity of the hazardous chemical(s).
- Appropriate hazard warnings (i.e., any words, pictures, symbols, or combination thereof, which provide employees with specific information regarding the physical or health hazard[s] including primary target organ effect[s]).
- The name of the chemical manufacturer, importer, or other responsible party, if appropriate.

Labels and other forms of warning will be legible, in English, and prominently displayed on the container, or readily available in the work area throughout each work shift. If existing labels already contain the required information, new labels are not required.

9.6.5 Alternatives to Labeling, Tagging, or Marking Requirements

Alternatives to the above-referenced labeling, tagging, or marking requirements are described below:

- Signs, placards, process sheets, batch tickets, operating procedures, or other such written materials may be used in lieu of affixing labels to individual stationary process containers, as long as the alternative method identifies the containers to which it is applicable and conveys the marking information required above. The written materials will be readily accessible to employees in their work area throughout each work shift. If this alternative system is utilized, it will be done only with approval of the Corporate Health and Safety Supervisor or the Task Manager and/or SSHO.
- Portable containers into which hazardous chemicals are transferred from labeled containers, and which are intended only for the immediate use of the employee who performs the transfer are not required to be labeled.
- Laboratory-prepared sample collection bottles with sample preservative (30 milliliters or less) will not be labeled with hazard warnings.

9.6.6 Shipping Hazardous Chemicals

Chemical manufacturers, importers, and distributors must ensure that each container of hazardous chemicals leaving their workplace is labeled, tagged, or marked with specific information, including:

- Identity of the hazardous chemical(s) (i.e., chemical name or common name as listed on the Material Safety Data Sheet/Safety Data Sheet [MSDS/SDS]).
- Appropriate hazard warnings (i.e., any words, pictures, symbols, or combination thereof which provide employees with specific information regarding the specific physical or health hazard[s], including primary target organ effect[s]).
- The name and address of the chemical manufacturer, importer, or other responsible party, if appropriate.

In addition to the above, the SSHO will ensure that containers of hazardous chemicals being shipped are marked in a manner which does not conflict with the requirements of the U.S. Department of Transportation.

For the shipment of samples, labeling and MSDS/SDS requirements outlined herein are not required under this Hazard Communication Program. Personnel should follow proper packaging and shipping requirements as established by the U.S. Department of Transportation and/or International Air Transport Association/International Civil Aviation Organization.

9.6.7 Safety Data Sheets

Chemical manufacturers and importers are required to obtain or develop an SDS for each hazardous chemical they produce or import. The SSHO will maintain a copy of the SDS for each hazardous chemical and will ensure that they are readily accessible to employees working with or near the chemical. SDSs for chemicals expected to be used to complete the project are included in Attachment F.

The SSHO, or designee, will inform site workers of the type and location of hazardous chemicals onsite and the location SDSs. The SSHO will be made aware of new chemicals required at the site by the Site Manger, the PM, and/or subcontractors so that site workers are aware of the chemicals, the chemical can be added to the site inventory, and the SDSs can be included in the site files. SDSs will be referenced in the event that there is a spill that requires clean up by site personnel or by emergency responders.

9.6.8 Employee Information and Training

Training and education are an ongoing essential part of this Hazard Communication Program. It is important that employees not only have access to the technical information regarding the chemical hazards in their workplace but they must understand what it says. Training, information, and education are intended to give employees the skills they need to do their jobs in a way that protects their safety, health, and welfare. At a minimum, training will be conducted at the pre-entry briefing and whenever a new physical or health hazard the employees have not previously been trained in is introduced into their work scope. Training will include the following topics:

- Requirements of the Hazard Communication Program for the project
- The location of all hazardous or toxic agents for the project
- Identification and recognition of hazardous or toxic agents for the project
- Physical and health hazards of the hazardous or toxic agents pertinent to project activities
- Protective measures employees can implement when working with project-specific hazardous or toxic agents
- The location and content of the SDS for the chemicals; the content and meaning of the information provided on the SDS.

9.7 FIRE PREVENTION AND PROTECTION PLAN

The possible fire hazards and ignition sources expected at this project site include spark hazards during asphalt removal and repair (metal tools and/or equipment against rock or metal parts contacting each other) and exhaust from vehicles and generators creating enough heat to ignite combustibles (i.e., grass). Open flame work and fuel source fires are not expected for completion of this project work. Site work will be conveyed to local fire and police departments by the SSHO prior to the start of any field activities; however, it is anticipated that a potential fire caused by the fire hazards and ignition sources identified above can be effectively extinguished by site personnel.

Based on a review of the potential hazards associated with the SOW, no unusual fire hazards exist at the sites. Smoking is prohibited at the sites and there are no areas with underground fire hazards. No compressed gas cylinders or Department of Transportation-identified incompatible materials are required for completion of the SOW. No hot work, open flame devices, brush-control, steel-cabinets, insulating materials, disposal of combustible materials, burning operations, use of low-density fiberboard, temporary enclosures, temporary building spacing requirements, or fire lanes are required. Nothing will be placed in an area that will impede fire hydrants and there are no hazardous locations onsite with respect to a Fire Prevention Plan. No combustible materials are required to complete this SOW.

The SSHO, or designee, will ensure that onsite personnel are familiar with the Fire Prevention Plan prior to working onsite, and the Corporate Safety Officer will complete an annual survey of the suitability and effectiveness of fire prevention and protection measures at the site. Records of the survey findings and any recommendations will be retained in the project files.

9.7.1 Fire Prevention

The following guidelines should be practiced to prevent fires:

- Practice good housekeeping, including minimization of combustible materials.
- Designate, post, and enforce the prohibition of smoking, where required.
- Minimize the volume of flammables on hand and store them properly.
- Inspect heat-producing equipment frequently.
- Safeguard open flame operations.
- Keep exits clear.
- Maintain fire alarm and firefighting equipment in good working condition.
- Report potential fire hazards.

9.7.2 Fire Protection Equipment

A fire extinguisher rated to 1-A:10-B:C or higher, will be in vehicles transporting flammable materials. This equipment will not be removed except for inspection and/or use in an emergency. The SSHO will provide training on the use of the fire extinguisher during the pre-entry briefing.

Every fire extinguisher will be visually inspected at the frequency presented in Section 7.

9.8 HEAT/COLD STRESS MONITORING PLAN

A Heat/Cold Stress Monitoring Plan is not required for completion of the statement of work, however safety practices regarding heat/cold stress are addressed in the SSHP (Attachment E).

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10. RISK MANAGEMENT PROCESSES

An assessment of the hazards, training, and equipment required to perform the tasks were completed as part of a risk analysis by corporate health and safety management with input from personnel who have previously performed the tasks. As stated in EM 385-1-1 01.A.13, major activities and SOW to be performed will be covered in an AHA. AHAs will be reviewed with all personnel involved in a task prior to each work activity or phase presenting hazards not experienced in previous project operations.

Upon commencement and throughout the activity, the AHA will be used to verify compliance with the prescribed hazard controls and to note any potential changes in process. The AHAs provide detailed project-specific hazards and controls for each major phase/activity of work. The primary activities and SOW required to complete the SOW are presented in Section 2. AHAs are included in Attachment A.

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11. PERSONAL PROTECTIVE EQUIPMENT

This section describes the anticipated level of PPE for performing the activities associated with this project. The SSHO will periodically evaluate site conditions and based on changes to expected site conditions may recommend modifications to PPE requirements. The SSHO will coordinate all changes with the PM.

Level D PPE is anticipated to be sufficient for the duration of all field activities. The following equipment will be considered mandatory:

- Gloves rated for full protection for the contaminants of concern when sampling water

- Steel-toed boots when working around heavy equipment

- Safety glasses with side shield or face shield when working near heavy equipment or power tools

- Orange traffic vest when working near traffic

- Hearing protection, either ear plugs or earmuffs, when working in with loud power tools.

Used PPE will be placed in trash bags for disposal. Personnel will wash hands before eating. Additional information pertaining to PPE is presented in the SSHP (Attachment E).

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12. ACCIDENT PREVENTION PLAN REVIEW RECORD

Project: PFAS RIs at Multiple Air National Guard Installations

Installation: ____

I have read the Site Safety and Health Plan and Accident Prevention Plan, along with the Installation Specific Addenda, and have been briefed on the nature, level, and degree of exposure likely as a result of participation in this project. I agree to conform to the requirements of this Plan.

Print Name	Signature	Affiliation	Date

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ATTACHMENT A

Activity Hazard Analyses

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ACTIVITY HAZARD ANALYSIS

Activity/Work Task:	**Mobilization and Demobilization**	Overall Risk Assessment Code (RAC) (use highest code from all subtasks):					**M**
Project Location:	Multiple Air National Guard Installations	**Risk Assessment Code (RAC) Matrix**					
Project Number:	6332106		**Probability**				
Date Prepared:	7 December 2020	**Severity**	1 Frequent	2 Likely	3 Occasional	4 Seldom	5 Unlikely
Prepared By:	A. Schroeder	1 Catastrophic	E	E	H	H	M
Reviewed By:	Rob Marcase, Corporate Health and Safety Director	2 Critical	E	H	H	M	L
Competent Person:	SSHO/Field Technician	3 Marginal	H	M	M	L	L
		4 Negligible	M	L	L	L	L

Step 1: Review each "hazard" and determine RAC.
Probability = The likelihood to cause an incident, near miss, or accident. Identified as frequent, likely, occasional, seldom, or unlikely.
Severity = The outcome/degree if an incident, near miss, or accident did occur. Identified as catastrophic, critical, marginal, or negligible.
Step 2: Identify the RAC as E, H, M, or L for each hazard on the AHA. Select the highest RAC and note it at the top of the form.

RAC Chart
E = Extremely High Risk
H = High Risk
M = Moderate Risk
L = Low Risk

TASK BREAKDOWN, HAZARDS, AND CONTROLS

Work Task Steps	Hazards	Controls	RAC Severity/ Probability / RAC
Mobilization and Demobilization	Physical Hazard: Slips, Trips, and Falls	• Keep work area free of excess material and debris. • Remove all trip hazards by keeping materials/objects organized and out of walkways. • Be aware of uneven surfaces while walking around work area. • Wear appropriate PPE, including non-slip rubber boots if working on wet or slick surfaces. • Stay aware of footing and do not run.	3/3/M
Mobilization and Demobilization	Physical Hazard: Material Handling, Moving, Lifting	• Follow proper lifting techniques. • Wear work gloves for materials handling. • Use two or more persons for heavy bulk lifting. • Use mechanical lifting equipment (hand carts, trucks, etc.) to move large awkward loads. • One person will not lift more than 60 pounds.	3/4/L

Work Task Steps	Hazards	Controls	RAC Severity/ Probability / RAC
Mobilization and Demobilization	Physical Hazard: Vehicular	• Utilize cones, signs, flags, and/or other traffic control devices as outlined in the Traffic Control Plan; wherever appropriate, use work truck as a safety shield to protect against traffic risk. • Wear high-visibility apparel (fluorescent yellow-green, fluorescent orange-red, or fluorescent red). Select color to provide highest contrast to the work environment. • If exposed to traffic up to 45 miles per hour, high visibility apparel meeting at minimum ANSI/ISEA Class 2 requirements (e.g. fluorescent shirt or vest with retro reflective material) will be worn. • If exposed to traffic above 45 miles per hour, the SSHO will make a determination as to whether high visibility apparel meeting ANSI/ISEA Class 3 requirements (i.e., fluorescent shirt or vest with retro reflective material and similar shorts, pants, coveralls etc.) will be worn.	2/4/M
Mobilization and Demobilization	Physical Hazard: Heat Stress	• Determine appropriate work schedule (resulting from WBGT readings); take regular breaks. • Have adequate water and electrolyte drinks available. • Designate shaded break areas. • Be aware of symptoms of heat-related illness.	3/4/L
Mobilization and Demobilization	Physical Hazard: Cold Stress	• Wear appropriate clothing to protect skin from wind and cold temperatures. Avoid working in extreme conditions. • Designate warm rest areas. • Be aware of symptoms of cold-related illness.	3/4/L
Mobilization and Demobilization	Physical Hazard: Weather	• Monitor weather conditions online or on the radio using a weather station that is part of the National Oceanic and Atmospheric Administration weather radio network or similar notification system. • If unfavorable weather conditions arise, SSHO and Investigation Manager will evaluate the safety hazards and activities will be halted by the Investigation Manager at the discretion of the SSHO. • Approach and stay upwind of potential sources of vapors.	2/4/M
Mobilization and Demobilization	Physical Hazard: Fire/Explosion	• Ensure type ABC, fully charged fire extinguisher is onsite. • Stop work if hazardous conditions are identified.	1/5/M

Work Task Steps	Hazards	Controls	RAC Severity/ Probability / RAC
Mobilization and Demobilization	Biological Hazards: Insects, Snakes, Wildlife, Vegetation	• Use insect repellant as necessary. • Stay alert and safe distance away from biological hazards. • Inspect work areas when arriving onsite to identify hazards. • Workers with allergies should carry antidote kits, if necessary. • Wash hands, face, and other exposed areas at the beginning of each break and at the end of the workday. If dermal contact occurs, wash the affected area with soap and water immediately. • Wear appropriate PPE including work gloves, long sleeves and pants, and snake chaps if probability of encountering snakes, ticks, or poison ivy is likely. Remove gloves prior to touching exposed areas of the body.	3/3/M

REQUIRED EQUIPMENT, INSPECTION, AND TRAINING:

Equipment	Inspection Requirements	Training Requirements (including Competent Person and Qualified Personnel, if applicable)
• Support vehicle • Level of PPE (initial/upgrade): D • Emergency equipment including first aid kit, eye wash, fire extinguishers • WBGT monitor	• Inspect PPE prior to each use • Inspect vehicle daily • Use appropriate PPE • Inspect emergency equipment/supplies daily (first aid kit, eye wash, fire extinguisher)	• Use and limitations of PPE • APP and AHA review • Valid driver's license • Operation of equipment • Proper lifting • First aid/CPR—at least 2 people on site • Hazardous waste sites require 40-hour HAZWOPER training, annual updates. • SSHO will require 30-hour OSHA Construction Safety Course. • Site Manager will require 8-hour HAZWOPER Supervisor Course

NOTES: AHA = Activity hazard analysis.
APP = Accident Prevention Plan.
ANSI = American National Standards Institute.
CPR = Cardiopulmonary resuscitation.
HAZWPOER = Hazardous Waste Operations and Emergency Response.
ISEA = International Safety Equipment Association.

ACTIVITY HAZARD ANALYSIS

Activity/Work Task:	**COVID-19 Hazard Mitigation**	Overall Risk Assessment Code (RAC) (use highest code from all subtasks):					**M**
Project Location:	Multiple Air National Guard Installations	**Risk Assessment Code (RAC) Matrix**					
Project Number:	6332106		**Probability**				
Date Prepared:	7 December 2020	**Severity**	1 Frequent	2 Likely	3 Occasional	4 Seldom	5 Unlikely
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RAC Chart
E = Extremely High Risk
H = High Risk
M = Moderate Risk
L = Low Risk

TASK BREAKDOWN, HAZARDS, AND CONTROLS:

Work Task Steps	Hazards	Controls	RAC Severity / Probability / RAC
All Tasks	Inhalation of virus from infected individual (symptomatic or asymptomatic) by other individuals	• Remain more than 6 feet from each other, unless necessary to perform job function. • Daily safety tailgate meetings will continue to be held in the warehouse but will be limited to no more than 10 people at a time (breaking up groups and staggering meeting times accordingly). • Maintain social spacing of 6 feet for meetings, with preference for tele-meetings. • Stay outside of individual offices (at doorways) when talking. • Use phones to communicate. • Maintain diligent use of personal protective equipment (PPE) including safety glasses to limit contact with eyes and nitrile gloves. Face shields may be worn for work that cannot be completed without maintaining a distance of 6 feet between individuals.	2/4/M

<table>
<tr><th rowspan="2">Work Task Steps</th><th rowspan="2">Hazards</th><th rowspan="2">Controls</th><th>RAC</th></tr>
<tr><th>Severity / Probability / RAC</th></tr>
<tr><td>All Tasks</td><td>Inhalation of virus from infected individual (symptomatic or asymptomatic) by other individuals</td><td>Staff are discouraged from taking breaks and eating lunch in communal settings where it is difficult to maintain a distance of 6 feet from co-workers. Breaks and lunches should be taken in offices, cubicles or personal vehicles.
Staff are encouraged to practice social distancing when not on the jobsite.
Staff are required to comply with all Federal, State, and local requirements and recommendations.</td><td>2/4/M</td></tr>
<tr><td>All Tasks</td><td>Dermal Contact with contaminated surfaces by individual personnel</td><td>Wash hands often with soap and water for at least 20 seconds especially if in a public place, or after blowing your nose, coughing, or sneezing.
If soap and water are not readily available, use a hand sanitizer that contains at least 60% alcohol. Cover all surfaces of hands and rub them together until they feel dry.
Avoid touching your eyes, nose, and mouth with unwashed hands.</td><td>2/4/M</td></tr>
<tr><td>All Tasks</td><td>Dermal Contact - Contamination on Surfaces</td><td>Clean AND disinfect frequently touched surfaces daily. This includes field equipment, personal mobile phones, vehicle surfaces (steering wheel, door handles, shift stick), tables, doorknobs, light switches, countertops, handles, desks, phones, keyboards, toilets, faucets, and sinks. If surfaces are dirty, clean them: Use detergent or soap and water prior to disinfection. Use disinfectant capable of killing the virus on surfaces including:
Bleach – mix 5 tablespoons (1/3 cup) bleach per gallon of water or 4 teaspoons bleach per quart of water
Alcohol solutions with at least 70% alcohol
Other approved disinfectants listed at https://www.epa.gov/pesticide-registration/list-n-disinfectants-use-against-sars-cov-2
The field office will be professionally cleaned twice weekly, with a focus on sanitizing/disinfecting all commonly touched surfaces such as doors, doorknobs and hardware, handrails, tabletops, windowsills, light switches, toilets, sinks, etc.</td><td>2/4/M</td></tr>
</table>

Work Task Steps	Hazards	Controls	RAC Severity / Probability / RAC

All Tasks	Infected individual(s)/ personnel at work	• The following questions below will be asked of each employee/subcontract employee and any potential site/office visitors to help identify people that should be excluded from office/job site. If an employee or subcontractor answers yes to any of the questions below, he/she will be asked to leave the job site immediately and contact their Supervisor and/or appropriate Human Resources Department for further instruction.
		  ○ Do you currently have fever, chills, a cough, sore throat, or shortness of breath?
		  ○ Have you been in contact with someone who has been medically diagnosed with COVID-19?
		  ○ Have you been in contact with anyone, including family members, who have traveled to any of the known COVID-19 “hotspots” within the last 14 days?
		• The field office will be professionally cleaned if an infected individual is identified onsite, with a focus on sanitizing/disinfecting all commonly touched surfaces such as doors, doorknobs and hardware, handrails, tabletops, windowsills, light switches, toilets, sinks, etc.
			2/4/M

REQUIRED EQUIPMENT, INSPECTION, AND TRAINING

Equipment	Inspection Requirements	Training Requirements (including Competent Person and Qualified Personnel, if applicable)
• Emergency equipment including first aid kit, eye wash, fire extinguishers • Safety glasses, nitrile gloves, face shields • Hand soap or hand sanitizer • Disinfectant	• Inspect emergency equipment/supplies daily (first aid kit, eye wash, fire extinguisher) • Confirm disinfectant is approved to kill COVID-19	All Personnel: • COVID-19 awareness training covering symptoms, routes of transmission, mitigation efforts required

NOTES: AHA = Activity hazard analysis.
PPE = Personal protective equipment.

ACTIVITY HAZARD ANALYSIS

Activity/Work Task:	**Drilling and Well Installation**	Overall Risk Assessment Code (RAC) (use highest code from all subtasks):					**M**
Project Location:	Multiple Air National Guard Installations	**Risk Assessment Code (RAC) Matrix**					
Project Number:	6332106		**Probability**				
Date Prepared:	7 December 2020	**Severity**	1 Frequent	2 Likely	3 Occasional	4 Seldom	5 Unlikely
Prepared By:	A. Schroeder	1 Catastrophic	E	E	H	H	M
Reviewed By:	Rob Marcase, Corporate Health and Safety Director	2 Critical	E	H	H	M	L
Competent Person:	SSHO/Field Technician	3 Marginal	H	M	M	L	L
		4 Negligible	M	L	L	L	L

Step 1: Review each "hazard" and determine RAC. Probability = The likelihood to cause an incident, near miss, or accident. Identified as frequent, likely, occasional, seldom, or unlikely. Severity = The outcome/degree if an incident, near miss, or accident did occur. Identified as catastrophic, critical, marginal, or negligible. Step 2: Identify the RAC as E, H, M, or L for each hazard on the AHA. Select the highest RAC and note it at the top of the form.	RAC Chart E = Extremely High Risk H = High Risk M = Moderate Risk L = Low Risk

TASK BREAKDOWN, HAZARDS, AND CONTROLS:

Work Task Steps	Hazards	Controls	RAC Severity / Probability / RAC
Drilling/Well Installation	Physical Hazard: Slips, Trips, Falls	• Keep work area free of excess material and debris. • Remove all trip hazards by keeping materials/objects organized and out of walkways. • Be aware of uneven surfaces while walking around drilling and well installation locations. • Wear appropriate PPE, including non-slip rubber boots if working on wet or slick surfaces. • Stay aware of footing, and do not run.	3/3/M

Work Task Steps	Hazards	Controls	RAC Severity / Probability / RAC
Drilling/Well Installation	Physical Hazard: Injury from heavy equipment (drill rig and support vehicles).	• Be aware of the location of equipment, wear high visibility safety colors (fluorescent yellow-green, fluorescent orange-red, or fluorescent red), and establish eye contact with operator. • If exposed to traffic up to 45 miles per hour, high visibility apparel meeting at minimum ANSI/ISEA Class 2 requirements (e.g., fluorescent shirt or vest with retro reflective material) will be worn. • Use spotters when moving in/out of nominal clearance areas. • Heavy equipment should be equipped with back-up alarm or use horn when backing. • Be aware of pinch points, swinging chains, augers, etc. • Wear hard hat, steel or composite toed footwear, and safety glasses with side shields when working in proximity of drill rig.	2/4/M
Drilling/Well Installation	Physical Hazard: Faulty or Inappropriate Equipment	• Qualified driller must inspect drill rig and all associated equipment prior to use; if faulty or inappropriate, do not proceed until repaired or replaced. • Inspect all hand tools prior to use; if faulty or inappropriate, do not proceed until repaired or replaced.	2/4/M
Drilling/Well Installation	Physical Hazard: Moving Equipment/Air Rotary Drilling	• Clear area of obstructions and communicate with all workers involved that drilling is beginning. • Do not exceed manufacturer's recommended speed, force, torque, etc. and penetrate the ground slowly with hands on the controls for at least the first foot of soil to minimize chance of auger kick-out. • Stay clear of rotating auger. • Use long-handled shovel to clear away cuttings when auger has stopped. • Secure loose clothing. • Do not walk under suspended loads. • When possible, remove overhead hazards promptly. • Wear appropriate PPE including hard hats, safety glasses with side shields, and steel/composite-toed footwear.	3/4/L

Work Task Steps	Hazards	Controls	RAC Severity / Probability / RAC
Drilling/Well Installation	Physical Hazard: Pressure Washing	• Keep work area clear of debris and organize site to minimize walking distance. • Avoid creating wet walking surfaces that may become slippery. Ensure equipment is not leaking. • Wear appropriate PPE including PVC-dipped gloves, hard hats, face shield in addition to safety glasses with side shields, and steel/composite-toed footwear. • Keep hands and clothing arm's length away from the discharge opening of the nozzle. • Use in accordance with manufacturer guidelines and ensure all manufacturer safety devices are in place. • Work so that high pressure spray is directed away from the body and other personnel. Keep face clear of heater exhaust. • Do not hold equipment that is being cleaned.	3/4/L
Drilling/Well Installation	Physical Hazard: Hearing loss	• Wear appropriate PPE (ear plugs capable of reducing worker noise exposure below an 8-hour TWA of 85 dBA) when working in proximity to drill rig.	3/4/L
Drilling/Well Installation	Physical Hazard: Material Handling, Moving, Lifting	• Follow proper lifting techniques. • Wear work gloves for materials handling. • Use two or more persons for heavy bulk lifting. • Use mechanical lifting equipment (hand carts, trucks, etc.) to move large awkward loads. • One person will not lift more than 60 pounds.	3/4/L

Work Task Steps	Hazards	Controls	RAC Severity / Probability / RAC
Drilling/Well Installation	Physical Hazard: Vehicular	• Utilize cones, signs, flags, and/or other traffic control devices as outlined in the Traffic Control Plan; wherever appropriate, use work truck as a safety shield to protect against traffic risk. • Wear high-visibility apparel (fluorescent yellow-green, fluorescent orange-red, or fluorescent red). Select color to provide highest contrast to the work environment. • If exposed to traffic up to 45 miles per hour, high visibility apparel meeting at minimum ANSI/ISEA Class 2 requirements (e.g. fluorescent shirt or vest with retro reflective material) will be worn. • If exposed to traffic above 45 miles per hour, the SSHO will make a determination as to whether high visibility apparel meeting ANSI/ISEA Class 3 requirements (i.e., fluorescent shirt or vest with retro reflective material and similar shorts, pants, coveralls etc.) will be worn.	2/4/M
Drilling/Well Installation	Physical Hazard: Heat Stress	• Determine appropriate work schedule (resulting from WBGT readings); take regular breaks. • Have adequate water and electrolyte drinks available. • Designate shaded break areas. • Be aware of symptoms of heat-related illness.	3/4/L
Drilling/Well Installation	Physical Hazard: Cold Stress	• Wear appropriate clothing to protect skin from wind and cold temperatures. Avoid working in extreme conditions. • Designate warm rest areas. • Be aware of symptoms of cold-related illness.	3/4/L
Drilling/Well Installation	Physical Hazard: Fire/Explosion	• Ensure type ABC, fully charged fire extinguisher is onsite. • Perform utility clearance to avoid possible gas or utility lines. • Stop work if hazardous conditions are identified.	1/5/M
Drilling/Well Installation	Physical Hazard: Electrical	• Inspect work areas for spark sources, maintain safe distances, and provide barriers to prevent inadvertent contact. • Maintain minimum clearance distances for overhead energized electrical lines. Use a spotter to confirm clearance of overhead lines and other obstructions. • Perform utility clearance to avoid possible buried electrical lines. Interview property owners on location of possible private utilities.	1/5/M

Work Task Steps	Hazards	Controls	RAC Severity / Probability / RAC
Drilling/Well Installation	Physical Hazard: Weather	• Monitor weather conditions online or on the radio using a weather station that is part of the National Oceanic and Atmospheric Administration weather radio network or similar notification system. • If unfavorable weather conditions arise, SSHO and Investigation Manager will evaluate the safety hazards and activities will be halted by the Investigation Manager at the discretion of the SSHO. • Approach from and stay upwind of potential sources of vapors.	2/4/M
Drilling/Well Installation	Chemical Hazard: Exposure to Contaminants of Concern	• Wear safety glasses with side shields and nitrile gloves. • Perform environmental monitoring as per APP/SSHP. • Calibrate instruments prior to use. • Ensure personnel using equipment have been trained on instrument use and site-specific action levels/upgrades. • Position personnel and equipment upwind of sampling activities. • Decontaminate tools and PPE after use. • Wash hands and face.	3/4/L
Drilling/Well Installation	Chemical Hazard: Decontamination Material Handling and Contaminated Media Residue Exposure	• Only those personnel with HAZWOPER training will be allowed to perform equipment decontamination. • Safety data sheets will be maintained onsite for decontamination materials/fluids (e.g., detergents, etc.). • Proper PPE will be required, including nitrile gloves and safety glasses with side shields. If vigorous scrubbing is required (creating a splash hazard) a face shield and/or disposable coverall may be required at the discretion of the SSHO.	3/4/L
Drilling/Well Installation	Biological Hazards: Insects, Snakes, Wildlife, Vegetation	• Use insect repellant as necessary. • Stay alert and safe distance away from biological hazards. • Inspect work areas when arriving onsite to identify hazards. • Workers with allergies should carry antidote kits, if necessary. • Wash hands, face, and other exposed areas at the beginning of each break and at the end of the workday. If dermal contact occurs, wash the affected area with soap and water immediately. • Wear appropriate PPE including work gloves, long sleeves and pants, and snake chaps if probability of encountering snakes, ticks, or poison ivy is likely. Remove gloves prior to touching exposed areas of the body.	3/3/M

Work Task Steps	Hazards	Controls	RAC Severity / Probability / RAC
Drill Rig / Direct Push Relocation / Setup	Physical Hazard: Rig Roll Over	• Do not move rig with mast raised. • Cross all hills and obstructions head on. • Set riggers prior to raising mast.	2/5/L
Drill Rig / Direct Push Relocation / Setup	Physical Hazard: Collision with property or personnel	• Heavy equipment should be equipped with back-up alarm or use horn when backing. • Use spotters when moving in/out of nominal clearance areas.	2/5/L

REQUIRED EQUIPMENT, INSPECTION, AND TRAINING

Equipment	Inspection Requirements	Training Requirements (including Competent Person and Qualified Personnel, if applicable)
• Support vehicle • Level of PPE (initial/upgrade): D/C • Monitoring equipment • Heavy equipment and drill rig • Power tools/hand tools • Emergency equipment including first aid kit, eye wash, fire extinguishers • Pressure washing equipment • Decontamination pad • WBGT monitor	• Inspect PPE prior to each use • Inspect vehicle daily • Calibrate environmental monitoring equipment daily prior to use • Use appropriate PPE • Underground hazards require clearance • Inspect emergency equipment/supplies daily (first aid kit, eye wash, fire extinguisher)	• Use and limitations of PPE • APP and AHA review • Valid driver's license • Operation of equipment • Use of monitoring equipment • Proper lifting • First aid/CPR—at least 2 people onsite • Hazardous waste sites require 40 hour HAZWOPER training, annual updates. • SSHO will require 30-hour OSHA Construction Safety Course. • Site Manager will require 8-hour HAZWOPER Supervisor Course • Drill rig operator (and any other large equipment operator) will be trained in equipment use and maintenance

NOTES:
AHA = Activity hazard analysis.
ANSI = American National Standards Institute.
APP = Accident Prevention Plan.
CPR = Cardiopulmonary resuscitation.
dBA = Decibels.
HAZWOPER = Hazardous Waste Operations and Emergency Response.
ISEA = International Safety Equipment Association.
OSHA = Occupational Safety and Health Administration.
PPE = Personal protective equipment.
PVC = Polyvinyl chloride.
RAC = Risk assessment code.
SSHO = Site Safety and Health Officer.
SSHP = Site Safety and Health Plan.
TWA = Time weighted average.
WBGT = Wet-bulb globe temperature.

ACTIVITY HAZARD ANALYSIS

Activity/Work Task:	**Groundwater Sampling and Well Purging**	Overall Risk Assessment Code (RAC) (use highest code from all subtasks):					**M**
Project Location:	Multiple Air National Guard Installations	**Risk Assessment Code (RAC) Matrix**					
Project Number:	6332106	**Severity**	**Probability**				
Date Prepared:	7 December 2020		1 Frequent	2 Likely	3 Occasional	4 Seldom	5 Unlikely
Prepared By:	A. Schroeder	1 Catastrophic	E	E	H	H	M
Reviewed By:	Rob Marcase, Corporate Health and Safety Director	2 Critical	E	H	H	M	L
Competent Person:	SSHO/Field Technician	3 Marginal	H	M	M	L	L
		4 Negligible	M	L	L	L	L

Step 1: Review each "hazard" and determine RAC. Probability = The likelihood to cause an incident, near miss, or accident. Identified as frequent, likely, occasional, seldom, or unlikely. Severity = The outcome/degree if an incident, near miss, or accident did occur. Identified as catastrophic, critical, marginal, or negligible. Step 2: Identify the RAC as E, H, M, or L for each hazard on the AHA. Select the highest RAC and note it at the top of the form.	RAC Chart E = Extremely High Risk H = High Risk M = Moderate Risk L = Low Risk

TASK BREAKDOWN, HAZARDS, AND CONTROLS:

Work Task Steps	Hazards	Controls	RAC Severity / Probability / RAC
Groundwater Sampling	Physical Hazard: Slips, Trips, Falls	• Keep work area free of excess material and debris. • Remove all trip hazards by keeping materials/objects organized and out of walkways. • Be aware of uneven surfaces while walking around drilling and well installation locations. • Wear appropriate PPE, including non-slip rubber boots if working on wet or slick surfaces. • Stay aware of footing, and do not run.	3/3/M
Groundwater Sampling	Physical Hazard: Heat Stress	• Determine appropriate work schedule (resulting from WBGT readings); take regular breaks. • Have adequate water and electrolyte drinks available. • Designate shaded break areas. • Be aware of symptoms of heat-related illness.	3/4/L

Work Task Steps	Hazards	Controls	RAC Severity / Probability / RAC
Groundwater Sampling	Physical Hazard: Cold Stress	• Wear appropriate clothing to protect skin from wind and cold temperatures. Avoid working in extreme conditions. • Designate warm rest areas. • Be aware of symptoms of cold-related illness.	3/4/L
Groundwater Sampling	Physical Hazard: Weather	• Monitor weather conditions online or on the radio using a weather station that is part of the National Oceanic and Atmospheric Administration weather radio network or similar notification system. • If unfavorable weather conditions arise, SSHO and Investigation Manager will evaluate the safety hazards and activities will be halted by the Investigation Manager at the discretion of the SSHO. • Approach from and stay upwind of potential sources of vapors.	2/4/M
Groundwater Sampling	Chemical Hazards – Exposure to Organic Vapors from Well, Contaminants in Groundwater	• Perform environmental monitoring as required in APP. Where appropriate PPE (including nitrile gloves) as indicated in the site-specific addendum. • Ensure personnel using have been trained on instrument use and site-specific action levels/upgrades. • Calibrate instrument prior to use. • Position personnel and equipment up wind of well.	2/4/M
Groundwater Sampling	Physical Hazard: Hearing loss	• Wear appropriate PPE (ear plugs capable of reducing worker noise exposure below an 8-hour TWA of 85 dBA) when working in proximity to drill rig.	3/4/L
Groundwater Sampling	Physical Hazard: Material Handling, Moving, Lifting	• Follow proper lifting techniques. • Wear work gloves for materials handling. • Use two or more persons for heavy bulk lifting. • Use mechanical lifting equipment (hand carts, trucks, etc.) to move large awkward loads. • One person will not lift more than 60 pounds.	3/4/L

Work Task Steps	Hazards	Controls	RAC Severity / Probability / RAC
Groundwater Sampling	Physical Hazard: Vehicular	• Utilize cones, signs, flags, and/or other traffic control devices as outlined in the Traffic Control Plan; wherever appropriate, use work truck as a safety shield to protect against traffic risk. • Wear high-visibility apparel (fluorescent yellow-green, fluorescent orange-red, or fluorescent red). Select color to provide highest contrast to the work environment. • If exposed to traffic up to 45 miles per hour, high visibility apparel meeting at minimum ANSI/ISEA Class 2 requirements (e.g. fluorescent shirt or vest with retro reflective material) will be worn. • If exposed to traffic above 45 miles per hour, the SSHO will make a determination as to whether high visibility apparel meeting ANSI/ISEA Class 3 requirements (i.e., fluorescent shirt or vest with retro reflective material and similar shorts, pants, coveralls etc.) will be worn.	2/4/M
Groundwater Sampling	Chemical Hazard: Exposure to Contaminants of Concern	• Wear safety glasses with side shields and nitrile gloves. • Perform environmental monitoring as per APP/SSHP. • Calibrate instruments prior to use. • Ensure personnel using equipment have been trained on instrument use and site-specific action levels/upgrades. • Position personnel and equipment upwind of sampling activities. • Decontaminate tools and PPE after use. • Wash hands and face.	3/4/L
Groundwater Sampling	Chemical Hazard: Decontamination Material Handling and Contaminated Media Residue Exposure	• Only those personnel with HAZWOPER training will be allowed to perform equipment decontamination. • Safety data sheets will be maintained onsite for decontamination materials/fluids (e.g., detergents, etc.). • Proper PPE will be required, including nitrile gloves and safety glasses with side shields. If vigorous scrubbing is required (creating a splash hazard) a face shield and/or disposable coverall may be required at the discretion of the SSHO.	3/4/L

Work Task Steps	Hazards	Controls	RAC Severity / Probability / RAC
Groundwater Sampling	Biological Hazards: Insects, Snakes, Wildlife, Vegetation	• Inspect work areas when arriving at a sampling site to identify hazard(s). Specifically, inspect well casing immediately upon opening for stinging insects. • Use insect repellant as necessary. • Stay alert and safe distance away from biological hazards. • Inspect work areas when arriving onsite to identify hazards. • Workers with allergies should carry antidote kits, if necessary. • Wash hands, face, and other exposed areas at the beginning of each break and at the end of the workday. If dermal contact occurs, wash the affected area with soap and water immediately. • Wear appropriate PPE including work gloves, long sleeves and pants, and snake chaps if probability of encountering snakes, ticks, or poison ivy is likely. Remove gloves prior to touching exposed areas of the body.	3/3/M
Well Purging	Physical, Chemical, and Biological Hazards Listed Above, In Addition To Those Listed Below	• Controls as listed above, as well as those listed below.	2/4/M
	Physical Hazard: Hearing loss	• Where appropriate PPE (ear plugs) when working in proximity to air compressor.	3/4/L
	Physical Hazard: Material Handling, Moving, Lifting Accident	• Observe proper lifting techniques. Obey sensible lifting limits (60 lb maximum per person manual lifting). • Use two or more persons for heavy bulk lifting. • Use mechanical lifting equipment (hand carts, trucks, etc.) to move large awkward loads.	3/4/L
	Physical Hazard: Fire	• Ensure type ABC, fully charged fire extinguisher on-site. • Stop work if hazardous conditions are identified.	1/5/M
	Chemical Hazard: Uncontrolled Release of Groundwater	• Ensure tubing discharge pressure is controlled and contained in bucket or drum.	2/4/M

REQUIRED EQUIPMENT, INSPECTION, AND TRAINING

Equipment	Inspection Requirements	Training Requirements (including Competent Person and Qualified Personnel, if applicable)
• Support vehicle • Level of PPE (initial/upgrade): D/C • Monitoring equipment • Heavy equipment and drill rig • Power tools/hand tools • Emergency equipment including first aid kit, eye wash, fire extinguishers • Pressure washing equipment • Decontamination pad • WBGT monitor	• Inspect PPE prior to each use • Inspect vehicle daily • Calibrate environmental monitoring equipment daily prior to use • Use appropriate PPE • Underground hazards require clearance • Inspect emergency equipment/supplies daily (first aid kit, eye wash, fire extinguisher) • Inspect air compressor • Inspect gas cylinders	• Use and limitations of PPE • APP and AHA review • Valid driver’s license • Operation of equipment • Use of monitoring equipment • Proper lifting • First aid/CPR—at least 2 people onsite • Hazardous waste sites require 40 hour HAZWOPER training, annual updates. • SSHO will require 30-hour OSHA Construction Safety Course. • Site Manager will require 8-hour HAZWOPER Supervisor Course

NOTES:

AHA	=	Activity hazard analysis.
ANSI	=	American National Standards Institute.
APP	=	Accident Prevention Plan.
CPR	=	Cardiopulmonary resuscitation.
dBA	=	Decibels.
HAZWOPER	=	Hazardous Waste Operations and Emergency Response.
OSHA	=	Occupational Safety and Health Administration.
PPE	=	Personal protective equipment.
PVC	=	Polyvinyl chloride.
RAC	=	Risk assessment code.
SSHO	=	Site Safety and Health Officer.
SSHP	=	Site Safety and Health Plan.

ACTIVITY HAZARD ANALYSIS

Activity/Work Task:	**Soil Sampling**	Overall Risk Assessment Code (RAC) (use highest code from all subtasks):					**M**
Project Location:	Multiple Air National Guard Installations	**Risk Assessment Code (RAC) Matrix**					
Project Number:	6332106	**Severity**	**Probability**				
Date Prepared:	7 December 2020		1 Frequent	2 Likely	3 Occasional	4 Seldom	5 Unlikely
Prepared By:	A. Schroeder	1 Catastrophic	E	E	H	H	M
Reviewed By:	Rob Marcase, Corporate Health and Safety Director	2 Critical	E	H	H	M	L
Competent Person:	SSHO/Field Technician	3 Marginal	H	M	M	L	L
		4 Negligible	M	L	L	L	L

Step 1: Review each "hazard" and determine RAC. Probability = The likelihood to cause an incident, near miss, or accident. Identified as frequent, likely, occasional, seldom, or unlikely. Severity = The outcome/degree if an incident, near miss, or accident did occur. Identified as catastrophic, critical, marginal, or negligible. Step 2: Identify the RAC as E, H, M, or L for each hazard on the AHA. Select the highest RAC and note it at the top of the form.	RAC Chart E = Extremely High Risk H = High Risk M = Moderate Risk L = Low Risk

TASK BREAKDOWN, HAZARDS, AND CONTROLS:

Work Task Steps	Hazards	Controls	RAC Severity / Probability / RAC
Soil Sampling	Physical Hazard: Slips, Trips, Falls	Keep work area free of excess material and debris. Remove all trip hazards by keeping materials/objects organized and out of walkways. Be aware of uneven surfaces while walking around drilling and well installation locations. Wear appropriate PPE, including non-slip rubber boots if working on wet or slick surfaces. Stay aware of footing, and do not run.	3/3/M
	Physical Hazard: Lifting and Handling of Equipment/Tools	Follow proper lifting techniques. One person will not lift more than 60 pounds. Get assistance or use mechanical aids. Wear leather gloves for materials handling.	3/3/M
Soil Sampling	Chemical Hazard: Exposure to Contaminants of Concern	Wear safety glasses and nitrile gloves Perform environmental monitoring as per APP/SSHP Decontaminate sampling tools and PPE after use Wash hands and face after sampling events	3/4/L

Work Task Steps	Hazards	Controls	RAC Severity / Probability / RAC
Soil Sampling	Physical Hazard: Working Near Water	No one will work alone when collecting surface soil or sediment samples	3/3/M
		If collecting samples from the shore, be alert to site conditions and proximity to water	
		If wading into water is required, one person will stay on shore	
		Wade only into shallow water; be alert for debris, obstructions	
	Physical Hazard: Heat Stress	Determine appropriate work schedule; take regular breaks	3/3/M
		Have adequate water and electrolyte drinks available	
		Designate shaded break areas	
		Be aware of symptoms of heat-related illness	
	Biological Hazards: Insects, Snakes, Wildlife, Vegetation Exposures	Inspect work areas when arriving at a sampling site to identify hazard(s)	3/3/M
		Use insect repellant as necessary	
		Stay alert and safe distance away from biological hazards	
		Wear appropriate PPE including work gloves, long sleeves and pants, and snake chaps if probability of encountering snakes, ticks, poison ivy or oak	
		Workers with allergies should carry antidote kits, if necessary	

REQUIRED EQUIPMENT, INSPECTION, AND TRAINING

Equipment	Inspection Requirements	Training Requirements (including Competent Person and Qualified Personnel, if applicable)
• Support vehicle • PPE • Monitoring equipment • Power tools/hand tools • Emergency equipment including first aid kit, eye wash, fire extinguishers • Respiratory Protection – not required	• Inspect PPE prior to each use • Inspect vehicle daily • Calibrate environmental monitoring equipment daily prior to use. • Use appropriate PPE • Inspect emergency equipment/supplies daily (first aid kit, eye wash, fire extinguisher)	• Use and limitations of PPE • Valid driver's license • Lifting • APP and AHA review • First aid/CPR—at least 2 people on site • Hazardous waste sites require 40-hour HAZWOPER training, annual updates • SSHO will require HAZWOPER 40-hour Worker Training and 30-hour OSHA Construction Safety Course

NOTES:
AHA = Activity hazard analysis.
ANSI = American National Standards Institute.
APP = Accident Prevention Plan.
CPR = Cardiopulmonary resuscitation.
dBA = Decibels.
HAZWOPER = Hazardous Waste Operations and Emergency Response.
OSHA = Occupational Safety and Health Administration.
PPE = Personal protective equipment.
PVC = Polyvinyl chloride.
RAC = Risk assessment code.
SSHO = Site Safety and Health Officer.
SSHP = Site Safety and Health Plan.

ACTIVITY HAZARD ANALYSIS

Activity/Work Task:	**Sediment Sampling**	Overall Risk Assessment Code (RAC) (use highest code from all subtasks):					**M**
Project Location:	Multiple Air National Guard Installations	**Risk Assessment Code (RAC) Matrix**					
Project Number:	6332106	**Severity**	**Probability**				
Date Prepared:	7 December 2020		1 Frequent	2 Likely	3 Occasional	4 Seldom	5 Unlikely
Prepared By:	A. Schroeder	1 Catastrophic	E	E	H	H	M
Reviewed By:	Rob Marcase, Corporate Health and Safety Director	2 Critical	E	H	H	M	L
Competent Person:	SSHO/Field Technician	3 Marginal	H	M	M	L	L
		4 Negligible	M	L	L	L	L

Step 1: Review each "hazard" and determine RAC. Probability = The likelihood to cause an incident, near miss, or accident. Identified as frequent, likely, occasional, seldom, or unlikely. Severity = The outcome/degree if an incident, near miss, or accident did occur. Identified as catastrophic, critical, marginal, or negligible. Step 2: Identify the RAC as E, H, M, or L for each hazard on the AHA. Select the highest RAC and note it at the top of the form.	RAC Chart E = Extremely High Risk H = High Risk M = Moderate Risk L = Low Risk

TASK BREAKDOWN, HAZARDS, AND CONTROLS:

Work Task Steps	Hazards	Controls	RAC Severity / Probability / RAC
Sediment Sampling	Physical Hazard: Slips, Trips, Falls	Keep work area free of excess material and debris.	3/3/M
		Remove all trip hazards by keeping materials/objects organized and out of walkways.	
		Be aware of uneven surfaces while walking around drilling and well installation locations.	
		Wear appropriate PPE, including non-slip rubber boots if working on wet or slick surfaces.	
	Physical Hazard: Lifting and Handling of Equipment/Tools	Follow proper lifting techniques.	3/3/M
		One person will not lift more than 60 pounds.	
		Get assistance or use mechanical aids.	
		Wear leather gloves for materials handling.	
		Wear Kevlar gloves for cut resistance.	
	Chemical Hazard: Exposure to Contaminants of Concern	Wear safety glasses and nitrile gloves	3/4/L
		Decontaminate sampling tools and PPE after use	
		Wash hands and face after sampling events	

Work Task Steps	Hazards	Controls	RAC Severity / Probability / RAC
Sediment Sampling	Physical Hazard: Working Near Water	No one will work alone when collecting surface soil or sediment samples	3/4/L
		If collecting samples from the shore, be alert to site conditions and proximity to water	
		If wading into water is required, one person will stay on shore	
		Wade only into shallow water; be alert for debris, obstructions	
	Physical Hazard: Heat Stress	Determine appropriate work schedule; take regular breaks	3/3/M
		Have adequate water and electrolyte drinks available	
		Designate shaded break areas	
		Be aware of symptoms of heat-related illness	
	Biological Hazards: Insects, Snakes, Wildlife, Vegetation Exposures	Inspect work areas when arriving at a sampling site to identify hazard(s)	3/3/M
		Use insect repellant as necessary	
		Stay alert and safe distance away from biological hazards	
		Wear appropriate PPE including work gloves, long sleeves and pants, and snake chaps if probability of encountering snakes, ticks, poison ivy or oak	
		Workers with allergies should carry antidote kits, if necessary	
	Biological Hazards: Microorganisims	Wear nitrile gloves, safety glasses, and waders Wash PPE after use	4/3/L
		Wash hands and face prior to eating, drinking, or smoking	

REQUIRED EQUIPMENT, INSPECTION, AND TRAINING

Equipment	Inspection Requirements	Training Requirements (including Competent Person and Qualified Personnel, if applicable)
• Support vehicle • PPE • Power tools/hand tools • Emergency equipment including first aid kit, eye wash, fire extinguishers	• Inspect PPE prior to each use • Inspect vehicle daily • Calibrate environmental monitoring equipment daily prior to use. • Use appropriate PPE • Inspect emergency equipment/supplies daily (first aid kit, eye wash, fire extinguisher)	• Use and limitations of PPE • Valid driver's license • Lifting • APP and AHA review • First aid/CPR—at least 2 people on site • Hazardous waste sites require 40-hour HAZWOPER training, annual updates • SSHO will require HAZWOPER 40-hour Worker Training and 30-hour OSHA Construction Safety Course

NOTES:
AHA = Activity hazard analysis.
ANSI = American National Standards Institute.
APP = Accident Prevention Plan.
CPR = Cardiopulmonary resuscitation.
dBA = Decibels.
HAZWOPER = Hazardous Waste Operations and Emergency Response.
OSHA = Occupational Safety and Health Administration.
PPE = Personal protective equipment.
PVC = Polyvinyl chloride.
RAC = Risk assessment code.
SSHO = Site Safety and Health Officer.
SSHP = Site Safety and Health Plan.

ACTIVITY HAZARD ANALYSIS

Activity/Work Task:	**Surface Water Sampling**	Overall Risk Assessment Code (RAC) (use highest code from all subtasks):					**M**
Project Location:	Multiple Air National Guard Installations	**Risk Assessment Code (RAC) Matrix**					
Project Number:	6332106	**Severity**	**Probability**				
Date Prepared:	7 December 2020		1 Frequent	2 Likely	3 Occasional	4 Seldom	5 Unlikely
Prepared By:	A. Schroeder	1 Catastrophic	E	E	H	H	M
Reviewed By:	Rob Marcase, Corporate Health and Safety Director	2 Critical	E	H	H	M	L
Competent Person:	SSHO/Field Technician	3 Marginal	H	M	M	L	L
		4 Negligible	M	L	L	L	L

Step 1: Review each “hazard” and determine RAC. Probability = The likelihood to cause an incident, near miss, or accident. Identified as frequent, likely, occasional, seldom, or unlikely. Severity = The outcome/degree if an incident, near miss, or accident did occur. Identified as catastrophic, critical, marginal, or negligible. Step 2: Identify the RAC as E, H, M, or L for each hazard on the AHA. Select the highest RAC and note it at the top of the form.	<u>RAC Chart</u> E = Extremely High Risk H = High Risk M = Moderate Risk L = Low Risk

TASK BREAKDOWN, HAZARDS, AND CONTROLS:

Work Task Steps	Hazards	Controls	RAC Severity / Probability / RAC
Surface Water Sampling	Physical Hazard: Slips, Trips, Falls	Keep work area free of excess material and debris.	3/3/M
		Remove all trip hazards by keeping materials/objects organized and out of walkways.	
		Be aware of uneven surfaces while walking around drilling and well installation locations.	
		Wear appropriate PPE, including non-slip rubber boots if working on wet or slick surfaces.	
	Physical Hazard: Lifting and Handling of Equipment/Tools	Follow proper lifting techniques.	3/3/M
		One person will not lift more than 60 pounds.	
		Get assistance or use mechanical aids.	
		Wear leather gloves for materials handling.	
		Wear Kevlar gloves for cut resistance.	
	Chemical Hazard: Exposure to Contaminants of Concern	Wear safety glasses and nitrile gloves	3/4/L
		Decontaminate sampling tools and PPE after use	
		Wash hands and face after sampling events	

Work Task Steps	Hazards	Controls	RAC Severity / Probability / RAC
Surface Water Sampling	Physical Hazard: Working Near Water	No one will work alone when collecting surface water samples	3/4/L
		If collecting samples from the shore, be alert to site conditions and proximity to water	
		If wading into water is required, one person will stay on shore	
		Wade only into shallow water; be alert for debris, obstructions	
	Physical Hazard: Heat Stress	Determine appropriate work schedule; take regular breaks	3/3/M
		Have adequate water and electrolyte drinks available	
		Designate shaded break areas	
		Be aware of symptoms of heat-related illness	
	Biological Hazards: Insects, Snakes, Wildlife, Vegetation Exposures	Inspect work areas when arriving at a sampling site to identify hazard(s)	3/3/M
		Use insect repellant as necessary	
		Stay alert and safe distance away from biological hazards	
		Wear appropriate PPE including work gloves, long sleeves and pants, and snake chaps if probability of encountering snakes, ticks, poison ivy or oak	
		Workers with allergies should carry antidote kits, if necessary	
	Biological Hazards: Microorganisims	Wear nitrile gloves, safety glasses, and waders Wash PPE after use	4/3/L
		Wash hands and face prior to eating, drinking, or smoking	

REQUIRED EQUIPMENT, INSPECTION, AND TRAINING

Equipment	Inspection Requirements	Training Requirements (including Competent Person and Qualified Personnel, if applicable)
• Support vehicle • PPE • Power tools/hand tools • Emergency equipment including first aid kit, eye wash, fire extinguishers	• Inspect PPE prior to each use • Inspect vehicle daily • Calibrate environmental monitoring equipment daily prior to use. • Use appropriate PPE • Inspect emergency equipment/supplies daily (first aid kit, eye wash, fire extinguisher)	• Use and limitations of PPE • Lifting • APP and AHA review • First aid/CPR—at least 2 people on site • Hazardous waste sites require 40-hour HAZWOPER training, annual updates • SSHO will require HAZWOPER 40-hour Worker Training and 30-hour OSHA Construction Safety Course

NOTES:
AHA = Activity hazard analysis.
ANSI = American National Standards Institute.
APP = Accident Prevention Plan.
CPR = Cardiopulmonary resuscitation.
dBA = Decibels.
HAZWOPER = Hazardous Waste Operations and Emergency Response.
OSHA = Occupational Safety and Health Administration.
PPE = Personal protective equipment.
PVC = Polyvinyl chloride.
RAC = Risk assessment code.
SSHO = Site Safety and Health Officer.
SSHP = Site Safety and Health Plan.

ACTIVITY HAZARD ANALYSIS

Activity/Work Task:	**IDW Handling**	Overall Risk Assessment Code (RAC) (use highest code from all subtasks):					**M**
Project Location:	Multiple Air National Guard Installations	**Risk Assessment Code (RAC) Matrix**					
Project Number:	6332106		**Probability**				
Date Prepared:	7 December 2020	**Severity**	1 Frequent	2 Likely	3 Occasional	4 Seldom	5 Unlikely
Prepared By:	A. Schroeder	1 Catastrophic	E	E	H	H	M
Reviewed By:	Rob Marcase, Corporate Health and Safety Director	2 Critical	E	H	H	M	L
Competent Person:	SSHO/Field Technician	3 Marginal	H	M	M	L	L
		4 Negligible	M	L	L	L	L

Step 1: Review each "hazard" and determine RAC.
Probability = The likelihood to cause an incident, near miss, or accident. Identified as frequent, likely, occasional, seldom, or unlikely.
Severity = The outcome/degree if an incident, near miss, or accident did occur. Identified as catastrophic, critical, marginal, or negligible.
Step 2: Identify the RAC as E, H, M, or L for each hazard on the AHA. Select the highest RAC and note it at the top of the form.

RAC Chart
E = Extremely High Risk
H = High Risk
M = Moderate Risk
L = Low Risk

TASK BREAKDOWN, HAZARDS, AND CONTROLS:

Work Task Steps	Hazards	Controls	RAC Severity / Probability / RAC
Handling and Accumulation of IDW	Physical Hazard: Slips, Trips, Falls	• Keep work area free of excess material and debris. • Remove all trip hazards by keeping materials/objects organized and out of walkways. • Be aware of uneven surfaces while walking around sampling locations. • Wear appropriate PPE, including non-slip rubber boots if working on wet or slick surfaces. • Stay aware of footing, and do not run.	3/3/M
Handling and Accumulation of IDW	Physical Hazard: Waste Handling, Moving, Lifting	• Do not exceed recommended weight limits for container handling equipment. • Obey sensible lifting limits (60 pound maximum per person manual lifting).	3/4/L
Handling and Accumulation of IDW	Physical Hazard: Heat/Cold Stress	• Take breaks as needed. • Be aware of weather conditions and dress appropriately. • Consume adequate food/beverages. • If possible, adjust work schedule to avoid heat/cold stresses.	3/4/L

Work Task Steps	Hazards	Controls	RAC Severity / Probability / RAC
Handling and Accumulation of IDW	Physical Hazard: Weather	• Monitor radio for up-to-date severe weather forecasts. • Discontinue work during thunderstorms and severe weather events. • Approach and stay upwind of potential sources of vapors.	3/4/L
Handling and Accumulation of IDW	Biological Hazards: Insects, Snakes, Wildlife, Vegetation	• Use insect repellant as necessary. • Stay alert and safe distance away from biological hazards. • Wear appropriate PPE including work gloves, long sleeves and pants, and snake chaps if there is a probability of encountering snakes, ticks, poison ivy, or poison oak.	3/3/M
Handling and Accumulation of IDW/Disposal of IDW	Chemical Hazard: Solid and Liquid IDW	• Only those personnel with HAZWOPER training will be allowed to perform IDW handling. • Perform environmental monitoring with properly calibrated equipment as required in APP. • Transfer of IDW will be performed with equipment that will limit direct contact with IDW (pumps, skid loaders, etc.) when possible. • Transfer of IDW into over pack drums will be performed with appropriate equipment to either lift the drums up and into the over pack containers or safely flip drums into the new over pack drums). • IDW will be properly containerized and/or covered and labeled. • Proper PPE will be required, including nitrile gloves and safety glasses. If open container pouring/transfer of liquid IDW is required (creating a splash hazard) a face shield and/or disposable coverall may be required at the discretion of the SSHO.	3/4/L
Handling and Accumulation of IDW/Disposal of IDW	Physical Hazard: Heavy Equipment/Collision with Property or Personnel	• Heavy equipment should be equipped with back-up alarm or use horn when backing. • Use spotters when moving in/out of nominal clearance areas.	2/5/L

REQUIRED EQUIPMENT, INSPECTION, AND TRAINING:

Equipment	Inspection Requirements	Training Requirements (including Competent Person and Qualified Personnel, if applicable)
• Support vehicle • Monitoring equipment • PPE • Material/drum/overpack drum moving equipment (skid loader, dolly, drum lift, etc.) • Containers/containerization material (drums, overpack drums, polyethylene liners) • Power and hand tools • Emergency equipment including first aid kit, eye wash, fire extinguishers • Water pumps • Respiratory Protection – not required	• Inspect PPE prior to each use • Inspect vehicle and IDW moving/lifting equipment daily • Calibrate environmental monitoring equipment daily prior to use. • Inspect emergency equipment/supplies daily (first aid kit, eye wash, fire extinguisher)	• Use and limitations of PPE • APP and AHA review • Valid driver's license • Operation of equipment (e.g., skid loader) • Use of monitoring equipment • Use and limitations of PPE • Lifting • First aid/CPR—at least 2 people on site • Hazardous waste sites require 40-hour HAZWOPER training, annual updates for any intrusive activities. • SSHO will require HAZWOPER 40-hour Worker Training and 30-hour OSHA Construction Safety Course.

NOTES:
AHA = Activity hazard analysis.
APP = Accident Prevention Plan.
CPR = Cardiopulmonary resuscitation.
HAZWPOER = Hazardous Waste Operations and Emergency Response.
IDW = Investigation-derived waste.
OSHA = Occupational Safety and Health Administration.
PPE = Personal protective equipment.
RAC = Risk assessment code.
SSHO = Site Safety and Health Officer.

ATTACHMENT B

Occupational Safety and Health Administration
3000/300A Forms

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OSHA's Form 300 (Rev. 01/2004)

Log of Work-Related Injuries and Illnesses

Attention: This form contains information relating to employee health and must be used in a manner that protects the confidentiality of employees to the extent possible while the information is being used for

Year 2019

U.S. Department of Labor
Occupational Safety and Health Administration

You must record information about every work-related injury or illness that involves loss of consciousness, restricted work activity or job transfer, days away from work, or medical treatment beyond first aid. You must also record significant work-related injuries and illnesses that are diagnosed by a physician or licensed health care professional. You must also record work-related injuries and illnesses that meet any of the specific recording criteria listed in 29 CFR 1904.8 through 1904.12. Feel free to use two lines for a single case if you need to. You must complete an injury and illness incident report (OSHA Form 301) or equivalent form for each injury or illness recorded on this form. If you're not sure whether a case is recordable, call your local OSHA office for help.

Form approved OMB no. 1218-0176

Establishment name EA Engineering, Science, and Technology, Inc., PBC

City Hunt Valley State Maryland

Identify the person			Describe the case			Classify the case: CHECK ONLY ONE box for each case based on the most serious outcome for that case:				Enter the number of days the injured or ill worker was:		Check the "injury" column or choose one type of illness: (M)					
(A) Case No.	(B)	(C) Job Title (e.g., Welder)	(D) Date of injury or onset of ... (mo./day)	(E) Where the event occurred (e.g. Loading dock north end)	(F) Describe injury or illness, parts of body affected, and object/substance that directly injured or made person ill (e.g. Second degree burns on right forearm from acetylene torch)	Death (G)	Days away from work (H)	Remained at work: Job transfer or (I)	Remained at work: Other record- (J)	Away From Work (days) (K)	On job transfer or restriction (days) (L)	Injury (1)	Skin Disorder (2)	Respiratory Condition (3)	Poisoning (4)	Hearing Loss (5)	All other illnesses (6)
1		geologist	1/2	Syracuse New York office, 269 W. Jefferson St. Syr, NY	cut finger with box cutter trying to separate file folders				x			x					
2		intern	7/10	Jones Falls stream, Stevenson, Maryland	employee got a bug bite and cellulitis ensued on 7/18				x			x					
3		Sr. Env Tech	11/6	fishing in Palmetto Creek, near Deridder, La	fish hook stuck in finger, hospital visit with tetanus shot				x			x					
4		scientist	12/20	106 Lake Street, Port Washington, Wisconsin	put on gloves to carry euipment, developed dermatitis				x				x				
5																	
6																	
7																	
8																	
					Page totals	*0*	*0*	*0*	*4*	*0*	*0*	*3*	*1*	*0*	*0*	*0*	*0*

Be sure to transfer these totals to the Summary page (Form 300A) before you post it.

Injury	Skin Disorder	Respiratory Condition	Poisoning	Hearing Loss	All other illnesses
(1)	(2)	(3)	(4)	(5)	(6)

Public reporting burden for this collection of information is estimated to average 14 minutes per response, including time to review the instruction, search and gather the data needed, and complete and review the collection of information. Persons are not required to respond to the collection of information unless it displays a currently valid OMB control number. If you have any comments about these estimates or any aspects of this data collection, contact: US Department of Labor, OSHA Office of Statistics, Room N-3644, 200 Constitution Ave, NW, Washington, DC 20210. Do not send the completed forms to this office.

OSHA's Form 300A (Rev. 01/2004)
Summary of Work-Related Injuries and Illnesses

Year 2019

U.S. Department of Labor
Occupational Safety and Health Administration

Form approved OMB no. 1218-0176

All establishments covered by Part 1904 must complete this Summary page, even if no injuries or illnesses occurred during the year. Remember to review the Log to verify that the entries are complete

Using the Log, count the individual entries you made for each category. Then write the totals below, making sure you've added the entries from every page of the log. If you had no cases write "0."

Employees former employees, and their representatives have the right to review the OSHA Form 300 in its entirety. They also have limited access to the OSHA Form 301 or its equivalent. See 29 CFR 1904.35, in OSHA's Recordkeeping rule, for further details on the access provisions for these forms.

Number of Cases

Total number of deaths	Total number of cases with days away from work	Total number of cases with job transfer or restriction	Total number of other recordable cases
0	0	0	4
(G)	(H)	(I)	(J)

Number of Days

Total number of days away from work	Total number of days of job transfer or restriction
0	0
(K)	(L)

Injury and Illness Types

Total number of...
(M)

(1) Injury	3	(4) Poisoning	0
(2) Skin Disorder	1	(5) Hearing Loss	0
(3) Respiratory Condition	0	(6) All Other Illnesses	0

Post this Summary page from February 1 to April 30 of the year following the year covered by the form

Public reporting burden for this collection of information is estimated to average 50 minutes per response, including time to review the instruction, search and gather the data needed, and complete and review the collection of information. Persons are not required to respond to the collection of information unless it displays a currently valid OMB control number. If you have any comments about these estimates or any aspects of this data collection, contact: US Department of Labor, OSHA Office of Statistics, Room N-3644, 200 Constitution Ave, NW, Washington, DC 20210. Do not send the completed forms to this office.

Establishment information

Your establishment name EA Engineering, Science, and Technology Inc., PBC

Street 225 Schilling Circle

City Hunt Valley State Maryland Zip 21031

Industry description (e.g., Manufacture of motor truck trailers)
Environmental Remediation and Consulting

Standard Industrial Classification (SIC), if known (e.g., SIC 3715)

__ __ __ __

OR North American Industrial Classification (NAICS), if known (e.g., 336212)

5 6 2 9 1 0

Employment information

Annual average number of employees 535

Total hours worked by all employees last year 1,123,596

Sign here

Knowingly falsifying this document may result in a fine.

I certify that I have examined this document and that to the best of my knowledge the entries are true, accurate, and complete.

Tom D McFarlane
Company executive

President and CEO
Title

410 584-7000
Phone

8-Jan-20
Date

OSHA's Form 300 (Rev. 01/2004)

Log of Work-Related Injuries and Illnesses

Attention: This form contains information relating to employee health and must be used in a manner that protects the confidentiality of employees to the extent possible while the information is being used for

Year 2018

U.S. Department of Labor
Occupational Safety and Health Administration

Form approved OMB no. 1218-0176

You must record information about every work-related injury or illness that involves loss of consciousness, restricted work activity or job transfer, days away from work, or medical treatment beyond first aid. You must also record significant work-related injuries and illnesses that are diagnosed by a physician or licensed health care professional. You must also record work-related injuries and illnesses that meet any of the specific recording criteria listed in 29 CFR 1904.8 through 1904.12. Feel free to use two lines for a single case if you need to. You must complete an injury and illness incident report (OSHA Form 301) or equivalent form for each injury or illness recorded on this form. If you're not sure whether a case is recordable, call your local OSHA office for help.

Establishment name EA Engineering, Science, and Technology, Inc., PBC

City Hunt Valley State Maryland

Identify the person			Describe the case			Classify the case											
						CHECK ONLY ONE box for each case based on the most serious outcome for that case:				Enter the number of days the injured or ill worker was:		Check the "injury" column or choose one type of illness:					
(A) Case No.	(B) Employee's Name	(C) Job Title (e.g., Welder)	(D) Date of injury or onset of illness (mo./day)	(E) Where the event occurred (e.g. Loading dock north end)	(F) Describe injury or illness, parts of body affected, and object/substance that directly injured or made person ill (e.g. Second degree burns on right forearm from acetylene torch)	Death (G)	Days away from work (H)	Remained at work: Job transfer or restriction (I)	Remained at work: Other record-able cases (J)	Away From Work (days) (K)	On job transfer or restriction (days) (L)	(M) Injury (1)	Skin Disorder (2)	Respiratory Condition (3)	Poisoning (4)	Hearing Loss (5)	All other illnesses (6)
1		scientist II	7/25	GWTS field trailer at Kirtland, AFB	laceration to right index finger tip with box cutter			x			14	x					
2		UXO tech II	9/21	Aberdeen Proving Ground Range area	during magnetometer sweep contacted poison ivy				x				x				
					Page totals	0	0	1	1	0	14	1	1	0	0	0	0

Be sure to transfer these totals to the Summary page (Form 300A) before you post it.

Injury (1) Skin Disorder (2) Respiratory Condition (3) Poisoning (4) Hearing Loss (5) All other illnesses (6)

Public reporting burden for this collection of information is estimated to average 14 minutes per response, including time to review the instruction, search and gather the data needed, and complete and review the collection of information. Persons are not required to respond to the collection of information unless it displays a currently valid OMB control number. If you have any comments about these estimates or any aspects of this data collection, contact: US Department of Labor, OSHA Office of Statistics, Room N-3644, 200 Constitution Ave, NW, Washington, DC 20210. Do not send the completed forms to this office.

OSHA's Form 300A (Rev. 01/2004)
Summary of Work-Related Injuries and Illnesses

Year 2018

U.S. Department of Labor
Occupational Safety and Health Administration

Form approved OMB no. 1218-0176

All establishments covered by Part 1904 must complete this Summary page, even if no injuries or illnesses occurred during the year. Remember to review the Log to verify that the entries are complete

Using the Log, count the individual entries you made for each category. Then write the totals below, making sure you've added the entries from every page of the log. If you had no cases write "0."

Employees former employees, and their representatives have the right to review the OSHA Form 300 in its entirety. They also have limited access to the OSHA Form 301 or its equivalent. See 29 CFR 1904.35, in OSHA's Recordkeeping rule, for further details on the access provisions for these forms.

Number of Cases

Total number of deaths	Total number of cases with days away from work	Total number of cases with job transfer or restriction	Total number of other recordable cases
0	0	1	1
(G)	(H)	(I)	(J)

Number of Days

Total number of days away from work	Total number of days of job transfer or restriction
0	14
(K)	(L)

Injury and Illness Types

Total number of...
(M)

(1) Injury	1	(4) Poisoning	0
(2) Skin Disorder	1	(5) Hearing Loss	0
(3) Respiratory Condition	0	(6) All Other Illnesses	0

Establishment information

Your establishment name: EA Engineering, Science, and Technology Inc., PBC

Street: 225 Schilling Circle

City: Hunt Valley State: Maryland Zip: 21031

Industry description (e.g., Manufacture of motor truck trailers): Environmental Remediation and Consulting

Standard Industrial Classification (SIC), if known (e.g., SIC 3715): __ __ __ __

OR North American Industrial Classification (NAICS), if known (e.g., 336212): 5 6 2 9 1 0

Employment information

Annual average number of employees: 511

Total hours worked by all employees last year: 1,062,015

Sign here

Knowingly falsifying this document may result in a fine.

I certify that I have examined this document and that to the best of my knowledge the entries are true, accurate, and complete.

Company executive: [signature] Title: President and CEO

Phone: 410 584-7000 Date: 4-Jan-19

Post this Summary page from February 1 to April 30 of the year following the year covered by the form

OSHA's Form 300 (Rev. 01/2004)

Log of Work-Related Injuries and Illnesses

Attention: This form contains information relating to employee health and must be used in a manner that protects the confidentiality of employees to the extent possible while the information is being used for

Year 2017

U.S. Department of Labor
Occupational Safety and Health Administration

Form approved OMB no. 1218-0176

You must record information about every work-related injury or illness that involves loss of consciousness, restricted work activity or job transfer, days away from work, or medical treatment beyond first aid. You must also record significant work-related injuries and illnesses that are diagnosed by a physician or licensed health care professional. You must also record work-related injuries and illnesses that meet any of the specific recording criteria listed in 29 CFR 1904.8 through 1904.12. Feel free to use two lines for a single case if you need to. You must complete an injury and illness incident report (OSHA Form 301) or equivalent form for each injury or illness recorded on this form. If you're not sure whether a case is recordable, call your local OSHA office for help.

Establishment name EA Engineering, Science, and Technology, Inc., PBC

City Hunt Valley State Maryland

Identify the person			Describe the case			Classify the case: CHECK ONLY ONE box for each case based on the most serious outcome for that case:				Enter the number of days the injured or ill worker was:		Check the "injury" column or choose one type of illness: (M)					
(A) Case No.	(B) Employee's Name	(C) Job Title (e.g., Welder)	(D) Date of injury or onset of illness (mo./day)	(E) Where the event occurred (e.g. Loading dock north end)	(F) Describe injury or illness, parts of body affected, and object/substance that directly injured or made person ill (e.g. Second degree burns on right forearm from acetylene torch)	Death (G)	Days away from work (H)	Remained at work: Job transfer or restriction (I)	Remained at work: Other record- able cases (J)	Away From Work (days) (K)	On job transfer or restriction (days) (L)	Injury (1)	Skin Disorder (2)	Respiratory Condition (3)	Poisoning (4)	Hearing Loss (5)	All other illnesses (6)
1		geologist 1	5/3	Kirtland AFB project , parking lot north of Bullhead park	broken nose from collision with service dog			x			7	x					
2		scientist 1	6/30	Howard County Recs and Parks, Columbia MD	bee sting with allergic reaction and prescription meds				x			x					
3		technician 2	7/10	on the Missouri River near Brownville, NE	employee wiped eye with formalin solution on hands				x			x					
4		project mgr	8/12	FCC, Louisiana - Camp Clairborne	laceration to right ring finger requiring stitches				x			x					
5		technician 3	8/14	Sprague Road Project, Odessa , Texas	sulfuric acid burn to back from faulty pipe connection				x			x					
6		uxo tech	8/24	Joint Base Cape Cod , old K range	pulled shoulder muscle going through thick vegetation				x			x					
7		geologist	8/14	Waugh Chapel Town Center, Maryland	tick bite with bullseye rash - rash not noted until 8/28				x			x					
					Page totals	*0*	*0*	*1*	*6*	*0*	*7*	*7*	*0*	*0*	*0*	*0*	*0*

Be sure to transfer these totals to the Summary page (Form 300A) before you post it.

Injury (1) | Skin Disorder (2) | Respiratory Condition (3) | Poisoning (4) | Hearing Loss (5) | All other illnesses (6)

Public reporting burden for this collection of information is estimated to average 14 minutes per response, including time to review the instruction, search and gather the data needed, and complete and review the collection of information. Persons are not required to respond to the collection of information unless it displays a currently valid OMB control number. If you have any comments about these estimates or any aspects of this data collection, contact: US Department of Labor, OSHA Office of Statistics, Room N-3644, 200 Constitution Ave, NW, Washington, DC 20210. Do not send the completed forms to this office.

OSHA's Form 300A (Rev. 01/2004)

Summary of Work-Related Injuries and Illnesses

Year 2017

U.S. Department of Labor
Occupational Safety and Health Administration

Form approved OMB no. 1218-0176

All establishments covered by Part 1904 must complete this Summary page, even if no injuries or illnesses occurred during the year. Remember to review the Log to verify that the entries are complete

Using the Log, count the individual entries you made for each category. Then write the totals below, making sure you've added the entries from every page of the log. If you had no cases write "0."

Employees former employees, and their representatives have the right to review the OSHA Form 300 in its entirety. They also have limited access to the OSHA Form 301 or its equivalent. See 29 CFR 1904.35, in OSHA's Recordkeeping rule, for further details on the access provisions for these forms.

Number of Cases

Total number of deaths	Total number of cases with days away from work	Total number of cases with job transfer or restriction	Total number of other recordable cases
0	0	1	6
(G)	(H)	(I)	(J)

Number of Days

Total number of days away from work	Total number of days of job transfer or restriction
0	7
(K)	(L)

Injury and Illness Types

Total number of...
(M)

(1) Injury	7	(4) Poisoning	0
(2) Skin Disorder	0	(5) Hearing Loss	0
(3) Respiratory Condition	0	(6) All Other Illnesses	0

Establishment information

Your establishment name: EA Engineering, Science, and Technology Inc., PBC

Street: 225 Schilling Circle

City: Hunt Valley State: Maryland Zip: 21031

Industry description (e.g., Manufacture of motor truck trailers)
Environmental Remediation and Consulting

Standard Industrial Classification (SIC), if known (e.g., SIC 3715)

OR North American Industrial Classification (NAICS), if known (e.g., 336212)
5 6 2 9 1 0

Employment information

Annual average number of employees: 514

Total hours worked by all employees last year: 1,072,638

Sign here

Knowingly falsifying this document may result in a fine.

I certify that I have examined this document and that to the best of my knowledge the entries are true, accurate, and complete.

Company executive: [signature] Title: President and CEO

Phone: 410 584-7000 Date: 8-Jan-18

Post this Summary page from February 1 to April 30 of the year following the year covered by the form

ATTACHMENT C

Resumes and Certifications of Key Personnel

(Will be included with Final Version of this Document)

(Any certification that is set to expire prior to, or during, field activities will be renewed before said expiration date. Onsite files will be amended with current certifications as appropriate.)

1540 *This page intentionally left blank*

ATTACHMENT D

Field and Inspection Forms

1544 *This page intentionally left blank*

TAILGATE SAFETY MEETING

1. Reason for Briefing:

	Daily Safety Briefing		New Site Procedure
	Initial Safety Briefing		New Site Information
	New Task Briefing		Review of Site Information
	Periodic Safety Meeting		Other: (Specify)

2. Personnel Attending:

Name	Signature	Position

Briefing Given By:

3. Topics: (Check All That Apply)

	Site Safety Personnel		Decontamination Procedures
	Site/Work Area Description		Emergency Response/Equipment
	Physical Hazards		On-Site Injuries/Illnesses
	Chemical/Biological Hazards		Reporting Procedures
	Heat/Cold Stress		Directions to Medical Facility
	Work/Support Zones		Drug and Alcohol Policies
	PPE		Medical Monitoring
	Safe Work Practices		Evacuation/Egress Procedures
	Air Monitoring		Communications
	Task Being Performed		Confined Spaces
	OE Precautions		Other:

4. Remarks:

SAFETY INSPECTION REPORT

Site / Location: __________________________ Date: ____/____/____

Type of Inspection: ____ Initial ____ Daily ____ Weekly ____ Other

List Job Function Inspected:____

Inspection List:

Category	Yes	No	NA	Comments
Biological Hazards				
Biting/Stinging insects.				
Poisonous plants (i.e. poison ivy, poison oak, nettles)				
Wildlife				
Work Environment				
Work area clean and orderly.				
Walk surface dry and/or slip-resistant.				
Spilled materials or liquids cleaned immediately.				
Trash in appropriate containers and removed as needed.				
Emergency Planning				
Emergency contacts phone numbers available.				
Emergency routes to hospital available.				
Weather forecast discussed for daily activities. Cold/Heat Stress discussed. Actions to take.				
First Aid kit(s) available.				
Eye wash station available.				
Current certified Fire Extinguisher available.				
Cell phones available.				
PPE				
Required PPE (Hardhats, safety shoes, safety glasses with side shields) worn.				
Safety Vest available and worn when needed.				
Proper dermal protection available for the task and worn.				
Hearing protection available and worn when needed.				
Utilities				
State-Specific Diggers Hotline been contacted.				
Electrical been located. Buried Overhead (Been sheathed if within 10 ft /boom)				
Telephone				
Cable				
Buried water/sewer/gas.				
Vehicle/Pedestrian Traffic				
Lights in proper working order.				
Alarms working properly.				
Internal safety equipment in proper working order. (i.e. safety belts, shoulder harness)				

Deficiency Date:

Deficiency Description:____
____
____

Date of Correction:

Actual Date of Correction:

Re-Inspection Required: ____ Yes ____ No. Date Re-Inspection: ____/____/___

Signature: ____ Onsite SSHO

VISITORS LOG

Project Location: ______________________ **Month of:** _________________________

DATE:	NAME:	AGENCY OR COMPANY:	PURPOSE OF VISIT:	SAFETY BRIEFING:	ESCORT REQ:	TIME IN:	TIME OUT:	REMARKS:

ACCIDENT/LOSS REPORT

This report must be completed by the injured employee or supervisor and faxed to EA Corporate Human Resources **within 24 hours** of any accident. The fax number is: **(410) 771-1780**.

NOTE: Whenever an employee is sent for medical treatment for a work-related injury or illness, Page 4 of this report must accompany that individual to ensure that all invoices/bills/correspondence are sent to Human Resources for timely response.

A. DEMOGRAPHIC INFORMATION

Name of Injured Employee:						
Home Address:						
Home Phone:		Date of Birth:				
Age:		Sex:	M:		F:	
Marital Status:		Hourly Rate:				
Employee Number:		Date of Hire:				
Number of Dependents:						
Employee's Job Title:						
Department Regularly Employed by:						
Was the Employee Injured on the Job:		Yes:	No:			
Primary Language of the Employee						

B. ACCIDENT/INCIDENT INFORMATION

Date of Accident:		Time of Accident:	
Report to Whom:		Name of Supervisor:	
Exact Location Where Accident Occurred (including street, city, state, and county:			
Explain what happened (include what the employee was doing at the time of the accident and how the accident occurred):			
Describe the injury and the specific part(s) of the body affected (e.g., laceration, right hand, third finger)			

Object or Substance that Directly Injured the Employee:			
Number of Days or Hours Employee Usually Works per Week:			
Is the Employee Expected to Lose at Least One Full Day of Work?			
Does the Employee Have a Previous Claim (Yes or No):		If yes, status (Open/Closed):	
Was the Employee Assigned to Restricted Duty (Yes or No)?			

C. ACCIDENT INVESTIGATION INFORMATION (Yes or No)

Was Safety Equipment Provided?		If yes, was it used	
Was an Unsafe Act Being Performed?		If yes, describe:	
Was a Machine Part Involved?		If yes, describe:	
Was the Machine Part Defective?		If yes, in what way?	
Was a Third Party Responsible for the Accident/Incident?		If yes, list name, address, and phone number:	
Was the Accident/Incident Witnessed?		If yes, list name, full address, and phone number:	

D. PROVIDER INFORMATION

Was First Aid Given Onsite (Yes or No)/		If yes, what type of medical treatment was given	
Physician Information (if medical attention was administered)?		Name, full address, and phone number	
Hospital Address		Name, full address, and phone number:	
Was the Employee Hospitalized (Yes or No)?		If yes, on what date?	
Was the Employee Treated as an Out-Patient. Receive Emergency Treatment, or Ambulance Service (Yes or No)?			

Please attach the physician's written Return to Work slip.

NOTE: A physician's Return to Work Slip is required prior to allowing the worker to return to work.

E. AUTOMOBILE ACCIDENT INFORMATION (complete if applicable)

Authority Contacted and Report Number			
EA Employee Vehicle Year, Make, and Model			
V.I.N.		Plate/Tag No.:	

Owner's Name and Address:			
Driver's Name and Address:		Driver's License No.:	
Relation to Insured:			
Describe Damage to Your Property:			
Describe Damage to Other Vehicle or Property:			

Other Driver's Name and Address:	
Other Driver's Phone No.:	
Other Driver's Insurance Company and Phone Number:	
Location of Other Vehicle:	
Name, Address, and Phone No. of Other Injured Parties:	

Witness 1 Name:		Phone No.:	
Address:			
Statement:			
Signature of Witness 1:			

Witness 2 Name:		Phone No.:	
Address:			
Statement:			
Signature of Witness 2:			

F. ACKNOWLEDGEMENT

Name of Supervisor:			
Report Prepared by:		Date Prepared:	

I have read this report and the contents as to how the accident/loss occurred are accurate to the best of my knowledge.

Signature of Injured Employee　　　　Date

I am seeking medical treatment for a work-related injury/illness.

Please forward all bills/invoices/correspondence to:

EA ENGINEERING, SCIENCE, AND TECHNOLOGY, INC.
11019 McCORMICK ROAD
HUNT VALLEY, MARYLAND 21031

ATTENTION: Michele Bailey
HUMAN RESOURCES

(410) 584-7000
(410) 771-1780 (FAX)

"NEAR MISS" INCIDENT REPORT

A "near miss" is a potential hazard or incident that has not resulted in any personal injury or property damage. Unsafe working conditions, unsafe employee work habits, improper use of equipment, or use of malfunctioning equipment have the potential to cause work-related injuries. It is everyone's responsibility to report and correct these potential accidents/incidents immediately.

Please complete this form as a means to report these "near miss" situations.

Department/Location ____________________ Date: __________ Time: __________ a.m. / p.m.

Please check all appropriate conditions:

_______ Unsafe act _______ Unsafe equipment _______ Other
_______ Unsafe condition _______ Unsafe use of equipment

Description of incident or potential hazard ____
____
____
____

Employee Signature ______________________________ Date ____________________

"NEAR MISS" INVESTIGATION

Description of the "Near Miss" Condition ____
____
____

Causes (primary and contributing) ____
____
____

Corrective Action Taken (i.e., remove the hazard; replace, repair, or retrain in the proper procedures for the task)
____

Signed ______________________________ Date Completed ____________________

Form not completed within 4 hours of incident for the following reason(s) ____________________
____
____

______________________________ ____________________
Corporate Health and Safety Officer Date

******Forward to Corporate Health and Safety Officer when completed.******

ATTACHMENT E

Site Safety and Health Plan

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Attachment E
Site Safety and Health Plan
for the
Accident Prevention Plan

Remedial Investigations for PFAS
at Multiple Air National Guard Installations

Joe Foss Field, South Dakota
Truax Field, Wisconsin
Volk Field, Wisconsin

Prepared for:

ANG Readiness Center, NGB/A4VR
3501 Fetchet Avenue
Joint Base Andrews MD 20762-5157

Under Contract to:

U.S. Army Corps of Engineers, Omaha District
1616 Capital Avenue, Suite 9000
Omaha, NE 68102-4901

Prepared by:

EA Engineering, Science, and Technology, Inc., PBC
221 Sun Valley Boulevard, Suite D
Lincoln, NE 68528

December 2021
Contract No. W9128F18D0026, Task Order No. W9128F20F0325
EA Project No. 6332106

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF ACRONYMS

AFFF	Aqueous film-forming foam
AHA	Activity Hazard Analyses
ANG	Air National Guard
ANSI	American National Standards Institute
APP	Accident Prevention Plan
ASSE	American Society of Safety Engineers
°C	Degrees Celsius
CFR	Code of Federal Regulations
CIH	Certified Industrial Hygienist
COCs	Contaminants of Concern
CPR	Cardiopulmonary resuscitation
CSP	Certified Safety Professional
dBA	A-weighted decibels
EA	EA Engineering, Science, and Technology, Inc., PBC
EM	Engineer Manual
°F	Degrees Fahrenheit
HAZWOPER	Hazardous Waste Operations and Emergency Response
NGB/A4VR	National Guard Bureau/Environmental Restoration Branch
OSHA	Occupational Safety and Health Administration
PFAS	Per- and Polyfluoroalkyl Substances
PPE	Personal protective equipment
RI	Remedial Investigation
SOP	Standard Operating Procedures
SSHO	Site Safety and Health Officer
SSHP	Site Safety and Health Plan
TBD	To Be Determined
UFP-QAPP	Uniform Federal Policy Quality Assurance Project Plan
USACE	U.S. Army Corps of Engineers

LIST OF EMERGENCY CONTACTS

The following list of emergency contacts shall be supplemented with the Installation Specific Addenda.

Ambulance	911
Police Department	911
Fire Department	911
Nearest Hospital	TBD
Nearest Urgent Care	TBD
Regional Poison Control	TBD

Directions to Hospital

A map for hospital routes will be provided in the Installation Specific Addenda.

Other Important Emergency Contacts

Title	Name	Phone Number
EA Health and Safety Manager	Peter Garger, CIH, CSP	410-790-6338 (cell)
EA Project Manager	Cybil Boss, P.E.	402-817-7613 (direct)
EA Site Safety and Health Officer	TBD	TBD
Site Manager	TBD	TBD

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1. INTRODUCTION

1.1 PURPOSE

This Site Safety and Health Plan (SSHP) has been prepared to support a Remedial Investigation (RI) for per- and polyfluoroalkyl substances (PFAS) resulting from aqueous film-forming foam (AFFF), non-AFFF, and secondary PFAS releases at multiple Air National Guard (ANG) installations (Figure 1 of the Accident Prevention Plan [APP]).

Work conducted under this contract will be performed in accordance with applicable federal, state, and local safety and occupational health laws and regulations, including Occupational Safety and Health Administration (OSHA) standards (e.g., 29 Code of Federal Regulations [CFR] 1910 and 29 CFR 1926), the United States Army Corps of Engineers (USACE) Safety and Health Requirements Manual (Engineer Manual [EM] 385-1-1, 30 November 2014), and all applicable health and safety procedures of EA Engineering, Science, and Technology, Inc., PBC (EA). The contents of the SSHP are subject to review and revision as new information becomes available.

The procedures and standards in this SSHP are prepared for employees and subcontractors of EA working at ANG installations under this contract. These policies are based on the available current information on potential hazards and contaminants, as identified in previous investigations. Personnel covered by this SSHP must consider newly acquired data or conditions when conducting their work, and must use appropriate, generally accepted practices to safeguard the health of onsite personnel.

1.1.1 Project Description

The site description and project background information, including work activities to be conducted at the site, are included in Section 2 of the APP.

1.1.2 Project Tasks

The scope of work for activities at the installations covered by this SSHP are detailed in Section 2.4 of the APP.

1.2 HEALTH AND SAFETY POLICY

The following basic policies apply to field operations involving hazardous wastes:

1. Personnel assigned to field operations involving hazardous wastes will participate in a medical surveillance program for hazardous waste operations.

2. Only personnel who have been certified and trained through the Federal OSHA Hazardous Waste Operations and Emergency Response (HAZWOPER) (29 CFR 1910.120) will be assigned to both supervise and do work involving hazardous waste or hazardous substances.

3. Compliance with this SSHP, to include subcontractors, will be documented by the Site Safety and Health Supervisor in the master copy of the SSHP.

All EA personnel shall follow the EA Corporate Safety and Health Program Manual.

2. PROJECT ORGANIZATION

2.1 FIELD WORK CHAIN OF COMMAND

Health and safety are everyone's responsibility. However, as with all projects, a significant portion of responsibility resides with the onsite Site Safety and Health Officer (SSHO). Safety responsibility is assigned to all levels of management and all phases of project implementation. EA personnel, identified below, are responsible for implementation of this plan.

2.1.1 Health and Safety Manager

The EA Health and Safety Manager is a Certified Industrial Hygienist (CIH) and Certified Safety Professional (CSP) and is responsible for establishing, implementing, monitoring, and administering the Health and Safety Program. The Health and Safety Manager is responsible for ensuring that the company Health and Safety Program complies with federal, state, and contract specific health and safety requirements, and will approve all amendments to this plan. Mr. Pete Garger, CIH, CSP, is the EA Health and Safety Manager.

2.1.2 Project Manager

The Project Manager is the primary contact with USACE/ National Guard Bureau/Environmental Restoration Branch (NGB/A4VR). The Project Manager is responsible for directing all project related activities in a safe manner, coordinating with the Site Manager, auditing compliance with this SSHP, and reviewing all technical reports and SSHP amendments prepared by the project team. Ms. Cybil Boss is the EA Project Manager.

2.1.3 Site Safety and Health Officer

The SSHO is responsible for aiding the Corporate Health and Safety Supervisor and the Field Technicians in ensuring that field activities are performed safely. The SSHO is responsible for coordinating the Health and Safety Program for all EA personnel involved in onsite activities, and for management of the hazards under their control. The SSHO will maintain health and safety training records for all onsite personnel. The SSHO or his designee will record in a daily logbook the site conditions; any site monitoring activities, personal protective equipment (PPE) used and any upgrading or downgrading of PPE levels, and other site specific or personnel related health and safety information.

The SSHO will additionally provide guidance for onsite health and safety developments, recommend and prepare health and safety plan addenda, and ensure that all personnel, including subcontractors, follow the provisions herein. The SSHO will notify the Project Manager of any dangers that threaten the health or safety of onsite personnel or the surrounding populace and has the authority to stop any operation until the situation is made safe.

During field operations where the SSHO will not be at the site, the SSHO shall designate a qualified individual to be an alternate. The individual will be responsible for ensuring that this plan is followed. The alternate will be responsible for contacting the SSHO if any problem should be encountered.

2.2 SUBCONTRACTORS RESPONSIBILITIES

Field personnel and subcontractors performing work associated with this project are responsible for compliance with all applicable federal, state, and local statutes, ordinances, or regulations regarding health and safety.

Each subcontractor to EA shall prepare a health and safety plan that provides planning equal to this plan or may adopt this plan in lieu of preparation of a separate plan. Regardless of the health and safety plan used, it is the responsibility of the subcontractor to ensure the compliance of its employees to the most stringent approved plan. The subcontractor will identify a lead individual responsible for the health and safety compliance of their employees, lower tier subcontractors, and consultants. This person will be responsible for reporting to the SSHO and demonstrating compliance with the health and safety procedures.

Health and safety issues associated with specific subcontractor activities, methods, and equipment must be provided by the subcontractor and shared with the rest of the field personnel and the SSHO. The forum for disseminating this information includes standard operating procedures (SOPs), pre project health and safety briefings, and daily tailgate meetings.

In conformance with the Department of Labor and Federal OSHA HAZWOPER (29 CFR 1910.120), each subcontractor employee proposed for intrusive onsite activities involving hazardous waste or hazardous substances must participate in a medical monitoring program, have been certified for hazardous waste field work by a licensed Occupational Health physician, and have successfully completed the required HAZWOPER training. All subcontractors are responsible for demonstrating compliance by providing documentation of current health and safety training and medical surveillance for onsite personnel prior to the start of their activities onsite.

2.3 VISITORS

Upon arrival to a site, all visitors will sign in at a pre-arranged location. The SSHO or designee will brief all visitors of the general health and safety requirements and specific requirements related to each task. Visitors will be escorted at all times onsite and will be responsible for compliance with the requirements specified in this SSHP. More specifically, visitors must be participating in a medical monitoring program (or attest that they meet the exclusion requirements of 29 CFR 1910.120) and must be certified for hazardous waste field work by a licensed Occupational Health Physician, if they are to enter the established controlled work site. Visitors must be able to provide documentation of current HAZWOPER health and safety training and medical surveillance, upon request.

3. TRAINING AND MEDICAL SURVEILLANCE

3.1 OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION

All individuals proposed for intrusive onsite activities involving hazardous waste or hazardous substances shall have the 40-hour health and safety training as well as 8-hour updates annually. Before the work begins, the SSHP shall be reviewed and the signature page (Section 12 of the APP) signed and dated stating that the reader understands and complies with the SSHP.

3.2 CARDIOPULMONARY RESUSCITATION/FIRST AID

When a medical facility or physician is not accessible within 5 minutes of an injury to a group of two or more employees for the treatment of injuries, at least two individuals trained in cardiopulmonary resuscitation (CPR) and first aid will be present during site operations. Training shall include Universal Precautions that all human blood and certain body fluids are to be treated as if known to contain Human Immunodeficiency Virus, Hepatitis B virus, and other pathogens, and the use of PPE as described in the Bloodborne Pathogen Standard of 29 CFR 1910.1030. These individuals may perform other duties at the site but shall be immediately available to render first aid if needed.

3.3 MEDICAL SURVEILLANCE

All individuals proposed for intrusive onsite activities involving hazardous waste or hazardous substances shall be enrolled in a Hazardous Waste Medical Surveillance program (annual physicals) as required by the OSHA 29 CFR 1926.65.

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4. HAZARD ANALYSIS

The primary scope of work is described in Section 2 of the APP. Each task has been analyzed to assess the potential chemical, physical, and biological hazards that may be encountered by site personnel and prescribe the proper engineering and/or administrative controls and/or PPE. These controls will ensure that the risks to site personnel safety and health are reduced or eliminated while performing the activities associated with the RI at each installation. The results of the task hazard analysis are documented using a task-specific Activity Hazard Analyses (AHA). An AHA has been developed for each task associated with this RI. The AHAs are provided in Attachment A of the APP.

4.1 CHEMICAL HAZARDS

The potential for exposure to chemical hazards may occur during system operation and sampling. It is anticipated for this project there will be minimal chemical exposure. PFAS compounds are identified contaminants of concern (COC), however field personnel will not ingest water from sampling locations. The anticipated COC concentrations are below direct contact risk.

Dermal contact with these chemical hazards is possible. Dermal protection appropriate for the chemical will be worn when handling or contacting potentially contaminated environmental media (Section 3).

4.1.1 Other Potential Chemical Hazards

The potential for chemical exposure also exists when using hazardous substances to conduct field activities and includes: (1) gasoline and diesel for vehicle and power equipment operation, and (2) decontamination fluids. The Safety Data Sheets for chemicals expected to be used during field activities will be maintained at the site (Attachment F of the APP).

4.1.2 Administrative Controls

All samples and sampling equipment will be kept separate and away from food items. Place food items in coolers marked specifically for food. Do not place food items in coolers used for samples.

4.1.3 Spills

Spills, if they occur, will be contained by controls and cleaned up. All materials will be properly disposed of offsite.

4.2 EQUIPMENT HAZARDS

The use of drilling and subsequent equipment may pose safety hazards to site personnel. If required, drilling equipment work will be conducted only by trained, licensed (as required by state law), and experienced personnel. Gasoline- and diesel-operated equipment (vehicles and equipment) will be re-fueled properly to prevent fire hazards; power will be off, no smoking allowed, and proper dispensing equipment (fire extinguishers nearby and self-locking cans if not filled at a stand-alone commercial gas station or from a truck mounted tank) will be used. When not operational, equipment will be set and locked so that it cannot be activated, released, dropped, etc. Site personnel are prohibited from approaching the gears/belts/pulleys of equipment when the equipment is operating in order to prevent physical harm in the form of abrasions, lacerations, or other physical harm.

Equipment such as pipe cutters or other sharp objects and hand operated power tools may be used during well installation. Site personnel will practice safe handling of hand tools to prevent worker related injuries. Hearing protection will be worn if the use of loud hand tools is required. Hand tools will be inspected prior to use to ensure the tools are not damaged.

4.3 HAND AND POWER TOOLS

Equipment such as pipe cutters or other sharp objects and hand operated power tools may be used during well installation activities. Site personnel will practice safe handling of hand tools to prevent worker related injuries. Hearing protection will be worn if the use of loud hand tools is required. Hand tools will be inspected prior to use to ensure the tools are not damaged.

4.3.1 Use, Inspection, and Maintenance

- Unsafe tools will not be used.
- Impact tools, such as chisels, will be kept free of mushroomed heads.
- Wooden handles will be kept free of splinters or cracks and will be kept tight in the tool.
- Hand and power tools will be used, inspected, and maintained in accordance with the manufacturer's instructions and recommendations and will be used only for the purpose for which it was designed.
- Hand and power tools will be inspected, tested, and determined to be in safe operating condition before use: continued periodic inspections will be made to ensure safe operating condition and proper maintenance.
- Hand and power tools will be in good repair with all required safety devices installed and properly adjusted: tools having defects that will impair their strength or render them unsafe will be removed from service.

4.3.2 Required Safety Measures

- Electric power-operated tools will be double insulated and properly grounded.
- Power tools designed to accommodate guards will be equipped with such guards.

- Portable power-driven circular saws will be equipped with guards above and below the base plate or shoe. When the tool is withdrawn from work, the lower guard will automatically and instantly return to the covering position.

- All hand-held powered drills, tappers, fastener drivers, horizontal, vertical, and angle grinders with wheels greater than 2 inches in diameter, disc sanders, belt sanders, reciprocating saws, saber saws, and other similar operating powered tools shall be equipped with a momentary contact "on-off" control and may have a lock-on control provided that turnoff can be accomplished by a single motion of the same finger or fingers that turn it on.

- All other hand-held powered tools, such as circular saws, chain saws, and percussion tools without positive accessory holding means, shall be equipped with a constant pressure switch that will shut off the power when the pressure is released.

4.3.3 Personal Protective Equipment and Clothing

- Loose and frayed clothing, loose long hair, dangling jewelry (including dangling rings, chains, earrings, and wristwatches) will not be worn while working with power tools.

- Employees using hand and power tools and exposed to the hazard of falling, flying, abrasive, and splashing objects, or exposed to harmful dust, fumes, mists, vapors, or gases will be provided with the PPE necessary to protect them from the hazard (Section 3).

4.4 GENERAL PHYSICAL HAZARDS

Field operations at the installations may include many general physical safety hazards, such as:

- Holes, ditches, etc.

- Precariously positioned objects, which may cause crushing or other injuries

- Noise

- Sharp objects (e.g., nails, metal shards, glass), which may cause cuts, punctures, or other injuries

- Slippery surfaces, posing slip and fall hazards

- Uneven terrain, posing slip, trip, and fall hazards.

Field personnel will look constantly, closely, and carefully for these basic safety hazards and immediately inform the SSHO of conditions that they feel may be hazardous. If hazards are present, these hazards will be recorded by the SSHO, and precautionary measures will be taken to prevent injury. These and additional physical hazards are discussed in the following sections.

4.4.1 Working Surfaces

Weather conditions can also adversely affect working surfaces. Surfaces may also be unleveled and present a variety of tripping hazards. Unstable soil conditions may exist near open excavations and slopes that can attribute to the slip/fall hazard. Work areas, platforms, walkways, scaffolding, and other access ways must be kept free of materials, debris, obstructions or substances such as ice, grease, or mud that could cause the surface to become slick or otherwise hazardous. Awareness of environmental conditions, avoiding unstable soils when possible, not standing near edges of an excavation, and use of safety shoes with deep treaded soles is recommended.

4.4.2 Slip/Trip/Fall Hazards

Work sites will generally be in remote locations, and most areas will have uneven terrain, slippery locations, and other slip/trip/fall hazards. All team members are required to wear American National Standards Institute (ANSI) Z41 approved steel toed footwear and are to take special care in obtaining sure footing and walking slowly, when necessary.

4.4.3 Moving/Lifting Materials

Materials handling at the site will include manually moving/lifting items. Injuries to back and abdominal muscles from improperly lifting of loads are the most common occupational injuries reported. Such injuries can range from relatively mild strains to major, permanently disabling injuries. Before lifting a load (e.g., sample coolers, field equipment), personnel will consider the overall weight, distribution of weight, unwieldiness or awkwardness of the load, distance to be carried, obstacles to be negotiated, site conditions, and visibility. Personnel will lift with their legs, keeping their back straight, keep the load close to their body, not twist while lifting, and not lift more than 50 pounds.

When using equipment to move materials, proper work practices will be followed. Equipment used will be designed for the task to be performed. Equipment will be inspected regularly by the SSHO, and damaged or defective equipment will be removed from service. Planning is critical when handling materials. The SSHO will plan where the materials are to be moved, taking into consideration the current location of such materials and hazards associated with moving them. Routes for moving materials will be clearly outlined, with paths cleared of obstructions so materials may be transported safely.

The item to be lifted will be approached to balance the load evenly. Personnel will lift with their legs, keeping their back straight, keep the load close to their body, not twist while lifting, and not lift more than 50 pounds. Bulky, heavy loads will be handled by at least two people, ensuring that the load is level and evenly distributed between personnel helping to carry it. Carriers will know the destination and path for the load. Risks associated with moving loads are described more fully in the APP and the AHAs; however, items likely moved will be restricted to equipment, supplies, and monitoring equipment.

4.4.4 Heat and Cold Stress

At ambient temperatures above 70 degrees Fahrenheit (°F) (21.1 degrees Celsius [°C]) or below 40°F (4.4°C) heat or cold stress are concerns. Respective sections in this plan should be followed as conditions mandate.

4.4.4.1 Heat Stress

Heat stress hazards can occur even in temperatures not commonly considered "hot" due to the level of physical activity, the level of PPE the worker is wearing, or the physical condition of the worker. Site training will include symptoms of heat-related illnesses and prevention techniques. Personnel will be familiar with the signs and symptoms of heat stress, including the following.

Heat Cramps—Muscle spasms in the abdomen or limbs. Frequent rest periods and fluid intake are appropriate measures to prevent or reduce heat cramps.

Heat Exhaustion—Severe dehydration; pale, clammy skin; profuse sweating; dizziness, light-headedness; slurred speech; rapid pulse; confusion; fainting; fatigue; cool skin; nausea. Affected personnel will be escorted from the site, set in a cool, shaded area, and given fluids slowly.

Heat Stroke—Life-threatening condition occurring when the body's temperature-regulating system improperly functions. Hot dry skin; rapid, deep breathing; lack of perspiration; delirium; high fever (often 106 °F or more), nausea; unconsciousness. Brain damage and/or death may occur, if body temperature is not reduced. Provide fluids, use cooling devices (hose-down or shower), call emergency medical services or transport to hospital immediately.

Heat stress prevention techniques include:

- Resting frequently in a shaded or airconditioned area.
- Allowing personnel who are not acclimatized to take additional breaks.
- Drink at least 8 ounces of water or diluted Gatorade every 15–20 minutes.
- Monitoring personnel on a periodic basis as described below.

Heat stress monitoring will be conducted in a manner that anticipates and prevents the onset of heat stress symptoms (i.e., work-rest regimens). The radial pulse of each worker will be counted by the SSHO during a 30-second period as early as possible during the rest period immediately following work activities. If the heart rate exceeds 110 beats per minute at the beginning of the rest period, the next work cycle will be shortened by one-third and the rest period will be maintained. If the heart rate still exceeds 110 beats per minute at the next rest period, the following work cycle will be shortened by another one-third. When ambient temperatures are expected to exceed 75 °F, the resting heart rate of each worker will be measured prior to the start of onsite activities.

The suggested frequency for physiological monitoring is provided in Table 4-1.

Table 4-1. Suggested Frequency of Physiological Monitoring for Fit and Acclimatized Personnel

Adjusted Temperature (°F)		Monitoring Interval (Minutes of Work)
90	Above 90	45
87.5	90	60
82.5	87.5	90
77.5	82.5	120
72.5	77.5	150

Assumes work levels of 250 kilocalories/hour (e.g., a moderate work level). Consider increasing the frequency for heavier work rates.

Adjusted Air Temperature: Calculate the adjusted air temperature by using this equation:
Adjusted Temperature(°F) = *Air Temperature*(°F) + ([*13*] × [*% sunshine*]).

Measure the air temperature with a standard thermometer, with the bulb shielded from radiant heat. Estimate the percent sunshine by judging what percent time the sun is not covered by clouds that are thick enough to produce a shadow.
100% sunshine = no cloud cover and a sharp, distinct shadow.
0% sunshine = cloud cover and no shadows.

For the purpose of this table, a normal work ensemble consists of cotton coveralls or other cotton clothing with long sleeves and pants.

Adapted from: National Institute for Occupational Safety and Health/ Occupational Safety and Health Administration/U.S. Coast Guard/U.S. Environmental Protection Agency Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities, Chapter 8 (1985).

The suggested and work-rest regimen is provided in Table 4-2.

Table 4-2. Suggested Work-Rest Regimen

Ambient Temperature (°F)	Work Period (Hours)	Rest Period (Minutes)
70	3.0	15
75	2.5	15
80	2.0	15
85	1.5	15
90	1.0	15
95	0.5	15

Other factors, such as a worker’s level of acclimation, level of physical fitness, and age, may increase or decrease his/her susceptibility to heat stress. Before assigning a task to an individual worker, these factors will be taken into account to ensure that the task will not endanger the worker’s health. Sunscreen lotions will be provided and used per manufacturer’s recommendations.

If a heat-related illness is suspected or observed, the affected person will be moved to a cool or shaded area and given plenty of liquids to consume. If symptoms of a heat stroke are observed, the victim will be cooled and site personnel will immediately call 911.

4.4.4.2 Cold Stress

Cold stress hazards are most likely to occur at low temperatures or low wind chill factors, with wet, windy conditions contributing to risk. As temperatures could fluctuate during these events, personnel will be trained in signs and symptoms of cold stress and controls. Personnel will be familiar with the signs and symptoms of cold stress, which include:

- ***Hypothermia***—Cold-induced decreasing of the core body temperature that produces shivering, numbness, drowsiness, and muscular weakness. If severe enough, it can lead to unconsciousness and death.

- ***Frostbite***—Constriction of blood vessels in the extremities, decreasing the supply of warming blood may result in formation of ice crystals in the tissues, causing tissue damage. Condition may range from frostnip, which is a numbing of extremities, to deep-freezing tissue beneath the skin. Symptoms include white or grayish skin, blisters, numbness, mental confusion, failing eyesight, fainting, shock, and cessation of breathing. Death may occur from heart failure.

Pain in the extremities may be the first warning of cold stress and precautions will be taken to reduce exposure. Maximum severe shivering will be taken as a sign of immediate danger to the worker and exposure to cold will be immediately terminated. Personnel exhibiting signs and symptoms of cold stress will be removed from the site and given appropriate first aid. Emergency medical services will be contacted if symptoms are severe (e.g., more than numbness of the extremities or shivering). Employees will not be immersed in water.

As a precautionary measure, employees will wear layers of loose-fitting clothing including insulated coveralls, head cover, gloves, and boots when temperatures fall below 40 °F. Protection of the hands, feet, and head is particularly important because these are likely to be injured first by cold. However, actual injury to hands, feet, and head is not likely to occur without prior development of early signs of hypothermia such as numbing and shivering. Bare skin contact with cold surfaces (below 32 °F) will be avoided. No continuous exposure to cold is permitted when the air speed and temperature results in an equivalent chill temperature of 26 ºF or less. The equivalent chill temperature will be determined by using the wind chill temperature shown in Table 2-3. Warm rest areas (support vehicles) will be provided. Air temperature and wind speed will be monitored at least every 4 hours at air temperatures below 45 ºF.

Table 4-3. Wind Chill Temperature

Air Temperature (ºF)	Wind Speed (miles per hour)										
	0	5	10	15	20	25	30	35	40	45	50
40	40	36	34	32	30	29	28	28	27	26	26
35	35	31	27	25	24	23	22	21	20	19	19
30	30	25	21	19	17	16	15	14	13	12	12
25	25	19	15	13	11	9	8	7	6	5	4
20	20	13	9	6	4	3	1	0	-1	-2	-3
15	15	7	3	0	-2	-4	-5	-7	-8	-9	-10
10	10	1	-4	-7	-9	-11	-12	-14	-15	-16	-17
5	5	-5	-10	-13	-15	-17	-19	-21	-22	-23	-24
0	0	-11	-16	-19	-22	-24	-26	-27	-29	-30	-31
-5	-5	-16	-22	-26	-29	-31	-33	-34	-36	-37	-38
-10	-10	-22	-28	-32	-35	-37	-39	-41	-43	-44	-45
-15	-15	-28	-35	-39	-42	-44	-46	-48	-50	-51	-52
-20	-20	-34	-41	-45	-48	-51	-53	-55	-57	-58	-60
-25	-25	-40	-47	-51	-55	-58	-60	-62	-64	-65	-67
-30	-30	-46	-53	-58	-61	-64	-67	-69	-71	-72	-74
-35	-35	-52	-59	-64	-68	-71	-73	-76	-78	-79	-81
-40	-40	-57	-66	-71	-74	-78	-80	-82	-84	-86	-88
-45	-45	-63	-72	-77	-81	-84	-87	-89	-91	-93	-95

Green	**LITTLE DANGER** (frostbite occurs in >2 hours in dry, exposed skin)
Yellow	**INCREASED DANGER** (frostbite could occur in 45 minutes or less in dry, exposed skin)
Red	**GREAT DANGER** (frostbite could occur in 5 minutes or less in dry, exposed skin)

Adapted from: Sustaining Health and Performance in Cold Weather Operations: U.S. Army Research Institute of Environmental Medicine. October 2001.

4.4.5 Noise Hazards

Noise hazards are addressed in section 9.5 of the APP.

4.4.6 Utilities

The Project Manager and SSHO will be responsible for ensuring that the utility locating service has completed a utility marking for the site prior to site intrusive work. These markings show an estimated location of underground installations, including sewer, telephone, fuel, electric, water lines or other underground installations that reasonably may be expected to be encountered during intrusive work. Site maps will also be utilized when available to note underground hazards.

Underground utilities pose hazards to personnel involved in intrusive operations. These hazards include electrical hazards, explosion, and asphyxiation, as well as costly and annoying hazards associated with damaging communication, sewer, and water lines. Prior to commencement of intrusive operations, underground utilities, including buried wires, pipes, tanks, etc., will be visibly marked with flags or marking paint to alert personnel to areas unsafe for digging/excavating. Personnel will be aware that although an area may be “cleared,” unanticipated hazards may occur. Intrusive subsurface work will be located at least 3 feet from utility markings.

4.5 FIRE/EXPLOSION HAZARDS

Section 9.8 in the APP discusses the Fire Prevention and Protection Plan and the associated fire and explosion hazards.

4.6 VEHICLE AND PEDESTRIAN HAZARDS

Motor vehicles must always be driven in a safe manner, which includes strictly obeying posted speed limits and using defensive driving skills.

During rainy weather, off-road trails can become slippery or muddy, and off-road driving can be dangerous. Those unfamiliar with off-road vehicle operation should practice in a supervised, safe location.

Traffic within certain areas of the site, particularly active locations in busy areas, may present a hazard to site personnel. Mobile equipment will be located in an area that does not present hazards to bystanders. Barriers will be used to separate the work areas from both vehicle and pedestrian traffic areas, and to prevent inadvertent entry of either type of traffic into the work area. Barriers demarcating the work area required even if the site is inactive during work operations.

Employees exposed to vehicular traffic will be provided with, and will wear, warning vests or other suitable high visibility clothing meeting at minimum ANSI/International Safety Equipment Association Class 2 requirements (e.g., fluorescent shirt or vest with retro-reflective material).

4.7 WEATHER HAZARDS

It is not anticipated that frequent inclement weather will be encountered by site personnel. Most site activities can continue through extremes in temperature and light rain. The SSHO will monitor weather conditions using a weather station that is part of the National Oceanic and Atmospheric Administration weather radio network at least two times per day. To safely mitigate the hazards from severe weather (i.e., heavy rains, electrical storms, or heavy snowfall) site personnel (including the SSHO) will also look for indications, or triggers, of impending severe weather (e.g., changes in wind direction, cloud formation, or humidity).

If weather conditions are to the point of causing unacceptable safety hazards (i.e., lightening, vision impairment, footing becomes slippery and difficult, icy working surfaces, or attention of the crew is distracted from the task at hand), work will be stopped. The SSHO will be responsible for evaluating and stopping work, as necessary and informing the office if the delays are anticipated to be significant. If severe weather is likely, based on weather review, site personnel will retreat to their support vehicle(s). The SSHO will monitor weather conditions, and activity will not resume for 30 minutes following cessation of severe weather (i.e., the last visible flash of lightning). Training on severe weather precautions and actions will be conducted during the pre-entry briefing.

4.8 BIOLOGICAL HAZARDS

A biological hazard photo log is presented in Attachment G of the APP.

Insect Bites/Stings: Protective outer clothing such as gloves, hard hats, and coveralls can help reduce the potential for insect bites and stings. Insect bite symptoms may include redness, rash, swelling, chills, fever, diarrhea, and vomiting. Any worker who has been bitten or stung and shows symptoms of a severe reaction should seek medical assistance immediately. Workers who know of allergies they may have to insects must advise their employer prior to engaging in field activities; the company will provide the workers with antidote kits. The insects that workers may encounter varies at each installation. The Installation Specific Addenda shall include common insect hazards that may be encountered for each installation.

Wildlife: The wildlife workers may encounter varies significantly at each installation. The Installation Specific Addenda shall include common wildlife hazards that may be encountered for each installation.

Plants: The plants workers may encounter varies significantly at each installation. The Installation Specific Addenda shall include common plant hazards that may be encountered for each installation.

5. PERSONAL PROTECTIVE EQUIPMENT

Personnel will be equipped with PPE for the tasks they are asked to perform. The SSHO will distribute PPE to employees and will also train employees in proper donning, doffing, use, and disposal of PPE. Subcontractors are responsible for providing proper PPE for their own employees; however, the SSHO is responsible for ensuring that the PPE meets or exceeds the PPE requirements listed in the subsections below. If the SSHO cannot determine whether subcontractor-supplied PPE meets the RI specific requirements, the Corporate Safety Officer will be consulted.

Prior to any field work activities, the SSHO will conduct a daily hazard assessment to determine appropriate PPE required for scheduled activities. After the daily hazard assessment has been performed by the SSHO, PPE will be selected based on the site hazards, site conditions, and the judgment of the SSHO in accordance with 29 CFR 1910.132. The PPE used will be chosen to be effective against the hazards present on site and will be monitored for effectiveness against site hazards by the SSHO.

5.1 PERSONAL PROTECTIVE EQUIPMENT LEVELS

Engineering controls and work practices will be used where feasible to minimize potential chemical, physical, and biological hazards. The components of each level of PPE anticipated to be donned during field activities are listed below. Use of Levels A, B, and/or C PPE is not anticipated at this site.

Level D protection will be required during field operations as described in Section 11 of the APP and in this section. The following are the minimum requirements for Level D at the site:

- Steel-toe, steel-shank safety shoes/boots (in accordance with ANSI Z41, and American Society Testing and Materials International Standards F2412 and F2413).

- Snake chaps (if there is potential for encountering a poisonous snake).

- Hard hat that is less than 5 years old and meets ANSI Standard Z89.1-1986 (whenever working in close proximity to heavy equipment, when overhead hazards are present, and as required by SSHO).

- Chemical-resistant gloves (when contact with potentially contaminated media is expected or when working with applicable chemicals listed in Section 9.7.3 of the APP). Based on the contaminant type(s) and concentration at this site and chemicals listed in Section 9.7.3 of the APP, nitrile gloves will be utilized)[1,2].

- Heavy duty cloth or leather gloves, as necessary, for work not involving the handling of potentially contaminated media (cut-resistant if handling potentially sharp items).

[1] Kimberly-Clark Nitrile Gloves, Chemical Resistance Guide, www.kimtech.com, accessed 3/27/2017.
[2] Ansell Chemical Resistance Guide, Permeation and Degradation Data, 7th Edition. 2003.

- Heat resistant gloves whenever working with hot asphalt and/or hot tack coat materials.

- Safety glasses with side shields in accordance with ANSI/American Society of Safety Engineers (ASSE) Z87.1 that bear the Z87 logo.

- Face shield in accordance with ANSI/ASSE Z87.1 in addition to safety glasses (all bearing the Z87 logo) when a splash or flying debris hazard exists.

- National Institute for Occupational Safety and Health-approved N95 particulate filtering face piece dust mask whenever visible dust is present.

- High visibility apparel meeting a minimum of ANSI/International Safety Equipment Association Class 2 requirements (when exposed to traffic and/or heavy equipment).

5.1.1 Hearing Protection

Site personnel noise exposure will be monitored initially and periodically during activities involving drilling to confirm sound pressure levels. Personnel involved with the operations identified above will be provided with and will be required to wear hearing protection in the form of ear plugs capable of reducing worker noise exposure below an 8-hour time-weighted average of 85 decibels (dBA). If worker noise exposure exceeds 115 dBA, secondary hearing protection will be required in the form of earmuffs over the ear plugs.

5.1.2 Personal Protective Equipment Training

During the daily tailgate safety meeting, the SSHO will ensure that all field personnel have the proper PPE training by reviewing proper PPE use/adjustment, limitations of the PPE, proper care, and inspection of PPE, and disposal of PPE. If the SSHO determines during the safety meeting and inspection that an employee needs to be retrained, the SSHO will not allow the employee to perform the work activities until this retraining has occurred. The SSHO will provide the retraining to the individual or groups of employees, as needed. Employees will certify they have received and understood the required PPE training and retraining (if required) by signing the PPE training form in Attachment D of the APP.

All aspects of proper PPE use, including the selection of appropriate PPE, donning, doffing, adjusting, and wearing PPE, limitations of the PPE; and proper care, inspection, testing, maintenance, storage, and disposal of the PPE, are also a fundamental part of the OSHA 29 CFR 1910.120 40-hour and 8-hour (refresher) HAZWOPER refresher training. Evidence of training for key personnel is provided in Attachment C of the APP. Documentation of training for all other site support personnel will be maintained onsite during all field activities.

6. MEDICAL SURVEILLANCE

Site personnel that anticipate being exposed to contaminants at the Permissible Exposure Limit for 30 or more days a year will be enrolled in a medical surveillance program and will satisfactorily complete a comprehensive medical examination by or under the supervision of a licensed physician knowledgeable in occupational medicine prior to the initiation of fieldwork. EA employees and subcontractors involved in those activities that may contact contaminated media, will be in the medical surveillance program.

Medical clearance documenting enrollment in the program is included in Attachment C of the APP. The local Emergency Medical Services will be notified immediately if needed. Emergency contact numbers are presented in Table 9-2 of the APP. Personnel will not transport victims to emergency medical facilities unless the injury does not pose immediate threat to life, and transport to the emergency medical facility can be accomplished without the risk of further injury. Directions and route to the nearest hospital are presented on Figure 3 of the APP.

First aid equipment will be available in company vehicles. Mishap reporting and investigation will be performed in accordance with Section 8 of the APP.

Medical examinations will be provided according to the following schedule:

- Prior to fieldwork assignment

- At least annually for employees covered by the program (biennially for those employees that do limited site work, with the approval of the occupational physician)

- At termination of employment or reassignment to an area where the employee had not been examined within the past 6 months

- As soon as possible after the development of signs or symptoms that may indicate an overexposure to hazardous substances or health hazards

- More frequently if the physician deems such examination necessary to maintain employee health.

Documentation for compliance with medical surveillance will be kept onsite. Further documentation is maintained in EA's Office of Human Resources (410-584-7000). The records shall be complete and accurate and be kept on file for at least 30 years after termination of employment. A minimum of the following information shall be kept:

- Name and social security number

- Physician's written opinions, recommendations, limitations, and test results

- Employee medical complaints related to hazardous waste operations

- Information provided to the physician by the employee concerning possible exposures, mishaps, etc.

6.1 FIRST AID AND MEDICAL TREATMENT

At least one onsite personnel will be currently certified in both first aid and Cardiopulmonary Resuscitation (CPR) by the American Red Cross or equivalent organization. For this site, the SSHO and one field person at a minimum are certified and will be onsite. Documentation of all personnel certifications will be kept onsite and will include separate EM 385-1-1 03.A.06a-c-compliant bloodborne pathogen training. A Bloodborne Pathogen Exposure Control Plan is contained in Section 9.4 of the APP. Individuals onsite currently certified in first aid will be called out at the start of each day's activities during the health and safety meeting. Employees will have the telephone number to the hospital during working hours should an occupational illness or injury occur.

6.2 MEDICAL RESTRICTION

Should an occupational injury or illness occur that restricts or limits an employee's ability to function at full capacity, EA maintains a policy of providing these employees with restricted or modified duty assignments whenever possible to allow them to continue to be productive.

6.3 MEDICAL RECORDS

Medical and personal exposure monitoring records will be maintained according to the requirements of 29 CFR 1910.120 (f) and shall be kept for a minimum of 30 years beyond employment. Employee confidentiality shall be maintained.

7. SAFETY EQUIPMENT AND SAFE WORK PRACTICE

7.1 SITE RULES

During field activities, personnel will remain in verbal or mobile phone contact with each other. The SSHO and field staff will use mobile telephones and will be responsible for handling communications during emergencies that may arise. Safe work practices that will be followed by site personnel include, but are not limited to, the following rules (which are described in more detail in pertinent sections of the APP):

- Working before or after daylight hours is prohibited.
- Eating, drinking, chewing tobacco, and smoking in the in the work area is prohibited.
- Possessing, using, purchasing, distributing, or having controlled substances in their system is prohibited.
- Consuming or possessing alcoholic beverages is prohibited.
- Good housekeeping – work areas will be kept clear of debris, tools, or other potential tripping hazards.
- Wash hands thoroughly upon leaving the work site and before sampling activities.
- Immediately repair or replace defective PPE.
- Personnel onsite will use the buddy system; visual contact will be maintained between team members while in the work area.
- Additional rules that are not included in this APP/SSHP but are posted at FTL will also be enforced.

7.2 DAILY COMMUNICATION AND SAFE WORK PROCDURES

The following general protocols will be followed daily prior to start of work activities and are a summarization of activities, training, and documentation covered in pertinent sections of the APP:

- The SSHO will review site conditions to establish whether modification of work and safety plans is needed.
- Personnel will be briefed and updated on new safety procedures as appropriate.
- Safety equipment will be checked for proper function.

- The SSHO will ensure that first aid equipment is readily available.

- The SSHO will inform personnel of any mishaps or deficiencies identified during inspections the previous day.

- Personnel will proceed through appropriate decontamination procedures and facilities (e.g., hand washing, PPE removal) when exiting the project site, at the end of daily operations, and before breaks.

- All personnel will have cellular telephones or radios to maintain constant communication with other site personnel and the SSHO. The SSHO will be in communication with the Project Manager and Corporate Safety Officer as needed.

7.2.1 Safety Equipment

The following safety equipment must be present at the work site:

- First aid kit
- Required PPE as described in Section 3
- ABC-type fire extinguisher (when flammable fluids present)
- Eye wash bottle or eyewash kit
- Drinking water.

7.2.2 Spill Containment

Information pertaining to spill containment and emergency responses related to spills is presented in Section 9.1.2 of the APP.

7.2.3 Emergency Equipment and First Aid

Emergency equipment and first aid information is presented in Section 10.

8. PERSONNEL HYGIENE AND DECONTAMINATION

Field work will be conducted in Level D PPE. Remove and discard gloves used for sample collection and equipment decontamination purposes. Place disposable gloves in plastic bags prior to leaving the site and prior to entering any vehicle. Site personnel will wash their hands, face, and exposed skin surfaces prior to ingestion of food, liquids, or any other hand-to-mouth activities and whenever leaving the project site. Hand washing with potable water, soap, and paper towels will be available in each site support vehicle. Hand sanitizer will also be made available in each site support vehicle.

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9. EQUIPMENT DECONTAMINATION

All sampling and drilling equipment that comes into contact with potentially PFAS-contaminated site media be decontaminated before leaving the work area and before completing work in subsequent areas. It is anticipated that only drilling and sampling equipment and any other non-dedicated equipment and tools associated with sampling activities will require decontamination. Sampling equipment decontamination is detailed in the Programmatic Uniform Federal Policy–Quality Assurance Project Plan [UFP-QAPP (Appendix A – SOPs)].

Drilling equipment, especially stems and rods, will be decontaminated before and after completing new monitoring well installations or collecting soil borings to prevent the risk of cross contamination. A designated decontamination area approved by each installation POC will be located near the work areas for decontamination activities. Drilling equipment will be steam or high-pressure washed using water that is laboratory-certified as PFAS-free. All water used for decontamination of equipment will be provided by EA or the subcontractor unless otherwise approved by the installation POCs. Decontamination water will be collected after use and containerized for proper treatment and disposal as described in the Waste Management Plan (Appendix E of the Programmatic UFP-QAPP).

Hand-held, non-dedicated sampling equipment will be decontaminated by rinsing with Alconox detergent (or other non-PFAS detergent), PFAS-free water, and methanol in accordance with the SOPs in Appendix A of the Programmatic UFP-QAPP. All non-disposable sampling equipment will be decontaminated prior to use and after each use (except for dedicated tubing left in monitoring wells). All decontamination fluid will be containerized for offsite disposal as detailed in the Appendix D of the Programmatic UFP-QAPP.

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10. EMERGENCY EQUIPMENT AND FIRST AID

A complete first aid kit, meeting the requirements of a Type III, 16-unit or larger in a waterproof container, will be readily available onsite and contain, at a minimum, a pocket mouthpiece for CPR, absorbent compresses, adhesive bandages, adhesive tape, antiseptic swabs, burn gel, sterile pads, and a triangular bandage. The contents of the kit(s) will be evaluated and possibly modified for this specific task order. Kit(s) will be located not more than 300 feet from the work activity and will be transported in each EA or subcontractor vehicle located onsite.

The contents will be checked prior to their utilization for sterility and to replace expended items. The SSHO or other designated individual will inventory the kit(s) at least every 3 months and document the results in a log, using an email to the Corporate Safety Officer, or on an inspection form. Expended or non-sterile contents will be replaced with serviceable items.

Prior to the start of work, the SSHO will discuss with site personnel the prevention steps, symptoms, and medical personnel available to assist with injuries or questions on diseases, plants, or animals that could be encountered while working on this project. Diseases, plants, and animals for each installation are discussed in the Installation Specific Addenda.

Emergency response and contingency procedures are discussed in Section 9.1 of the APP and the Installation Specific Addenda including emergency contact telephone numbers and directions to the nearest hospital. A working cell phone with adequate signal in this area will be maintained onsite and fully charged at the start of each workday. Emergency contacts are presented in Table 6-1 of the Installation Specific Addenda. A fire extinguisher will be maintained in each vehicle. Site personnel are trained in the use of fire extinguishers commensurate with Table 6-1 of the APP.

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11. REPORTING

11.1 HEALTH AND SAFETY LOGBOOK

The Health and Safety Logbook will be completed by the Field Technician. Pertinent health and safety information, to include the names of subcontracting personnel working onsite and the names of visitors to the site, will be entered. At a minimum, the following information is required to be put in the Logbook on a daily basis:

- Daily Tailgate Health and Safety meeting forms
- Visitors to the site
- Upgrading or downgrading of PPE levels
- Instances of job-related injury or illness
- Health and safety issues
- Health and safety violations
- Emergencies.

11.1.1 Employee Exposure/Injury Incident Reporting

All incidents resulting in an exposure or injury to personnel onsite (employee or otherwise) are to be reported to the Corporate Safety and Health Officer and the Project Manager within 24 hours of the incident. In the event of an accident EA will maintain the emergency contact information for all employees and subcontractors.

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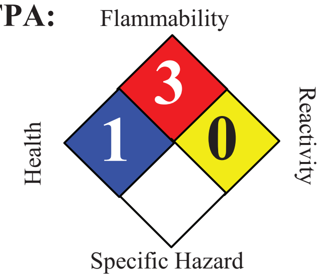
ATTACHMENT F

Safety Data Sheets

1552 *This page intentionally left blank*

Safety Data Sheet
Gasoline, Unleaded

NFPA:



SECTION 1. PRODUCT AND COMPANY IDENTIFICATION

Product name	:	Gasoline, Unleaded			
Synonyms	:	Blend of Highly Flammable Petroleum Distillates, Regular, Mid-Grade, Premium, 888100008809			
SDS Number	:	888100008809	**Version**	:	1.1
Product Use Description	:	Fuel			
Company	:	For: Tesoro Refining & Marketing Co. 19100 Ridgewood Parkway, San Antonio, TX 78259			
Tesoro Call Center	:	(877) 783-7676	**Chemtrec (Emergency Contact)**	:	(800) 424-9300

SECTION 2. HAZARDS IDENTIFICATION

Classifications : Flammable Liquid – Category 1 or 2 depending on formulation.
Aspiration Hazard – Category 1
Carcinogenicity – Category 2
Specific Target Organ Toxicity (Repeated Exposure) – Category 2
Specific Target Organ Toxicity (Single Exposure) – Category 3
Skin Irritation – Category 2
Eye Irritation – Category 2B
Chronic Aquatic Toxicity – Category 2

Pictograms :

Signal Word : **Danger**

Hazard Statements

Extremely flammable liquid and vapor.
May be fatal if swallowed and enters airways – do not siphon gasoline by mouth.
Suspected of causing blood cancer if repeated over-exposure by inhalation and/or skin contact occurs.
May cause damage to liver, kidneys and nervous system by repeated and prolonged inhalation or skin contact. Causes eye irritation. Can be absorbed through skin.
May cause drowsiness or dizziness. Extreme exposure such as intentional inhalation may cause unconsciousness, asphyxiation and death.
Repeated or prolonged skin contact can cause irritation and dermatitis.

Harmful to aquatic life.

Precautionary statements

Prevention : Obtain special instructions before use.
Do not handle until all safety precautions have been read and understood.
Keep away from heat, sparks, open flames, welding and hot surfaces.
No smoking.
Keep container tightly closed.
Ground and/or bond container and receiving equipment.
Use explosion-proof electrical equipment.
Use only non-sparking tools (if tools are used in flammable atmosphere).
Take precautionary measures against static discharge.
Wear gloves, eye protection and face protection (as needed to prevent skin and eye contact with liquid).
Wash hands or liquid-contacted skin thoroughly after handling.
Do not eat, drink or smoke when using this product.
Do not breathe vapors.
Use only outdoors or in a well-ventilated area.

Response : In case of fire: Use dry chemical, CO_2, water spray or fire fighting foam to extinguish.
If swallowed: Immediately call a poison center, doctor, hospital emergency room, medical clinic or 911. Do NOT induce vomiting. Rinse mouth.
If on skin (or hair): Take off immediately all contaminated clothing. Rinse skin with water/shower.
If in eye: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
If skin or eye irritation persists, get medical attention.
If inhaled: Remove person to fresh air and keep comfortable for breathing.
Get medical attention if you feel unwell.

Storage : Store in a well ventilated place. Keep cool. Store locked up. Keep container tightly closed . Use only approved containers. Some containers not approved for gasoline may dissolve and release flammable gasoline liquid and vapors.

Disposal : Dispose of contents/containers to approved disposal site in accordance with local, regional, national, and/or international regulations.

SECTION 3. COMPOSITION/INFORMATION ON INGREDIENTS

Component	CAS-No.	Weight %
Gasoline, natural; Low boiling point naphtha	8006-61-9	10 - 30%
Toluene	108-88-3	10 - 30%
Xylene	1330-20-7	10 - 30%
Ethanol; ethyl alcohol	64-17-5	0-8.2%
Trimethylbenzene	25551-13-7	1 - 5%
Isopentane; 2-methylbutane	78-78-4	1 - 5%

Naphthalene	91-20-3	1 - 5%
Benzene	71-43-2	Less than 1.3%
Pentane	109-66-0	1 - 5%
Cyclohexane	110-82-7	1 - 5%
Ethylbenzene	100-41-4	1 - 5%
Butane	106-97-8	1 - 20%
Heptane [and isomers]	142-82-5	0.5 - 0.75%
N-hexane	110-54-3	0.5 - 0.75%

SECTION 4. FIRST AID MEASURES

Inhalation : If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Seek medical attention immediately.

Skin contact : In case of contact, immediately flush skin with plenty of water. Take off contaminated clothing and shoes immediately. Wash contaminated clothing before re-use. Contaminated leather, particularly footwear, must be discarded. Note that contaminated clothing may be a fire hazard. Seek medical advice if symptoms persist or develop.

Eye contact : Remove contact lenses. Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes. Seek medical advice if symptoms persist or develop.

Ingestion : Do NOT induce vomiting. Never give anything by mouth to an unconscious person. Obtain medical attention.

Notes to physician : Symptoms: Dizziness, Discomfort, Headache, Nausea, Kidney disorders, Liver disorders. Aspiration may cause pulmonary edema and pneumonitis. Swallowing gasoline is more likely to be fatal for small children than adults, even if aspiration does not occur.

SECTION 5. FIRE-FIGHTING MEASURES

Suitable extinguishing media : SMALL FIRES: Any extinguisher suitable for Class B fires, dry chemical, CO2, water spray or fire fighting foam. LARGE FIRES: Water spray, fog or fire fighting foam. Water may be ineffective for fighting the fire, but may be used to cool fire-exposed containers. Keep containers and surroundings cool with water spray.

Specific hazards during fire fighting : Extremely flammable liquid and vapor. This material is combustible/flammable and is sensitive to fire, heat, and static discharge.

Special protective equipment for fire-fighters : Firefighting activities that may result in potential exposure to high heat, smoke or toxic by-products of combustion should require NIOSH/MSHA- approved pressure-demand self-contained breathing apparatus with full facepiece and full protective clothing.

Further information : Isolate area around container involved in fire. Cool tanks, shells, and containers exposed to fire and excessive heat with water. For massive fires the use of unmanned hose holders or monitor nozzles may be advantageous to further minimize personnel exposure. Major fires may require withdrawal, allowing the tank to burn. Large storage tank fires typically require specially trained personnel and equipment to extinguish the fire, often including the need for properly applied fire fighting foam. Exposure to decomposition products may be a hazard to health. Use extinguishing measures that are appropriate to local circumstances and the surrounding environment. Use water spray to cool unopened containers. Fire residues and contaminated fire extinguishing water must be disposed of in accordance with local regulations.

SECTION 6. ACCIDENTAL RELEASE MEASURES

Personal precautions : Evacuate personnel to safe areas. Ventilate the area. Remove all sources of ignition. Response and clean-up crews must be properly trained and must utilize proper protective equipment (see Section 8).

Environmental precautions : Discharge into the environment must be avoided. If the product contaminates rivers and lakes or drains inform respective authorities.

Methods for cleaning up : Contain and collect spillage with non-combustible absorbent material, (e.g. sand, earth, diatomaceous earth, vermiculite) and place in container for disposal according to local / national regulations.

SECTION 7. HANDLING AND STORAGE

Precautions for safe handling : Keep away from fire, sparks and heated surfaces. No smoking near areas where material is stored or handled. The product should only be stored and handled in areas with intrinsically safe electrical classification.

Hydrocarbon liquids including this product can act as a non-conductive flammable liquid (or static accumulators), and may form ignitable vapor-air mixtures in storage tanks or other containers. Precautions to prevent static-initated fire or explosion during transfer, storage or handling, include but are not limited to these examples:

(1) Ground and bond containers during product transfers. Grounding and bonding may not be adequate protection to prevent ignition or explosion of hydrocarbon liquids and vapors that are static accumulators.
(2) Special slow load procedures for "switch loading" must be followed to avoid the static ignition hazard that can exist when higher flash point material (such as fuel oil or diesel) is loaded into tanks previously containing low flash point products (such gasoline or naphtha).
(3) Storage tank level floats must be effectively bonded.

For more information on precautions to prevent static-initated fire or explosion, see NFPA 77, Recommended Practice on Static Electricity (2007), and API Recommended Practice 2003, Protection Against Ignitions Arising Out of Static, Lightning, and Stray Currents (2008).

Conditions for safe storage, including incompatibilities : Keep away from flame, sparks, excessive temperatures and open flame. Use approved containers. Keep containers closed and clearly labeled. Empty or partially full product containers or vessels may contain explosive vapors. Do not pressurize, cut, heat, weld or expose containers to sources of ignition. Store in a well-ventilated area. The storage area should comply with NFPA 30 "Flammable and Combustible Liquid Code". The cleaning of tanks previously containing this product should follow API Recommended Practice (RP) 2013 "Cleaning Mobile Tanks In Flammable and Combustible Liquid Service" and API RP 2015 "Cleaning Petroleum Storage Tanks".

Reports suggest that government-mandated ethanol, if present, may not be compatible with fiberglass gasoline tanks. Ethanol may dissolve fiberglass resin, causing engine damage and possibly allow leakage of explosive gasoline.

Keep away from food, drink and animal feed. Incompatible with oxidizing agents. Incompatible with acids.

No decomposition if stored and applied as directed. Emergency eye wash capability should be available in the near proximity to operations presenting a potential splash exposure. Store only in containers approved and labeled for gasoline.

SECTION 8. EXPOSURE CONTROLS / PERSONAL PROTECTION

Exposure Guidelines

List	Components	CAS-No.	Type:	Value
OSHA	Benzene	71-43-2	TWA	1 ppm
		71-43-2	STEL	5 ppm
		71-43-2	OSHA_ACT	0.5 ppm
OSHA Z1	Xylene	1330-20-7	PEL	100 ppm 435 mg/m3
	Ethanol; Ethyl alcohol	64-17-5	PEL	1,000 ppm 1,900 mg/m3
	Naphthalene	91-20-3	PEL	10 ppm 50 mg/m3
	Cyclohexane	110-82-7	PEL	300 ppm 1,050 mg/m3
	Ethylbenzene	100-41-4	PEL	100 ppm 435 mg/m3
	Heptane [and isomers]	142-82-5	PEL	500 ppm 2,000 mg/m3
	N-hexane	110-54-3	PEL	500 ppm 1,800 mg/m3
ACGIH	Toluene	108-88-3	TWA	50 ppm
	Xylene	1330-20-7	TWA	100 ppm
		1330-20-7	STEL	150 ppm
	Ethanol; Ethyl alcohol	64-17-5	TWA	1,000 ppm
	Trimethylbenzene	25551-13-7	TWA	25 ppm
	Isopentane; 2-Methylbutane	78-78-4	TWA	600 ppm
	Naphthalene	91-20-3	TWA	10 ppm
		91-20-3	STEL	15 ppm
	Benzene	71-43-2	TWA	0.5 ppm
		71-43-2	STEL	2.5 ppm
	Pentane	109-66-0	TWA	600 ppm
	Cyclohexane	110-82-7	TWA	100 ppm
	Ethylbenzene	100-41-4	TWA	100 ppm
		100-41-4	STEL	125 ppm
	Heptane [and isomers]	142-82-5	TWA	400 ppm
		142-82-5	STEL	500 ppm

	N-hexane	110-54-3	TWA	50 ppm

Engineering measures : Use adequate ventilation to keep gas and vapor concentrations of this product below occupational exposure and flammability limits, particularly in confined spaces. Use only intrinsically safe electrical equipment approved for use in classified areas.

Eye protection : Safety glasses or goggles are recommended where there is a possibility of splashing or spraying. Ensure that eyewash stations and safety showers are close to the workstation location.

Hand protection : Gloves constructed of nitrile or neoprene are recommended. Consult manufacturer specifications for further information.

Skin and body protection : If needed to prevent skin contact, chemical protective clothing such as of DuPont TyChem®, Saranex or equivalent recommended based on degree of exposure. Flame resistant clothing such as Nomex ® is recommended in areas where material is stored or handled.

Respiratory protection : A NIOSH/ MSHA-approved air-purifying respirator with organic vapor cartridges or canister may be permissible under certain circumstances where airborne concentrations are or may be expected to exceed exposure limits or for odor or irritation. Protection provided by air-purifying respirators is limited. Refer to OSHA 29 CFR 1910.134, ANSI Z88.2-1992, NIOSH Respirator Decision Logic, and the manufacturer for additional guidance on respiratory protection selection. Use a NIOSH/ MSHA-approved positive-pressure supplied-air respirator if there is a potential for uncontrolled release, exposure levels are not known, in oxygen-deficient atmospheres, or any other circumstance where an air-purifying respirator may not provide adequate protection.

Work / Hygiene practices : Emergency eye wash capability should be available in the near proximity to operations presenting a potential splash exposure. Use good personal hygiene practices. Avoid repeated and/or prolonged skin exposure. Wash hands before eating, drinking, smoking, or using toilet facilities. Do not use as a cleaning solvent on the skin. Do not use solvents or harsh abrasive skin cleaners for washing this product from exposed skin areas. Waterless hand cleaners are effective. Promptly remove contaminated clothing and launder before reuse. Use care when laundering to prevent the formation of flammable vapors which could ignite via washer or dryer. Consider the need to discard contaminated leather shoes and gloves.

SECTION 9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance : Clear to straw colored liquid

Odor : Characteristic hydrocarbon-like

Odor threshold 0.5 - 1.1 ppm

pH : Not applicable

Melting point/freezing point About -101°C (-150°F)

Initial boiling point & range Boiling point varies: 30 – 200°C (85 – 392°F)

Flash point < -21°C (-5.8°F)

Evaporation rate : Higher initially and declining as lighter components evaporate

Flammability (solid, gas) : Flammable vapor released by liquid

Upper explosive limit		7.6 %(V)
Lower explosive limit		1.3 %(V)
Vapor pressure		345 - 1,034 hPa at 37.8 °C (100.0 °F)
Vapor density (air = 1)		Approximately 3 to 4
Relative density (water = 1)		0.8 g/mL
Solubility (in water)		Negligible
Partition coefficient (n-octanol/water)		2 – 7 as log Pow
Auto-ignition temperature		Approximately 250°C (480°F)
Decomposition temperature		Will evaporate or boil and possibly ignite before decomposition occurs.
Kinematic viscosity		0.64 to 0.88 mm²/s range reported for gasoline
Conductivity (conductivity can be reduced by environmental factors such as a decrease in temperature)	:	Hydrocarbon liquids without static dissipater additive may have conductivity below 1 picoSiemens per meter (pS/m). The highest electro-static ignition risks are associated with "ultra-low conductivities" below 5 pS/m. See Section 7 for sources of information on defining safe loading and handling procedures for low conductivity products.

SECTION 10. STABILITY AND REACTIVITY

Reactivity	:	Vapors may form explosive mixture with air. Hazardous polymerization does not occur.
Chemical stability	:	Stable under normal conditions.
Possibility of hazardous reactions		Can react with strong oxidizing agents, peroxides, alkaline products and strong acids. Contact with nitric and sulfuric acids will form nitrocresols that can decompose violently.
Conditions to avoid	:	Avoid high temperatures, open flames, sparks, welding, smoking and other ignition sources. Avoid static charge accumulation and discharge (see Section 7).
Hazardous decomposition products	:	Ignition and burning can release carbon monoxide, carbon dioxide and non-combusted hydrocarbons (smoke).

SECTION 11. TOXICOLOGICAL INFORMATION

Skin contact	:	Irritating to skin. Can be partially absorbed through skin.
Eye contact	:	Irritating to eyes.
Ingestion	:	Aspiration hazard if liquid is inhaled into lungs, particularly from vomiting after ingestion. Aspiration may result in chemical pneumonia, severe lung damage, respiratory failure and even death. Ingestion may cause gastrointestinal disturbances, including irritation, nausea, vomiting and diarrhea, and central nervous (brain) effects similar to alcohol intoxication. In severe cases, tremors, convulsions, loss of consciousness, coma, respiratory arrest and death may occur.

Inhalation and further information

Acute toxicity of benzene results primarily from depression of the central nervous system (CNS). Inhalation of concentrations over 50 ppm can produce headache, lassitude, weariness, dizziness, drowsiness, over excitation. Exposure to very high levels can result in unconsciousness and death.

Repeated over-exposure may cause liver and kidney injuries.
Components of the product may affect the nervous system.

IARC has determined that gasoline and gasoline exhaust are possibly carcinogenic in humans. Inhalation exposure to completely vaporized unleaded gasoline caused kidney cancers in male rats and liver tumors in female mice. The U.S. EPA has determined that the male kidney tumors are species-specific and are irrelevant for human health risk assessment. The significance of the tumors seen in female mice is not known. Exposure to light hydrocarbons in the same boiling range as this product has been associated in animal studies with effects to the central and peripheral nervous systems, liver, and kidneys. The significance of these animal models to predict similar human response to gasoline is uncertain.
This product contains benzene. Human health studies indicate that prolonged and/or repeated overexposure to benzene may cause damage to the blood-forming system (particularly bone marrow), and serious blood disorders such as aplastic anemia and leukemia. Benzene is listed as a human carcinogen by the NTP, IARC, OSHA and ACGIH.

Component:

Gasoline, natural; Low boiling point naphtha 8006-61-9

Acute oral toxicity: LD50 rat
Dose: 18.8 mg/kg

Acute inhalation toxicity: LC50 rat
Dose: 20.7 mg/l
Exposure time: 4 h

Skin irritation: Classification: Irritating to skin.
Result: Mild skin irritation

Eye irritation: Classification: Irritating to eyes.
Result: Moderate eye irritation

Toluene 108-88-3

Acute oral toxicity: LD50 rat
Dose: 636 mg/kg

Acute dermal toxicity: LD50 rabbit
Dose: 12,124 mg/kg

Acute inhalation toxicity: LC50 rat
Dose: 49 mg/l
Exposure time: 4 h

Skin irritation: Classification: Irritating to skin.
Result: Mild skin irritation
Prolonged skin contact may defat the skin and produce dermatitis.
Eye irritation: Classification: Irritating to eyes.
Result: Mild eye irritation

Xylene 1330-20-7

Acute oral toxicity: LD50 rat
Dose: 2,840 mg/kg

Acute dermal toxicity: LD50 rabbit
Dose: ca. 4,500 mg/kg

Acute inhalation toxicity: LC50 rat
Dose: 6,350 mg/l
Exposure time: 4 h

Skin irritation: Classification: Irritating to skin.
Result: Mild skin irritation

		Repeated or prolonged exposure may cause skin irritation and dermatitis, due to degreasing properties of the product. Eye irritation: Classification: Irritating to eyes. Result: Mild eye irritation
Ethanol; Ethyl alcohol	64-17-5	Acute oral toxicity: LD50 rat Dose: 6,200 mg/kg Acute dermal toxicity: LD50 rabbit Dose: 19,999 mg/kg Acute inhalation toxicity: LC50 rat Dose: 8,001 mg/l Exposure time: 4 h Skin irritation: Classification: Irritating to skin. Result: Mild skin irritation Prolonged skin contact may cause skin irritation and/or dermatitis. Eye irritation: Classification: Irritating to eyes. Result: Mild eye irritation Mild eye irritation
Naphthalene	91-20-3	Acute oral toxicity: LD50 rat Dose: 2,001 mg/kg Acute dermal toxicity: LD50 rat Dose: 2,501 mg/kg Acute inhalation toxicity: LC50 rat Dose: 101 mg/l Exposure time: 4 h Skin irritation: Classification: Irritating to skin. Result: Mild skin irritation Eye irritation: Classification: Irritating to eyes. Result: Mild eye irritation Carcinogenicity: N11.00422130
Benzene	71-43-2	Acute oral toxicity: LD50 rat Dose: 930 mg/kg Acute inhalation toxicity: LC50 rat Dose: 44 mg/l Exposure time: 4 h Skin irritation: Classification: Irritating to skin. Result: Mild skin irritation Repeated or prolonged exposure may cause skin irritation and dermatitis, due to degreasing properties of the product. Eye irritation: Classification: Irritating to eyes. Result: Risk of serious damage to eyes.
Pentane	109-66-0	Acute oral toxicity: LD50 rat Dose: 2,001 mg/kg Acute inhalation toxicity: LC50 rat Dose: 364 mg/l Exposure time: 4 h Skin irritation: Repeated or prolonged exposure may cause skin irritation and dermatitis, due to degreasing properties of the product. Eye irritation: Classification: Irritating to eyes. Result: Mild eye irritation
Cyclohexane	110-82-7	Acute dermal toxicity: LD50 rabbit Dose: 2,001 mg/kg Acute inhalation toxicity: LC50 rat Dose: 14 mg/l Exposure time: 4 h

		Skin irritation: Classification: Irritating to skin. Result: Skin irritation Eye irritation: Classification: Irritating to eyes. Result: Mild eye irritation
Ethylbenzene	100-41-4	Acute oral toxicity: LD50 rat Dose: 3,500 mg/kg Acute dermal toxicity: LD50 rabbit Dose: 15,500 mg/kg Acute inhalation toxicity: LC50 rat Dose: 18 mg/l Exposure time: 4 h Skin irritation: Classification: Irritating to skin. Result: Mild skin irritation Eye irritation: Classification: Irritating to eyes. Result: Risk of serious damage to eyes.
Heptane [and isomers]	142-82-5	Acute oral toxicity: LD50 rat Dose: 15,001 mg/kg Acute inhalation toxicity: LC50 rat Dose: 103 g/m3 Exposure time: 4 h Skin irritation: Classification: Irritating to skin. Result: Skin irritation Repeated or prolonged exposure may cause skin irritation and dermatitis, due to degreasing properties of the product. Eye irritation: Classification: Irritating to eyes. Result: Mild eye irritation
N-hexane	110-54-3	Acute oral toxicity: LD50 rat Dose: 25,000 mg/kg Acute dermal toxicity: LD50 rabbit Dose: 2,001 mg/kg Acute inhalation toxicity: LC50 rat Dose: 171.6 mg/l Exposure time: 4 h Skin irritation: Classification: Irritating to skin. Result: Skin irritation Eye irritation: Classification: Irritating to eyes. Result: Mild eye irritation Teratogenicity: N11.00418960

Carcinogenicity

NTP	:	Naphthalene (CAS-No.: 91-20-3) Benzene (CAS-No.: 71-43-2)
IARC	:	Gasoline, natural; Low boiling point naphtha (CAS-No.: 8006-61-9) Naphthalene (CAS-No.: 91-20-3) Benzene (CAS-No.: 71-43-2) Ethylbenzene (CAS-No.: 100-41-4)
OSHA	:	Benzene (CAS-No.: 71-43-2)
CA Prop 65	:	WARNING! This product contains a chemical known to the State of California to cause birth defects or other reproductive harm. Toluene (CAS-No.: 108-88-3)

Benzene (CAS-No.: 71-43-2)

SECTION 12. ECOLOGICAL INFORMATION

Additional ecological information : Keep out of sewers, drainage areas, and waterways. Report spills and releases, as applicable, under Federal and State regulations.

Component:

Toluene	108-88-3	Toxicity to fish: LC50 Species: Carassius auratus (goldfish) Dose: 13 mg/l Exposure time: 96 h Acute and prolonged toxicity for aquatic invertebrates: EC50 Species: Daphnia magna (Water flea) Dose: 11.5 mg/l Exposure time: 48 h Toxicity to algae: IC50 Species: Selenastrum capricornutum (green algae) Dose: 12 mg/l Exposure time: 72 h
Ethanol; Ethyl alcohol	64-17-5	Toxicity to fish: LC50 Species: Leuciscus idus (Golden orfe) Dose: 8,140 mg/l Exposure time: 48 h Acute and prolonged toxicity for aquatic invertebrates: EC50 Species: Daphnia magna (Water flea) Dose: 9,268 - 14,221 mg/l Exposure time: 48 h
Isopentane; 2-Methylbutane	78-78-4	Toxicity to fish: LC50 Species: Oncorhynchus mykiss (rainbow trout) Dose: 3.1 mg/l Exposure time: 96 h Acute and prolonged toxicity for aquatic invertebrates: EC50 Species: Daphnia magna (Water flea) Dose: 2.3 mg/l Exposure time: 96 h
Naphthalene	91-20-3	Toxicity to algae: EC50 Species: Dose: 33 mg/l Exposure time: 24 h
Pentane	109-66-0	Acute and prolonged toxicity for aquatic invertebrates: EC50 Species: Daphnia magna (Water flea) Dose: 9.74 mg/l Exposure time: 48 h
Cyclohexane	110-82-7	Acute and prolonged toxicity for aquatic invertebrates: EC50 Species: Daphnia magna (Water flea) Dose: 3.78 mg/l Exposure time: 48 h

Heptane [and isomers]	142-82-5	Toxicity to fish: LC50 Species: Carassius auratus (goldfish) Dose: 4 mg/l Exposure time: 24 h Acute and prolonged toxicity for aquatic invertebrates: EC50 Species: Daphnia magna (Water flea) Dose: 1.5 mg/l Exposure time: 48 h
N-hexane	110-54-3	Toxicity to fish: LC50 Species: Pimephales promelas (fathead minnow) Dose: 2.5 mg/l Exposure time: 96 h Acute and prolonged toxicity for aquatic invertebrates: EC50 Species: Daphnia magna (Water flea) Dose: 2.1 mg/l Exposure time: 48 h

SECTION 13. DISPOSAL CONSIDERATIONS

Disposal : Dispose of container and unused contents in accordance with federal, state and local requirements.

SECTION 14. TRANSPORT INFORMATION

CFR

Proper shipping name : Petrol
UN-No. : 1203
Class : 3
Packing group : II

TDG

Proper shipping name : Gasoline
UN-No. : UN1203
Class : 3
Packing group : II

IATA Cargo Transport

UN UN-No. : UN1203
Description of the goods : Gasoline
Class : 3
Packaging group : II
ICAO-Labels : 3
Packing instruction (cargo aircraft) : 364
Packing instruction (cargo aircraft) : Y341

IATA Passenger Transport

UN UN-No. : UN1203
Description of the goods : Gasoline
Class : 3

Packaging group	:	II
ICAO-Labels	:	3
Packing instruction (passenger aircraft)	:	353
Packing instruction (passenger aircraft)	:	Y341

IMDG-Code

UN-No.	:	UN 1203
Description of the goods	:	Gasoline
Class	:	3
Packaging group	:	II
IMDG-Labels	:	3
EmS Number	:	F-E S-E
Marine pollutant	:	No

SECTION 15. REGULATORY INFORMATION

OSHA Hazards : Flammable liquid
Highly toxic by ingestion
Moderate skin irritant
Severe eye irritant
Carcinogen

TSCA Status : On TSCA Inventory

DSL Status : . All components are on the Canadian DSL list.

SARA 311/312 Hazards : Fire Hazard
Acute Health Hazard
Chronic Health Hazard

CERCLA SECTION 103 and SARA SECTION 304 (RELEASE TO THE ENVIROMENT)
The CERCLA definition of hazardous substances contains a "petroleum exclusion" clause which exempts crude oil. Fractions of crude oil, and products (both finished and intermediate) from the crude oil refining process and any indigenous components of such from the CERCLA Section 103 reporting requirements. However, other federal reporting requirements, including SARA Section 304, as well as the Clean Water Act may still apply.

California Prop. 65 : WARNING! This product contains a chemical known to the State of California to cause birth defects or other reproductive harm.

Toluene	108-88-3
Benzene	71-43-2

SECTION 16. OTHER INFORMATION

Further information

The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as guidance for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text.

Revision Date : 08/09/2012

6, 8, 10, 12, 14, 16, 64, 68, 91, 112, 306, 1092, 1106, 1500, 1570, 1571, 1651, 1652, 1654, 1700, 1701, 1702, 1710, 1711, 1714, 1726, 1729, 1730, 1732, 1733, 1826, 1848, 1880, 1950

Safety Data Sheet

Effective date: 11 May 2020 **Revision**: 11 May 2020

Trade Name: Alconox®

1 Identification of the substance/mixture and of the supplier

1.1 GHS Product identifier

Trade Name: Alconox®

Product number: 1101, 1103, 1104, 1104-1, 1112, 1112-1, 1125, 1150

1.2 Application of the substance / the mixture: Cleaning material/Detergent

1.2.1 Recommended dilution ratio: 1 – 2% in water

1.3 Details of the supplier of the Safety Data Sheet

Manufacturer:

Alconox Inc.
30 Glenn St
White Plains, NY 10603
(914) 948-4040

Supplier:

Emergency telephone number:

ChemTel Inc

North America: 1-888-255-3924
International: +1 813-248-0573

2 Hazards identification

2.1 Classification of the substance or mixture:

In compliance with EC regulation No. 1272, 29CFR1910/1200 and GHS requirements.

Hazard-determining components of labeling:

Tetrasodium Pyrophosphate
Sodium tripolyphosphate
Sodium Alkylbenzene Sulfonate

2.2 Label elements:

Eye damage, category 1.

Skin irritation, category 2.

Product at recommended dilution:

Eye irritation, category 2B

Hazard pictograms:

Signal word: Danger

Hazard statements:

H315 Causes skin irritation.
H318 Causes serious eye damage.

Precautionary statements:

P264 Wash skin thoroughly after handling.

Safety Data Sheet

Effective date: 11 May 2020 **Revision**: 11 May 2020

Trade Name: Alconox®

P280 Wear protective gloves/protective clothing/eye protection/face protection.
P302+P352 If on skin: Wash with soap and water.
P305+P351+P338 If in eyes: Rinse cautiously with water for several minutes. Remove contact lenses if present and easy to do. Continue rinsing.
P321 Specific treatment (see supplemental first aid instructions on this label).
P332+P313 If skin irritation occurs: Get medical advice/attention.
P362 Take off contaminated clothing and wash before reuse.
P501 Dispose of contents and container as instructed in Section 13.

Hazardous Elements at Use Dilution:

Hazard Pictograms:

Signal Word: Warning

Hazard Statements:

H320 Causes eye irritation

Precautionary statements:

P302+P352 If on skin: Wash with soap and water.
P305+P351+P338 If in eyes: Rinse cautiously with water for several minutes. Remove contact lenses if present and easy to do. Continue rinsing.
P501 Dispose of contents and container as instructed in Section 13

Additional information: None.

Hazard description

Hazards Not Otherwise Classified (HNOC): May cause surfaces to become slippery if wet. Use caution in areas of foot traffic if on floors.

Information concerning particular hazards for humans and environment:

The product has to be labelled due to the calculation procedure of the "General Classification guideline for preparations of the EU" in the latest valid version.

Classification system:

The classification is according to EC regulation No. 1272, 29CFR1910/1200 and GHS Requirements, and extended by company and literature data. The classification is in accordance with the latest editions of international substances lists and is supplemented by information from technical literature and by information provided by the company.

3 Composition/information on ingredients

3.1 Chemical characterization: Not determined or not available.

3.2 Description: None

3.3 Hazardous components (percentages by weight)

Identification	Chemical Name	Classification	Wt. %
CAS number: 7758-29-4	Sodium tripolyphosphate	Skin Irrit. 2; H315 Eye Irrit. 2; H319	12-28
CAS number: 68081-81-2 or 68411-30-3	Sodium Alkylbenzene Sulfonate	Acute Tox. 4; H303 Skin Irrit. 2; H315 Eye Dam. 1; H318	8-22
CAS number: 7722-88-5	Tetrasodium Pyrophosphate	Skin Irrit. 2; H315 Eye Irrit. 2; H319	2-16

Effective date: 11 May 2020 **Revision**: 11 May 2020
Trade Name: Alconox®

Hazardous components at use dilution (percentages by weight):

Identification	Chemical Name	Classification	Wt. %
CAS number: 7758-29-4	Sodium tripolyphosphate	Eye Irrit. 2; H319	0.12 - 0.28
CAS number: 68081-81-2 or 68411-30-3	Sodium Alkylbenzene Sulfonate	Eye Irrit. 2; H319	0.08 – 0.22
CAS number: 7722-88-5	Tetrasodium Pyrophosphate	Eye Irrit. 2; H319	0.02 – 0.16

3.4 Additional Information: None.

4 First aid measures

4.1 Description of first aid measures

General information: None.

After inhalation:
Maintain an unobstructed airway.
Loosen clothing as necessary and position individual in a comfortable position.

After skin contact:
Wash affected area with soap and water.
Seek medical attention if symptoms develop or persist.

After eye contact:
Rinse/flush exposed eye(s) gently using water for 15-20 minutes.
Remove contact lens(es) if able to do so during rinsing.
Seek medical attention if irritation persists or if concerned.

After swallowing:
Rinse mouth thoroughly.
Seek medical attention if irritation, discomfort, or vomiting persists.

4.2 Most important symptoms and effects, both acute and delayed

None

4.3 Indication of any immediate medical attention and special treatment needed:

No additional information.

First aid measure at recommended dilution:

General information: None.

After inhalation:
Maintain an unobstructed airway.
Loosen clothing as necessary and position individual in a comfortable position.

After skin contact:
Wash affected area with soap and water.

After eye contact:
Rinse/flush exposed eye(s) gently using water for 15-20 minutes.
Remove contact lens(es) if able to do so during rinsing.

After swallowing:
Rinse mouth thoroughly. Seek medical attention if irritation, discomfort, or vomiting develops.

5 Firefighting measures

5.1 Extinguishing media

Suitable extinguishing agents:

Use appropriate fire suppression agents for adjacent combustible materials or sources of ignition.

For safety reasons unsuitable extinguishing agents: None

5.2 Special hazards arising from the substance or mixture:

Thermal decomposition can lead to release of irritating gases and vapors.

5.3 Advice for firefighters

Protective equipment:

Wear protective eye wear, gloves and clothing.
Refer to Section 8.

5.4 Additional information:

Avoid inhaling gases, fumes, dust, mist, vapor and aerosols.
Avoid contact with skin, eyes and clothing.

6 Accidental release measures

6.1 Personal precautions, protective equipment and emergency procedures:

Ensure adequate ventilation.
Ensure air handling systems are operational.

6.2 Environmental precautions:

Should not be released into the environment.
Prevent from reaching drains, sewer or waterway.

6.3 Methods and material for containment and cleaning up:

Wear protective eye wear, gloves and clothing.

6.4 Reference to other sections: None

7 Handling and storage

7.1 Precautions for safe handling:

No expected hazards under normal use condition.

Avoid breathing mist or vapor if aerosolized.
Do not eat, drink, smoke or use personal products when handling chemical substances.

7.2 Conditions for safe storage, including any incompatibilities:

Store in a cool, well-ventilated area.

7.3 Specific end use(s):

No additional information.

Safety Data Sheet

Effective date: 11 May 2020 **Revision**: 11 May 2020

Trade Name: Alconox®

8 Exposure controls/personal protection

8.1 Control parameters:

a) 7722-88-5, Tetrasodium Pyrophosphate, ACGIH TWA 10 mg/m3
b) 7758-29-4, Sodium Tripolyphosphate, ACGIH TWA 10 mg/m3
c) Dusts, non-specific OEL, Irish Code of Practice
   (i) Total inhalable 10 mg/m3 (8hr)
   (ii) Respirable 4 mg/m3 (8hr)
   (iii) Tetrasodium Pyrophosphate, OSHA TWA 5 mg/m3, (8hr)

8.2 Exposure controls

Appropriate engineering controls:

Emergency eye wash fountains and safety showers should be available in the immediate vicinity of use or handling.

Respiratory protection:

Not needed under normal use conditions.

Protection of skin:

Select glove material impermeable and resistant to the substance.

Eye protection:

Safety goggles or glasses, or appropriate eye protection. Recommended to comply with ANSI Z87.1 and/or EN 166.

General hygienic measures:

Wash hands before breaks and at the end of work.
Avoid contact with skin, eyes and clothing.

Exposure Control and Personal Protective Equipment at recommended dilution:

Under normal use and operational conditions, no special personal protective equipment or engineering controls will be necessary. Handle with care.

9 Physical and chemical properties

Appearance (physical state, color):	White and cream colored flakes - powder	**Explosion limit lower**: **Explosion limit upper**:	Not determined or notavailable. Not determined or notavailable.
Odor:	Not determined or not available.	**Vapor pressure at 20°C**:	Not determined or notavailable.
Odor threshold:	Not determined or not available.	**Vapor density**:	Not determined or notavailable.
pH-value:	9.5 (1% aqueous solution)	**Relative density**:	Not determined or notavailable.

Effective date: 11 May 2020 **Revision**: 11 May 2020

Trade Name: Alconox®

Melting/Freezing point:	Not determined or not available.	**Solubilities**:	Not determined or notavailable.
Boiling point/Boiling range:	Not determined or not available.	**Partition coefficient (n-octanol/water)**:	Not determined or notavailable.
Flash point (closed cup):	Not determined or not available.	**Auto/Self-ignition temperature**:	Not determined or notavailable.
Evaporation rate:	Not determined or not available.	**Decomposition temperature**:	Not determined or notavailable.

Flammability (solid, gaseous):	Not determined or not available.	**Viscosity**:	a. Kinematic: Not determined or not available. b. Dynamic: Not determined or not available.
Density at 20°C:	Not determined or not available.		

10 Stability and reactivity

10.1 Reactivity: Not determined or not available.
10.2 Chemical stability: Not determined or not available.
10.3 Possibility hazardous reactions: Not determined or not available.
10.4 Conditions to avoid: Not determined or not available.
10.5 Incompatible materials: Not determined or not available.
10.6 Hazardous decomposition products: Not determined or not available.

11 Toxicological information

11.1 Information on toxicological effects:

Acute Toxicity:

Oral:

: LD50 > 5000 mg/kg oral rat - Product.

Chronic Toxicity: No additional information.

Skin corrosion/irritation:

Sodium Alkylbenzene Sulfonate: Causes skin irritation.

Serious eye damage/irritation:

Sodium Alkylbenzene Sulfonate: Causes serious eye damage.

Tetrasodium Pyrophosphate: Risk of serious damage to eyes.

Product information at recommended dilution:

Eye irritation may occur upon direct contact with eyes. No specific hazards for skin contact, inhalation, or chronic exposure are expected within normal use parameters.

Respiratory or skin sensitization: No additional information.

Carcinogenicity: No additional information.

IARC (International Agency for Research on Cancer): None of the ingredients are listed.

NTP (National Toxicology Program): None of the ingredients are listed.

Germ cell mutagenicity: No additional information.

Reproductive toxicity: No additional information.

STOT-single and repeated exposure: No additional information.

Additional toxicological information: No additional information.

12 Ecological information

12.1 Toxicity:

Sodium Alkylbenzene Sulfonate: Fish, LC50 1.67 mg/l, 96 hours.
Sodium Alkylbenzene Sulfonate: Aquatic invertebrates, EC50 Daphnia 2.9 mg/l, 48 hours.
Sodium Alkylbenzene Sulfonate: Aquatic Plants, EC50 Algae 29 mg/l, 96 hours.
Tetrasodium Pyrophosphate: Fish, LC50 - other fish - 1,380 mg/l - 96 h.
Tetrasodium Pyrophosphate: Aquatic invertebrates, EC50 - Daphnia magna (Water flea) - 391 mg/l - 48 h.

12.2 Persistence and degradability: No additional information.

12.3 Bioaccumulative potential: No additional information.

12.4 Mobility in soil: No additional information.

General notes: No additional information.

12.5 Results of PBT and vPvB assessment:

PBT: No additional information.

vPvB: No additional information.

12.6 Other adverse effects: No additional information.

13 Disposal considerations

13.1 Waste treatment methods (consult local, regional and national authorities for proper disposal)

Relevant Information:

It is the responsibility of the waste generator to properly characterize all waste materials according to applicable regulatory entities. (US 40CFR262.11).

14 Transport information

14.1 UN Number: ADR, ADN, DOT, IMDG, IATA	None
14.2 UN Proper shipping name: ADR, ADN, DOT, IMDG, IATA	None
14.3 Transport hazard classes: ADR, ADN, DOT, IMDG, IATA	**Class:** None **Label:** None **LTD.QTY:** None

US DOT

Limited Quantity Exception: None

Bulk:
RQ (if applicable): None
Proper shipping Name: None
Hazard Class: None
Packing Group: None
Marine Pollutant (if applicable): No additional information.

Non Bulk:
RQ (if applicable): None
Proper shipping Name: None
Hazard Class: None
Packing Group: None
Marine Pollutant (if applicable): No additional information.

	Comments: None	**Comments:** None
14.4	**Packing group:** ADR, ADN, DOT, IMDG, IATA	None
14.5	**Environmental hazards**:	None
14.6	**Special precautions for user:**	None
	Danger code (Kemler):	None
	EMS number:	None
	Segregation groups:	None
14.7	**Transport in bulk according to Annex II of MARPOL73/78 and the IBC Code:** Not applicable.	
14.8	**Transport/Additional information:**	
	Transport category:	None
	Tunnel restriction code:	None
	UN "Model Regulation":	None

15 Regulatory information

15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture.

North American

SARA

Section 313 (specific toxic chemical listings): None of the ingredients are listed.
Section 302 (extremely hazardous substances): None of the ingredients are listed.

CERCLA (Comprehensive Environmental Response, Clean up and Liability Act) Reportable Spill Quantity: None of the ingredients are listed.

TSCA (Toxic Substances Control Act):

Inventory: All ingredients are listed as active.
Rules and Orders: Not applicable.

Proposition 65 (California):

Chemicals known to cause cancer: None of the ingredients are listed.

Chemicals known to cause reproductive toxicity for females: None of the ingredients are listed.

Chemicals known to cause reproductive toxicity for males: None of the ingredients are listed.

Chemicals known to cause developmental toxicity: None of the ingredients are listed.

Canadian

Canadian Domestic Substances List (DSL):
All ingredients are listed.

EU

REACH Article 57 (SVHC): None of the ingredients are listed.

Germany MAK: Not classified.
EC 648/2004 – This is an industrial detergent. Contains >30% phosphate, 15-30% anionic surfactant, <5% EDTA salts
EC 551/2009 – This is not a laundry or dishwasher detergent
EC 907/2006 – Contains no enzymes, optical brighteners, perfumes, allergenic fragrances, or preservative agents

Asia Pacific

Australia

Australian Inventory of Chemical Substances (AICS): All ingredients are listed.

China

Inventory of Existing Chemical Substances in China (IECSC): All ingredients are listed.

Japan

Inventory of Existing and New Chemical Substances (ENCS): All ingredients are listed.

Korea

Existing Chemicals List (ECL): All ingredients are listed.

New Zealand

New Zealand Inventory of Chemicals (NZOIC): All ingredients are listed.

Philippines

Philippine Inventory of Chemicals and Chemical Substances (PICCS): All ingredients are listed.

Taiwan

Taiwan Chemical Substance Inventory (TSCI): All ingredients are listed.

16 Other information

Abbreviations and Acronyms: None

Summary of Phrases

Hazard statements:

H315 Causes skin irritation.
H318 Causes serious eye damage.

NFPA: 1-0-0
HMIS: 1-0-0

At recommended dilution:
NFPA: 1-0-0
HMIS: 1-0-0

Precautionary statements:

P264 Wash skin thoroughly after handling.
P280 Wear protective gloves/protective clothing/eye protection/face protection.
P302+P352 If on skin: Wash with soap and water.
P305+P351+P338 If in eyes: Rinse cautiously with water for several minutes. Remove contact lenses if present and easy to do. Continue rinsing.
P321 Specific treatment (see supplemental first aid instructions on this label).
P332+P313 If skin irritation occurs: Get medical advice/attention.
P362 Take off contaminated clothing and wash before reuse.
P501 Dispose of contents and container as instructed in Section 13.

Manufacturer Statement:

The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as guidance for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text.

SAFETY DATA SHEET
Permethrin

Revision: 02/06/2018

according to Regulation (EC) No. 1907/2006 as amended by (EC) No. 1272/2008

Section 1. Identification of the Substance/Mixture and of the Company/Undertaking

1.1 **Product Code:** 23821

Product Name: Permethrin

Synonyms: 3-(2,2-dichloroethenyl)-2,2-dimethyl-cyclopropanecarboxylic acid, (3-phenoxyphenyl)methyl ester;

1.2 **Relevant identified uses of the substance or mixture and uses advised against:**

Relevant identified uses: For research use only, not for human or veterinary use.

1.3 **Details of the Supplier of the Safety Data Sheet:**

Company Name: Cayman Chemical Company
1180 E. Ellsworth Rd.
Ann Arbor, MI 48108

Web site address: www.caymanchem.com

Information: Cayman Chemical Company +1 (734)971-3335

1.4 **Emergency telephone number:**

Emergency Contact: CHEMTREC Within USA and Canada: +1 (800)424-9300
CHEMTREC Outside USA and Canada: +1 (703)527-3887

Section 2. Hazards Identification

2.1 **Classification of the Substance or Mixture:**

Acute Toxicity: Inhalation, Category 4

Acute Toxicity: Oral, Category 4

Skin Sensitization, Category 1

Aquatic Toxicity (Acute), Category 1

Aquatic Toxicity (Chronic), Category 1

2.2 **Label Elements:**

GHS Signal Word: **Warning**

GHS Hazard Phrases:

H302: Harmful if swallowed.
H317: May cause an allergic skin reaction.
H332: Harmful if inhaled.
H400: Very toxic to aquatic life.
H410: Very toxic to aquatic life with long lasting effects.

GHS Precaution Phrases:

P261: Avoid breathing {dust/fume/gas/mist/vapors/spray}.
P264: Wash {hands} thoroughly after handling.
P272: Contaminated work clothing should not be allowed out of the workplace.
P273: Avoid release to the environment.
P280: Wear {protective gloves/protective clothing/eye protection/face protection}.

GHS Response Phrases:

P301+312: IF SWALLOWED: P312: Call a POISON CENTER or doctor/physician if you feel unwell.
P302+352: IF ON SKIN: Wash with plenty of soap and water.
P304+340: IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing.
P330: Rinse mouth.

P333+313: If skin irritation or rash occurs, seek medical advice/attention.
P362+364: Take off contaminated clothing and wash it before reuse.
P391: Collect spillage.

GHS Storage and Disposal Phrases:

Please refer to Section 7 for Storage and Section 13 for Disposal information.

2.3 Adverse Human Health Effects and Symptoms:
Harmful if inhaled or swallowed.
Material may be irritating to the mucous membranes and upper respiratory tract.
May be harmful by skin absorption.
May cause an allergic skin reaction.
May cause eye, skin, or respiratory system irritation.
Very toxic to aquatic life with long lasting effects.
To the best of our knowledge, the toxicological properties have not been thoroughly investigated.

Section 3. Composition/Information on Ingredients

CAS # / RTECS #	Hazardous Components (Chemical Name)/ REACH Registration No.	Concentration	EC No./ EC Index No.	GHS Classification
52645-53-1 GZ1255000	Permethrin	100.0 %	258-067-9 613-058-00-2	Acute Tox.(O) 4: H302 Skin Sens. 1: H317 Acute Tox.(I) 4: H332 Aquatic (A) 1: H400 Aquatic (C) 1: H410

Section 4. First Aid Measures

4.1 Description of First Aid Measures:

In Case of Inhalation: Remove to fresh air. If not breathing, give artificial respiration or give oxygen by trained personnel. Get immediate medical attention.

In Case of Skin Contact: Immediately wash skin with soap and plenty of water for at least 15 minutes. Remove contaminated clothing. Get medical attention if symptoms occur. Wash clothing before reuse.

In Case of Eye Contact: Hold eyelids apart and flush eyes with plenty of water for at least 15 minutes. Have eyes examined and tested by medical personnel.

In Case of Ingestion: Wash out mouth with water provided person is conscious. Never give anything by mouth to an unconscious person. Get medical attention. Do NOT induce vomiting unless directed to do so by medical personnel.

Section 5. Fire Fighting Measures

5.1 Suitable Extinguishing Media: Use alcohol-resistant foam, carbon dioxide, water, or dry chemical spray.
Use water spray to cool fire-exposed containers.

Unsuitable Extinguishing Media: A solid water stream may be inefficient.

5.2 Flammable Properties and Hazards: No data available.

No data available.

Flash Pt: No data.

Explosive Limits: LEL: No data. UEL: No data.

Autoignition Pt: No data.

5.3 Fire Fighting Instructions: As in any fire, wear self-contained breathing apparatus pressure-demand (NIOSH approved or equivalent), and full protective gear to prevent contact with skin and eyes.

Section 6. Accidental Release Measures

6.1	**Protective Precautions, Protective Equipment and Emergency Procedures:**	Avoid raising and breathing dust, and provide adequate ventilation. As conditions warrant, wear a NIOSH approved self-contained breathing apparatus, or respirator, and appropriate personal protection (rubber boots, safety goggles, and heavy rubber gloves).
6.2	**Environmental Precautions:**	Take steps to avoid release into the environment, if safe to do so.
6.3	**Methods and Material For Containment and Cleaning Up:**	Contain spill and collect, as appropriate. Transfer to a chemical waste container for disposal in accordance with local regulations.

Section 7. Handling and Storage

7.1	**Precautions To Be Taken in Handling:**	Avoid breathing dust/fume/gas/mist/vapours/spray. Avoid prolonged or repeated exposure.
7.2	**Precautions To Be Taken in Storing:**	Keep container tightly closed. Store in accordance with information listed on the product insert.

Section 8. Exposure Controls/Personal Protection

8.1 Exposure Parameters:

8.2 Exposure Controls:

8.2.1	**Engineering Controls (Ventilation etc.):**	Use process enclosures, local exhaust ventilation, or other engineering controls to control airborne levels below recommended exposure limits.
8.2.2	**Personal protection equipment:**	
	Eye Protection:	Safety glasses
	Protective Gloves:	Compatible chemical-resistant gloves
	Other Protective Clothing:	Lab coat
	Respiratory Equipment (Specify Type):	NIOSH approved respirator, as conditions warrant.
	Work/Hygienic/Maintenance Practices:	Do not take internally. Facilities storing or utilizing this material should be equipped with an eyewash and a safety shower. Wash thoroughly after handling. No data available.

Section 9. Physical and Chemical Properties

9.1 Information on Basic Physical and Chemical Properties

Physical States:	[ ] Gas [ ] Liquid [X] Solid	
Appearance and Odor:	A crystalline solid	
pH:	No data.	
Melting Point:	No data.	
Boiling Point:	No data.	
Flash Pt:	No data.	
Evaporation Rate:	No data.	
Flammability (solid, gas):	No data available.	
Explosive Limits:	LEL: No data.	UEL: No data.
Vapor Pressure (vs. Air or mm Hg):	No data.	
Vapor Density (vs. Air = 1):	No data.	

Specific Gravity (Water = 1):	No data.
Solubility in Water:	No data.
Solubility Notes:	~14 mg/ml in EtOH; ~16 mg/ml in DMSO; ~33 mg/ml in DMF;
Octanol/Water Partition Coefficient:	No data.
Autoignition Pt:	No data.
Decomposition Temperature:	No data.
Viscosity:	No data.

9.2 Other Information

Percent Volatile:	No data.
Molecular Formula & Weight:	$C_{21}H_{20}Cl_2O_3$ 391.3

Section 10. Stability and Reactivity

10.1 Reactivity: No data available.

10.2 Stability: Unstable [ ] Stable [X]

10.3 Stability Note(s): Stable if stored in accordance with information listed on the product insert.

Polymerization: Will occur [ ] Will not occur [X]

10.4 Conditions To Avoid: No data available.

10.5 Incompatibility - Materials To Avoid: strong oxidizing agents

10.6 Hazardous Decomposition or Byproducts: carbon dioxide
carbon monoxide
hydrogen chloride gas

Section 11. Toxicological Information

11.1 Information on Toxicological Effects: The toxicological effects of this product have not been thoroughly studied.
Permethrin - Toxicity Data: Oral TDLO (man): 2270 mg/kg; Oral LD50 (rat): 383 mg/kg; Subcutaneous LD50 (rat): 6600 mg/kg; Oral LD50 (mouse): 424 mg/kg; Intraperitoneal LD50 (mouse): 429 mg/kg; Subcutaneous LD50 (mouse): 10 gm/kg;

Chronic Toxicological Effects: Permethrin - Investigated as an agricultural chemical, mutagen, primary irritant, reproductive effector, and tumorigen.
Only select Registry of Toxic Effects of Chemical Substances (RTECS) data is presented here. See actual entry in RTECS for complete information.
Permethrin RTECS Number: GZ1255000

CAS #	Hazardous Components (Chemical Name)	NTP	IARC	ACGIH	OSHA
52645-53-1	Permethrin	n.a.	3	n.a.	n.a.

Section 12. Ecological Information

12.1 Toxicity: Avoid release into the environment.
Runoff from fire control or dilution water may cause pollution.

12.2 Persistence and Degradability: No data available.

12.3 Bioaccumulative Potential: No data available.

12.4 Mobility in Soil: No data available.

12.5 Results of PBT and vPvB assessment: No data available.

12.6 Other adverse effects: No data available.

Section 13. Disposal Considerations

13.1 Waste Disposal Method: Dispose in accordance with local, state, and federal regulations.

Section 14. Transport Information

14.1 LAND TRANSPORT (US DOT):

DOT Proper Shipping Name: Not dangerous goods.

DOT Hazard Class:

UN/NA Number:

14.1 LAND TRANSPORT (European ADR/RID):

ADR/RID Shipping Name: Environmentally hazardous substances, solid, n.o.s. (Permethrin)

UN Number:	3077	**Packing Group:**	III
Hazard Class:	9 - CLASS 9	**ADR Classification:**	9

14.3 AIR TRANSPORT (ICAO/IATA):

ICAO/IATA Shipping Name: Environmentally hazardous substances, solid, n.o.s. (Permethrin)

UN Number:	3077	**Packing Group:**	III
Hazard Class:	9 - CLASS 9	**IATA Classification:**	9

Additional Transport Information: Transport in accordance with local, state, and federal regulations.
When sold in quantities of less than or equal to 1 mL, or 1 g, with an Excepted Quantity Code of E1, E2, E4, or E5, this item meets the De Minimis Quantities exemption, per IATA 2.6.10. Therefore packaging does not have to be labeled as Dangerous Goods/Excepted Quantity.

Section 15. Regulatory Information

EPA SARA (Superfund Amendments and Reauthorization Act of 1986) Lists

CAS #	Hazardous Components (Chemical Name)	S. 302 (EHS)	S. 304 RQ	S. 313 (TRI)
52645-53-1	Permethrin	No	No	Yes

CAS #	Hazardous Components (Chemical Name)	Other US EPA or State Lists
52645-53-1	Permethrin	CAA HAP,ODC: No; CWA NPDES: No; TSCA: No; CA PROP.65: No

Regulatory Information Statement: This SDS was prepared in accordance with 29 CFR 1910.1200 and Regulation (EC) No.1272/2008.

Section 16. Other Information

Revision Date: 02/06/2018

Additional Information About This Product: No data available.

Company Policy or Disclaimer: DISCLAIMER: This information is believed to be accurate and represents the best information currently available to us. However, we make no warranty of merchantability or any other warranty, express or implied, with respect to such information, and we assume no liability resulting from its use. Users should make their own investigations to determine the suitability of the information for their particular purposes.

ATTACHMENT G

Biological Photographic Log

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Photo 1 – Poison Oak

Photo 2 – Poison Sumac

Photo 3 – Poison Ivy

Photo 4 – Stinging Nettle

Photo 5 – Wild Parsnip

Photo 6 – Western Water Hemlock Flower

Photo 7 – Western Water Hemlock Leaf and Stem

Photo 8 – Poison Hemlock Flower

Photo 9 – Poison Hemlock Stem

Photo 10 – Mosquito

Photo 11 – Lone Star Tick

Photo 12 – Female Western Black-Legged Tick

Photo 13 – Female American Dog Tick

Photo 14 – Symptom of Lyme Disease

Photo 15 – Brown Recluse Spider

Photo 16 – Black Widow Spider

Photo 17 – Timber Rattlesnake

Photo 18 – Massasauga Rattlesnake

Photo 19 – Black Bear

Photo 20 – Coyote

Photo 21 – Gray Wolf

Photo 22 – Mountain Lion

Appendix E

Waste Management Plan

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Draft Final
Programmatic Waste Management Plan

Remedial Investigations for Per- and Polyfluoroalkyl Substances (PFAS) at Multiple Air National Guard Installations

Joe Foss Field, South Dakota
Truax Field, Wisconsin
Volk Field, Wisconsin

Prepared for:

ANG Readiness Center, NGB/A4VR
3501 Fetchet Avenue
Joint Base Andrews MD 20762-5157

Under Contract to:

United States Army Corps of Engineers, Omaha District
1616 Capital Avenue, Suite 9000
Omaha, Nebraska 68102

Prepared by:

EA Engineering, Science, and Technology, Inc., PBC
221 Sun Valley Boulevard, Suite D
Lincoln, Nebraska 68528

December 2021
Contract No. W9128F-18-D-0026/ Delivery Order: W9128F20F0325
EA Project No. 6332106

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LIST OF ACRONYMS AND ABBREVIATIONS

μg/L	Micrograms per Liter
AFFF	Aqueous Film Forming Foam
ANG	Air National Guard
ASD	Assistant Secretary of Defense
EA	EA Engineering, Science, and Technology, Inc., PBC
EPA	Environmental Protection Agency
HQ	Hazard Quotient
IBC	Intermediate Bulk Container
ID	Identification
IDW	Investigation Derived Waste
ILCR	Incremental Lifetime Cancer Risk
mg/kg	milligrams/kilograms
NGB/A4VR	National Guard Bureau/Environmental Restoration Branch
NA	Not Available/Applicable
No.	Number
PFAS	Per- and polyfluoroalkyl substances
PFBS	perfluorobutane sulfonate
PFOA	Perfluorooctanioic Acid
PFOS	Perfluorooctane Sulfonate
ppb	Parts per Billion
PPE	Personal Protective Equipment
ppm	Parts per Million
ppt	Parts per Trillion
RfD	Oral Reference Dose
RI	Remedial Investigation
RSL	Regional Screening Level
SF	Slope Factor
TO	Task Order
UFP-QAPP	Uniform Federal Policy-Quality Assurance Project Plan
USACE	United States Army Corps of Engineers

LIST OF ACRONYMS AND ABBREVIATIONS (cont'd)

WMP	Waste Management Plan

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1. INTRODUCTION

This document presents the Waste Management Plan (WMP) for investigation derived waste (IDW) generated during the remedial investigations (RI) for per- and polyfluoroalkyl substances (PFAS) contamination resulting from aqueous film-forming foam (AFFF), non-AFFF, and secondary PFAS releases at multiple Air National Guard (ANG) Installations. The ANG installations include Joe Foss Field in South Dakota; Truax Field and Volk Field in Wisconsin. This WMP was prepared by EA Engineering, Science, and Technology, Inc., PBC (EA) for the United States Army Corps of Engineers (USACE) Omaha District and the National Guard Bureau/Environmental Restoration Branch (NGB/A4VR), under Contract Number (No.) W9128F18D0026, Task Order (TO) No. W9128F20F0325.

The WMP applies to all IDW generated from the activities performed as part of the RIs, including soil sampling, groundwater sampling, surface water sampling, soil boring, monitoring well sampling, monitoring well installation and development, and includes associated secondary waste streams and management of waste during mobilization and demobilization phases of the project. The IDW and subsidiary waste management will be in accordance with federal regulations and applicable state regulations. This IDW and subsidiary waste plan has been developed using a logical and systematic framework for waste identification, characterization, and decision pathway for media treatment and disposal of PFAS-contaminated media.

1.1 PURPOSE AND SCOPE

The purpose of this WMP is to provide a systemic approach to the management of IDW generated during the RIs that is designed to protect the health and safety of the worker, the public, and the environment. The WMP provides an overall strategy for how waste management activities will be implemented for all primary and secondary wastes generated by the Installation RI activities as described in the Final Project Management Plan (EA 2021). This WMP will also cover the management responsibilities, record keeping, document management, waste characterization and disposal of IDW. These procedures may be modified during project execution in response to unanticipated or changing conditions or updated guidance.

1.2 REGULATORY GUIDANCE

Per the Performance Work Statement, Screening criteria per the Office of the Assistant Secretary of Defense (ASD) Memorandum, *Investigating Per- and Polyfluoroalkyl Substances with the Department of Defense Cleanup Program*, shall be used to delineate perfluorooctanoic acid (PFOA), perfluorooctane sulfonic acid (PFOS), and perfluorobutane sulfonate (PFBS) for this RI (ASD 2021). These screening values, adapted from the ASD Memorandum, and anticipated treatment and final disposition methods are presented in Section 3. Under the Comprehensive Environmental Response, Compensation, and Liability Act, the site-specific levels (RSLs) for PFOS and PFOA are calculated using the Environmental Protection Agency (EPA) online calculator using the oral reference dose (RfD) of 2E-05 milligrams per kilogram (mg/kg)-day. The site-specific RSL for PFBS was calculated using the EPA online calculator using the oral RfD of 3E-04 (mg/kg)-day. When multiple PFAS are encountered at a site, a 0.1 factor is applied to the screening level. For example, in cases where there are multiple PFAS, the screening level for PFOS and PFOA individually in tap water is 40 parts per trillion (ppt) (0.1 x 400 ppt = 40 ppt) and for PFBS it is 600 ppb (ASD 2021).

2. TYPES OF INVESTIGATION DERIVED WASTE

There are several different potential IDW generation activities during the Installation RIs. A general discussion regarding the generation, sampling, and disposal of IDW is presented in the following sections.

To determine the ultimate disposition of IDW, the waste is typically distinguished as being either hazardous or non-hazardous. This determination is based on either clear regulatory guidance or by subsequent analysis.

2.1 PERSONAL PROTECTIVE EQUIPMENT

Waste Personal Protective Equipment (PPE) generated by RI activities (including used disposable masks, gloves, and single use samplers) will be placed in plastic bags and then disposed of at an approved disposal facility.

2.2 SAMPLING WASTE

For the purposes of this plan, sample wastes are those materials that are generated during sampling activities. As outlined in the Programmatic Uniform Federal Policy – Quality Assurance Project Plan (UFP-QAPP) and site-specific addenda, each waste stream will be sampled to verify compliance with the approved Subtitle D disposal facility waste acceptance requirements. The sampled material will be handled, packaged, stored, and transported in accordance with all applicable regulations. Sampling wastes includes, but is not limited to, the following:

- Disposable equipment and items such as plastic single use samplers, aluminum foil, polyvinyl chloride pipe, composite liquid waste sampling, tubing, broken or unused sample containers, sample container packaging, gloves, masks, and tape.
- Soil cuttings from direct-push and sonic drilling activities.
- Drilling mud or water used for drilling activities.
- Groundwater from well purging and well development activities.
- Cleaning fluids and decontaminants as well as wash water.
- Unused or excess packaging and shipping materials.

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3. INVESTIGATION-DERIVED WASTE MANAGEMENT PLAN

This section provides instructions for handling, packaging, transporting, and disposing of IDW generated during the field activities of the RI through the 4-step process summarized below. The 4-step process outlined in this WMP provides a logical and systematic framework for waste identification, characterization, and decision pathway for media treatment and disposal of PFAS-contaminated IDW.

3.1 STEP 1: WASTE MEDIA IDENTIFICATION

This project will include liquid, soil, and other solid IDW media as described in Section 2. Potential liquid IDW will include groundwater samples, surface water samples, rinse water, groundwater from well purging and development, and from accidental releases. Potential soil IDW will include soil boring cuttings, cuttings from monitoring well installation, and from accidental releases. Other solids media can include PPE (i.e. disposable gloves), construction waste (i.e. plastic sheeting, paper, rags, grout), and single use sampling equipment (i.e. used and unused sample containers, samplers, tubing).

3.2 STEP 2: CONTAINERIZE, SAMPLE, AND CHARACTERIZE WASTE

IDW will be containerized and isolated to minimize cross contamination. Liquid IDW will be stored in intermediate bulk containers (IBCs) while onsite. The liquid IDW will be treated with a portable ion exchange treatment system, stored in certified clean waste stream IBCs, and characterized for final treatment and disposal. If necessary, liquid IDW will be transported offsite in a vacuum tank truck. Soil IDW will be stored in lined roll off containers or 55-gallon drums. Soil and liquid IDW will be characterized using the specified soil, sediment, groundwater, and surface water samples specified by the contract and as described in the Programmatic UFP-QAPP and site-specific addenda. The decision points for disposal methods for liquid and soil IDW is described in Step 3.

Other solids (i.e., PPE, construction waste, and sampling equipment) will be placed in trash bags and disposed as non-hazardous solid waste in an appropriate off-base Subtitle D landfill.

3.3 STEP 3: MEDIA SPECIFIC TREATMENT AND DISPOSAL DECISION POINTS

Liquid and soil IDW representative samples will be collected, and lab tested to determine if the IDW is non-detect or detected at less than or equal to applicable screening levels. Screening criteria per the ASD Memorandum, *Investigating Per- and Polyfluoroalkyl Substances with the Department of Defense Cleanup Program*, shall be used to delineate PFOA, PFOS, and PFBS for this RI (ASD 2021). These screening values, adapted from the ASD Memorandum, are presented in Table 3-1 (ASD 2021).

Table 3-1. Risk Screening Levels Calculated for PFOS, PFOA, PFBS in Groundwater or Soil Using EPA's RSL Calculator

Chemical	Carcinogenic Slope Factor – Oral (SF) $(mg/kg\text{-}day)^{-1}$	Non-Carcinogenic RfD (mg/kg-day)	Residential Screening Levels					
			Tap Water (µg/L or ppb)			Soil (mg/kg or ppm)		
			HQ= 0.1	ILCR =1E-06	ILCR= 1E-04	HQ= 0.1	ILCR= 1E=06	ILCR= 1E-04
PFOS	NA	2.00E-05	0.040	NA	NA	0.13	NA	NA
PFOA	7.00E-02	2.00E-05	0.040	1.1	111	0.13	7.8	775
PFBS	NA	2.00E-02	0.600	NA	NA	1.9	NA	NA

NOTES:

µg/L = Micrograms per Liter
mg/kg = Milligrams per Kilogram
mg/kg-day = Milligrams per Kilogram per Day
HQ = Hazard Quotient
ILCR = Incremental Lifetime Cancer Risk
NA = Not available/applicable
ppm = parts per million
RfD = Reference Dose
SF = Slope Factor

SOURCE: (ASD 2021)

3.4 STEP 4: MEDIA SPECIFIC TREATMENT TECHNOLOGY FOR FINAL DISPOSAL

For liquid IDW, if lab PFOS, PFOA, and/or PFBS is less than the screening criteria presented in Table 3-1, no other contamination is present, and no state or local regulation prohibits it, the water may be returned to the source location at the point of generation or discharged to the sanitary sewer after disclosing the nature and concentrations of PFAS constituents to the local wastewater authority and obtaining a recordable authorization to discharge. Liquid IDW with PFOS, PFOA, and/or PFBS greater than the screening criteria presented in Table 3-1 will be treated onsite via portable ion exchange treatment system, then the liquid IDW will be coordinated for on-site disposal to the sanitary sewer system or transported to an approved, permitted treatment plant for disposal by an EA waste subcontractor.

For soil IDW, if lab PFOS, PFOA, and/or PFBS is less than the screening criteria presented in Table 3-1, and no other contamination is lab-confirmed, the soil IDW will be transported by an EA waste subcontractor and disposed of as non-hazardous waste at an EPA-approved Subtitle D Landfill. Written authorization and acceptance will be obtained from the landfill following coordination with the Installation Environmental Manager (EM).

If soil IDW is lab confirmed to be equal or greater than the screening criteria for PFOS, PFOA, and/or PFBS presented in Table 3-1, soil IDW with PFOS, PFOA, and/or PFBS will be removed from the site by an EA subcontractor for incineration/thermal destruction at an approved permitted facility. Incineration will meet all requirements of Section 330 of the National Defense Authorization Act for Fiscal Year 2020. EA will coordinate with the USACE Project Manager and Installation EM, and written authorization and acceptance will be obtained from the destruction facility.

If soil IDW lab confirmed PFOS, PFOA, and/or PFBS is less than the screening criteria presented in Table 3-1, but soil IDW is lab confirmed to be contaminated with another chemical of concern where concentrations exceeding regulatory standards and regulated hazardous waste were identified and properly managed for disposal, then the waste will be transported by an EA waste subcontractor and disposed of as hazardous solid waste at an EPA-approved RCRA Subtitle C Landfill, and written authorization and acceptance will be obtained from the landfill following coordination with the Installation EM.

PPE, other debris (i.e., rags, booms, containers, and construction debris) will be disposed of at a Subtitle D landfill.

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4. OFFSITE TRANSPORTATION AND DISPOSAL

4.1 SHIPPING DOCUMENTATION

Prior to any necessary offsite waste disposal, characterization information will be documented on a waste profile form provided by the offsite treatment and/or disposal facility as part of the waste acceptance process. The profile will be reviewed and approved by EA or the Installation Environmental Manager. EA will provide any required generator certification and/or signatures. Signed profile(s) will then be submitted to the disposal facility for acceptance.

The profile typically requires the following information, including but not limited to:

- Generator information, including name, mailing address, contact, and phone number
- Site name, including street address
- Process generating waste (for example, well development, well water sample collection, etc.)
- Source of contamination
- Historical use for area
- Waste composition
- Physical state of waste
- Applicable hazardous waste codes.

Once the approved profile or approval letter is received from the disposal facility, transportation can be scheduled. Each load of waste will be manifested prior to leaving the site. At a minimum, the manifest form will include the following information:

Generator information including name, address, contact, and phone number, and USACE / NGB/A4VR identification (ID) number:

- Transporter information including name, address, contact and phone number, and USACE/ NGB/A4VR ID number
- Facility information including name, address, phone number, and USACE/ NGB/A4VR ID number
- Site name including street/mailing address
- Department of Transportation Proper Shipping Name
- Type and number of container(s)
- Quantity of waste (volumetric estimate)
- Contract Task Order number or job number
- Profile number
- 24-hour emergency phone number.

The generator and the transporter must sign the manifest before the load of waste leaves the site. The original signed manifest will be returned to the address of the generator. EA anticipates that the facility will provide a copy of the facility-signed manifest to EA.

4.2 TRANSPORTATION

A contractor licensed for commercial transportation will transport non-hazardous wastes. If wastes are hazardous, the transporter selected will have the appropriate credentials and licenses to comply with all required regulations.

4.3 DISPOSAL AND WASTE STREAMS

Disposal facilities with proper permits and in good standing with the state and federal agencies will be used.

Offsite treatment and disposal facilities will use the waste profile and supporting documentation (for example, analytical data) to determine whether they will accept the waste. Hazardous and non-hazardous wastes will be disposed at facilities permitted to receive such wastes.

The treatment and disposal facility will be responsible for providing a copy of the final facility-signed waste manifest and a certificate of treatment or disposal for each load of waste received.

4.4 WASTE MANAGEMENT RECORDKEEPING

The following records and documents shall be maintained:

- Profiles and associated characterization data
- Manifests and bills of lading.

5. DOCUMENT MANAGEMENT

This section provides the project filing requirements.

5.1 DOCUMENT CONTROL

EA has implemented control procedures for project documents prepared by EA, by our team subcontractors, non-team subcontractors, vendors, and by our clients for each project. Project documents will be stored electronically in dedicated project folder located on EA's corporate server and file or paper copies will be maintained in the project manager's home office in order to provide control and confidentiality of documents and reports. Quality records and related documents will be stored in a dedicated section of the project file. Each draft or obsolete document will be discarded or destroyed after the final or next revised draft version is completed.

5.2 DOCUMENT DISTRIBUTION

In general, documents will be distributed as needed to project personnel, NGB/A4VR, and USACE. The project manager will distribute this WMP and any revisions to this plan to project team members.

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6. REFERENCES

Assistant Secretary of Defense (ASD). 2021. *Investigating Per- and Polyfluoroalkyl Substances with the Department of Defense Cleanup Program.* United States Department of Defense. 15 September.

EA Engineering, Science, and Technology, Inc., PBC (EA). 2021. *Final Project Management Plan, PFAS Remedial Investigations; Multiple Air National Guard Installations.* April.

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Appendix F

Field Forms

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BORING/WELL LOG

BORING/WELL LOG	Client	HOLE NUMBER AND PERMIT NUMBER
1. COMPANY NAME EA Engineering, Science, and Technology, Inc., PBC	2. DRILL SUBCONTRACTOR	SHEET 1 OF SHEETS

3. PROJECT	4. GEOLOGIST	5. COMPONENT	6. AREA	7. GRID LOC./BIASED POINT

8. NAME OF DRILLER	9. MANUFACTURER'S DESIGNATION OF DRILL
10. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT TYPE OF LINER USED, IF APPLICABLE	11. SURFACE ELEVATION AND CONDITIONS
12. DIRECT READING PARAMETERS: PID (ppm)	13. DATE STARTED / 14. DATE COMPLETED
15. OVERBURDEN THICKNESS	16. DEPTH GROUNDWATER ENCOUNTERED
17. DEPTH DRILLED INTO ROCK	18. DEPTH TO WATER AND ELAPSED TIME ATFER DRILLING COMPLETED
19. TOTAL DEPTH OF HOLE	20. OTHER WATER LEVEL MEASUREMENTS (SPECIFY)
21. WELL INSTALLED? IF SO COMPLETE CONSTRUCTION DIAGRAM	22. SAMPLE TYPE:

23. SAMPLE INTERVAL AND DESIGNATION FOR LAB ANALYSIS	24. SAMPLE INTERVAL AND DESIGNATION FOR FIELD SCREENING ANALYSIS COD (if applicable)= Hexavalent Chromium (if applicable)=	25. SCREENING ANALYSIS COD= Heavalent Chromium=
27. DISPOSITION OF HOLE	28. IF NOT A WELL, BACKFILLED WITH:	

USCS LOG	DEPTH (FT)	DESCRIPTION OF MATERIALS	DIRECT READING VOC (ppm)		ANALYTICAL SAMPLE DESIGNATION AND INTERVAL	DEPTH (FT)	RECOVERY (IN.)	REMARKS

PROJECT:	HOLE NO.:

EA Engineering, Science, and Technology, Inc., PBC

LOG OF SOIL/ROCK BORING

GPS Coordinates:	
GPS Projection/Datum:	
Surveyed Coordinates:	
Survey Projection/Datum:	
Surface Elevation:	
Casing Below Surface:	
Reference Elevation:	
Reference Desc:	

Job. No.	Client:	Location:

Drilling Method:

Sampling Method:

Boring No.

Sheet 1 of

Water Level			
Time	-		
Date			
Reference			

Drilling	
Start	Finish

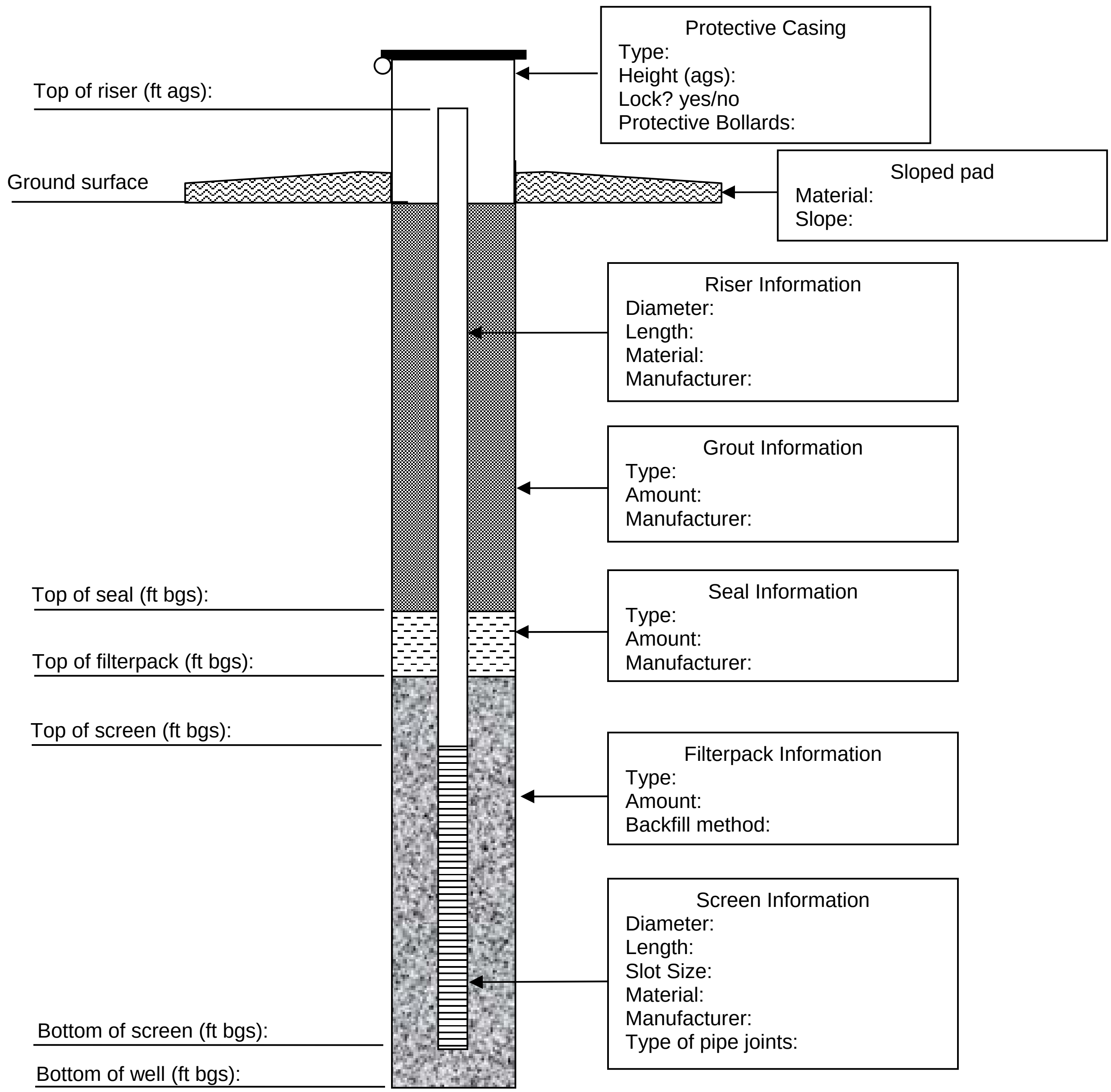
Sample Type	Inches Drvn/In. Recvrd	SC	pH	PID ppm	Blows per 6 in.	Depth in Feet		USCS Log	Surface Conditions:
						21			
						22			
						23			
						24			
						25			
						26			
						27			
						28			
						29			
						30			
						31			
						32			
						33			
						34			
						35			
						36			
						37			
						38			
						39			
						40			
						41			

Logged by: ____________________ Date: ____________

Drilling Contractor: ____________________ Driller: ____________

RECORD OF WELL CONSTRUCTION
(STICK-UP)

EA Engineering, Science, and Technology, Inc., PBC	Well/Soil Boring ID No.:
Project Title/ Project No.:	Date/Time Installed: Time Finished:
Location:	Depth to Water:
Site Geologist:	Drilling Method:



Note: All features not to scale

ags – Above Ground Surface
bgs – Below Ground Surface

EA Engineering, Science, and Technology, Inc., PBC

FIELD RECORD OF MONITORING WELL DEVELOPMENT (Page 1 of 3)

Well Designation: ____________________
Project Name: ____________________
Project Location: ____________________
Weather: ____________________
Developer Initials: ____________________

Well Development Date: ____________________
Development Time: ____________________
Gauge Date: ____________________
Gauge Time: ____________________
Static Water Level: ____________________
Measurement Reference: TOC ____________________
Well Grout Date: ____________________
Well Installation Date: ____________________
Well Diameter (inches): ____________________
Screen Length (ft): ____________________
Stick up/down (ft): ____________________
Sounding Method: ____________________
Condition: ____________________

Surge device and surge technique:____
Start/Stop times of surging intervals: ____
Pump device (type, size, capacity) and pump technique:____
Start/Stop times of pumping intervals:____
Quantity of water lost during drilling, removed prior to well installation, and other loss (list gallons and explain):____
____
Quantity of water added during granular filter placement, other additions (list gallons and explain):______________
____

Well Volume Calculation (prior to development):

A. Depth to bottom: _______ ft [from top of casing (TOC)]
B. Depth to water _______ft from TOC
C. Liquid depth (A-B) (ft) _______ft
D. Well volume/ft _______gallons/ft (2" – 0.1667 gallons/ft)

	Beginning	1	2	3	4	5
Time (min):						
Pump rate (well yield) (gpm):						
Volume purged (gal):						
pH:						
Temperature (ºC):						
Specific Conductivity (µS/cm):						
Dissolved oxygen (mg/L):						
ORP (mV):						
Turbidity (NTU):						

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FIELD RECORD OF MONITORING WELL DEVELOPMENT (Page 2 of 3)

	6	7	8	9	10	11
Time (min):						
Pump rate (well yield) (gpm):						
Volume purged (gal):						
pH:						
Temperature (ºC):						
Specific Conductivity (µS/cm):						
Dissolved oxygen (mg/L):						
ORP (mV):						
Turbidity (NTU):						

	12	13	14	15	16	17
Time (min):						
Pump rate (well yield) (gpm):						
Volume purged (gal):						
pH:						
Temperature (ºC):						
Specific Conductivity (µS/cm):						
Dissolved oxygen (mg/L):						
ORP (mV):						
Turbidity (NTU):						

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FIELD RECORD OF MONITORING WELL DEVELOPMENT (Page 3 of 3)

Total volume of water removed (gal): ____________

Physical characteristics of water removed (including changes in clarity, color, particulates, and any odor noted during development):____

Estimated recharge rate:__________gpm

Depth to water 24 hours after development:________ft

Depth to sediment before development_____ft Depth to sediment after development: _____ft

Total surging time: _____hours

____

____

____

PLEASE NOTE

- **A 1-quart (2-pint) sample of the final water removed during development should be placed in a clear glass jar and labeled with well number and date. Each sample should be individually agitated and immediately photographed (close-up). Photograph No.: ________________________**
- **A minimum removal of three times the volume of standing water in the well and further volumetric removal should include**:
  (a) For those wells where the boring was advanced without the use of drilling fluid (mud and/or water) but water was added during well installation, then three times the volume of any water unrecovered from the well during installation should be removed (in addition to three volumes of standing water in the well).
  (b) For those wells where the boring was advanced or enlarged (totally or partially) with the use of drilling fluid (mud and/or water), then three times the measured (or estimated) volume of total fluids lost while drilling plus three times the volume used for well installation should be removed (in addition to three volumes of standing water in the well).
- Monitoring well development is complete when the discharge from the well at the maximum pumping rate has a **turbidity of 50 NTU or less and temperature, pH, specific conductivity, dissolved oxygen, Eh, and turbidity are within 10 percent during three successive readings at 10 minute intervals.**
- **READ APPENDIX A OF WORK PLAN FOR MONITORING WELL DEVELOPMENT DETAILS**

Source: USACE SOW and USACE EM 1110-1-4000

Well Purging and Sampling Record

Well ID: ____________ **Sample ID:** ____________ **Sample Date/Time:** ____________

Casing diameter/type: Well location: Weather:

Screened interval(s): Sampling personnel:

Total depth: Sampling method:

Initial depth to water (w/o pump): Water level indicator:

Final depth to water (w/o pump): Water quality meter:

Measuring point: **North side of casing** Pump depth setting: Pump type/model:

	Δ < 1° C	Δ < 10%	Δ <10%	Δ <10%	Δ < 0.1 pH	Δ < 10 mV	Δ < 0.3 ft	< 1L/min	Δ < 10 NTU		
Time	**Temp (^oC)**	**Conductivity (mS/cm)** or **(μS/cm)**	**DO (%)**	**DO (mg/L)**	**pH**	**ORP (mV)**	**Water Level (feet btoc)**	**Flow Rate (L/min)** or **(mL/min)**	**Turbidity (NTU)**	**Purge Volume (L)** or **(mL)**	**Additional Comments**

Note:

Parameter Stabilization Limits:
(3 consecutive readings) for percent difference type parameters
Percent difference formula =
ABS[((first reading - second reading)/first reading) x 100]
Ex: Readings 12, 16, 15, 13
((12-16)/12)*100 = 33% ((16-15)/16)*100 = 6%
((15-13)/15)*100 = 13% In example, stabilization has not occurred.

# of Bottles / Analysis:

____
____
____
____
____
____
____

EA Engineering, Science, and Technology, Inc., PBC

Job. No.	Client: Project:	Location

Sampling Location Description:	Sample Location ID:
	Sheet 1 of 1
Sample Method:	
Depth of Water Body:	Sampling Date/Time
Width of Water Body:	Start / Finish
Water Body Location	DATE / DATE
	TIME / TIME

Log of Sediment Sample Collection

Coordinates: Northing: _____ Easting: _____

Surface Water Elevation: _____

Reference Elevation: _____

Reference Description: _____

	Water Quality Parameters						
	Time	pH	Cond.	Turb.	DO	Temp	ORP
	(hrs)	(pH units)	(mS/cm)	(ntu)	(mg/L)	(^{o}C)	(mV)

Surface Conditions:
Weather:
Description of Sample

Samplers: _____

Sampling Date: _____

Sampling Time: _____

Split Sample With: _____

Sample Type: _____

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and Technology, Inc., PBC

Site Name	Project No.
Site Location	Date/Time
Page of	Field Technician

Surface Conditions:

Weather / Temperature:

Drilling Equipment

Sample Collection Equipment/Method

Analyses

Sample Interval (in.)	PID (ppm)	Sample Date	Sample Time	Sample ID	QA/QC Collected	Sample Appearance / Description

Logged by: ______________________ Signature ______________________

PHOTOIONIZATION DETECTORFIELD CALIBRATION FORM

Site Name:

INSTRUMENT:	INSTRUMENT ID No:
OPERATOR:	WEATHER:
SPAN GAS TYPE:	DATE:
CALIBRATION NOTES:	
COMMENTS:	
SIGNATURE:	DATE:

WATER QUALITY METER FIELD CALIBRATION FORM

Model:
Parameters for Measurement:

CALIBRATION
DATE:
TIME:
METER ID:

pH CALIBRATION

pH STANDARD	INITIAL READING	FINAL READING
4.0		
7.0		
10.0		

CONDUCTIVITY CALIBARATION

CONDUCTIVITY STANDARD	STANDARD READING	FINAL READING
1.413		

TURBIDITY CALIBRATION

STANDARD	INITIAL READING	FINAL READING
0 NTU		
126 NTU		

ORP CALIBRATION

STANDARD	FINAL READING
240 millivolts	

DISSOLVED OXYGEN CALIBRATION

STANDARD	INTITIAL READING	FINAL READING
100% AIR SATURATION		

COMMENTS

SIGNATURE

NOTE: The manufacturer's acceptable range for calibrated readings will be notated on the form if available.
If the final reading is +/- 20% of the standard; Recalibrate or replace unit (if necessary).

Well Assessment Checklist

Facility Information

Site Name:
Site Address:
Site County:
Site State:
Site ID Number:
Site Owner:
Project Manager:

Well Locational Information

State Well ID:
Well Tag ID:
Well Installation date:

	From Log	*By GPS*
Ground Surface		
TOC Elevation		
Latitude (WGS84)		
Longitude (WGS84)		
Northing (State Plane) NAD27		
Easting (State Plane) NAD27		

Cross streets (if applicable):

GPS Instrument used:
Datum:
Accuracy/Precision:

Well Construction Details

Type of well (Circle one)	Flush Mount	Stick up	Multilevel Well*
Well lock\security type:			
Elevation (top of inner casing):			
Surface casing material:			
Well casing material:			
Surface Casing diameter:		*inches*	
Well Diameter:		*inches*	
Well Depth (as installed):		*ftbgs*	
Well Depth (as measured):		*fttoc*	
Screened interval:		*ft*	
Open hole interval:		*ft*	
Depth to water:		*ftbtoc*	
Date:	______________	*Time:*	

* If multilevel well please see attached worksheet.

Well Assessment Checklist

Well Headspace Readings

PID/FID Reading taken inside top of casing (if applicable): *ppm*

Multi-gas/CGI meter Readings taken (if applicable):

LEL:	______	*% LEL*
O_2:	______	*40% Vol.*
CO:	______	*ppm*
H_2S:	______	*ppm*

Do readings indicate unsafe conditions exist?	Yes	No

Well Condition

Is the concrete pad in good condition?	Yes	No
Is the well surface casing in good condition?	Yes	No
Is the surface casing vertical?	Yes	No
Is there an internal well seal?	Yes	No
Has there been physical damage to the well?	Yes	No
Does sounding depth match completed depth?	Yes	No
Is measuring point marked?	Yes	No
Is the well clearly labeled?	Yes	No
Flush mount - Is it secure from runoff?	Yes	No

Other Comments:

Recommendations

Well needs to be redeveloped	**Yes**	**No**
Well needs to be re-surveyed.	**Yes**	**No**
Well needs to be repaired.	**Yes**	**No**
Well needs to be replaced.	**Yes**	**No**
Well needs to be properly abandoned.	**Yes**	**No**
No action necessary.	**Yes**	**No**

Comments

Inspected by: ______

Date of Inspection: ______

Reviewed by: ______ **(Print)**

______ **(Sign)**